ENVIRONMENTAL ASSESSMENT

SECTION 4

NEWCASTLE COAL INFRASTRUCTURE GROUP
COAL EXPORT TERMINAL

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4 ENVIRONMENTAL ASSESSMENT

The following section presents the environmental assessment for the Project including: a description of the existing environment; an assessment of the potential impacts of the construction and operation of the Project; and a description of environmental mitigation and management measures and monitoring programmes. Compensatory measures and other ecological initiatives proposed by NCIG are also presented. NCIG's draft Statement of Commitments is provided in Section 5.

4.1 LAND RESOURCES

4.1.1 Existing Environment

Presented below is a description of land resources including landuse, landforms and soils across the Project site and surrounds.

Landuse

The Project is located on Kooragang Island, which lies near the mouth of the Hunter River, approximately 6 km north-west of the Newcastle Central Business District (CBD) (Figure 1-2). Kooragang Island is characterised by a combination of port, marine and industrial landuses in the south, the Kooragang Nature Reserve in the north, and the Kooragang Wetland Rehabilitation Project in the west.

The Project is located on the southern side of Kooragang Island on the south arm of the Hunter River. As described in Section 3.2, the Project site comprises land zoned Zone 4(b) (Port and Industry), Zone 5(a) (Special Uses Zone – Arterial Road) and an unzoned area (Hunter River) by the Newcastle LEP (Figure 1-4). The current landuse of the Project site comprises licensed landfill activities and vacant industrial land. RLMC currently holds EPL 6437 for the disposal of Solid Waste Class 2 at the KIWEF (Figure 2-1).

Land uses in the immediate proximity of the Project site include (Figure 2-1):

- a rail easement (Kooragang Island mainline) to the north and west of the Project site;
- the KWRP to the west of the Project site beyond the Kooragang Island mainline;
- the south arm of the Hunter River which forms part of the southern boundary of the Project site;
- public roads (Cormorant Road, Egret Street and Raven Street) and private roads (Pacific National access road and Delta access road);
- Blue Circle Southern Cement, Origin Energy and vacant land to the east of the Project site; and
- Kooragang Nature Reserve, Port Waratah Coal Services' (PWCS) Kooragang Coal Terminal and fines disposal area, and Delta EMD Australia's licensed landfill to the north of the Project site.

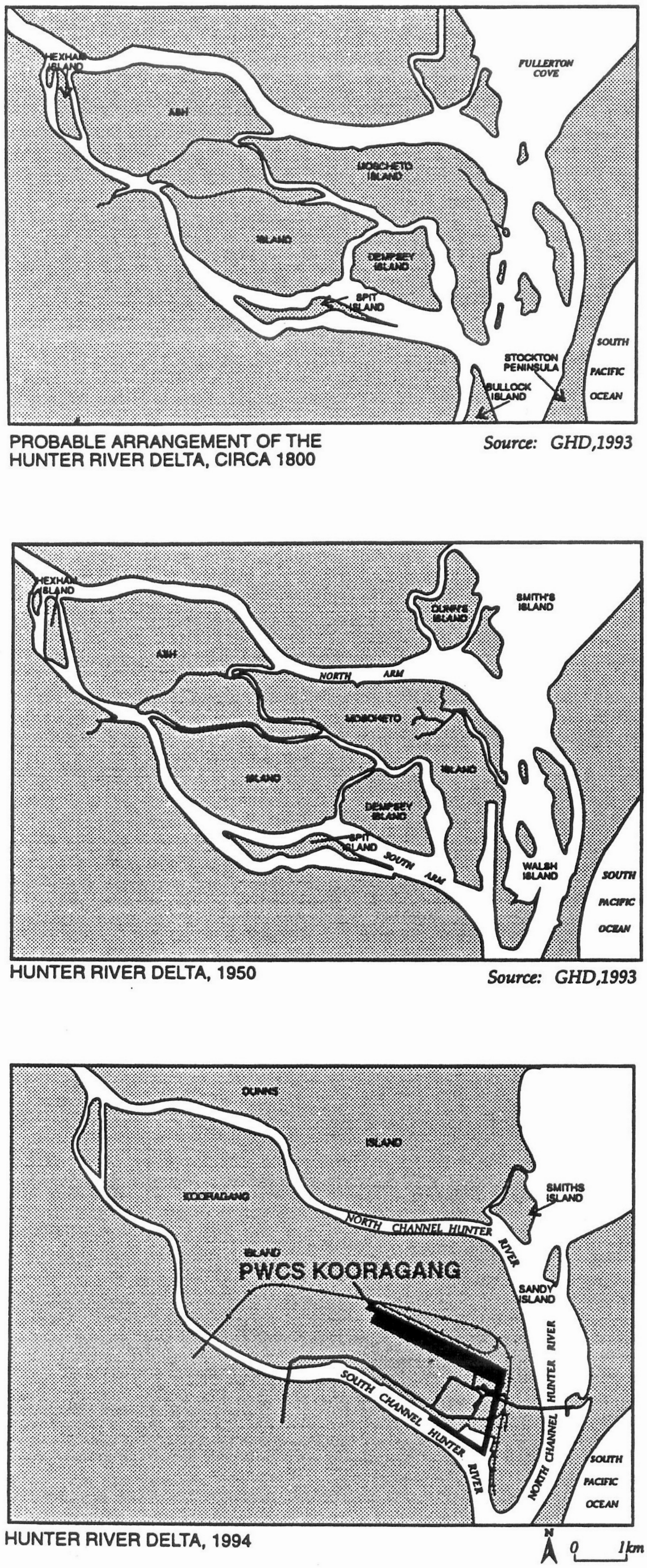
Historical landuses of the Project site include grazing, land reclamation and the long term disposal of dredge spoil and industrial waste (Appendix D). A series of plans and aerial photographs are provided on Figures 4-1 and 4-2, which illustrate the landuse changes from agricultural development to progressive reclamation of land and deposition of dredge spoil and landfill material to develop the current land surface in the Project site.

Kooragang Nature Reserve

The Kooragang Nature Reserve lies approximately 1 km to the north of the Project. The Kooragang Nature Reserve is part of the Hunter Estuary Wetlands which are recognised for their international significance as waterbird habitat (DEH, 2006). The Hunter Estuary Wetlands are listed on the Register of the National Estate (DEH, 2006) and as a Wetland of International Importance under the Ramsar Convention (Ramsar Convention, 2006).

Landforms and Local Topography

Kooragang Island was originally a series of deltaic islands (including Ash Island, Dempsey Island and Moscheto Island) near the mouth of the Hunter River (Figures 4-1 and 4-2). The original islands were low-lying and were susceptible to flooding and subject to tidal influence. Kooragang Island was formed by progressive land reclamation operations which modified the original islands into a single island by in-filling of tidal mudflats and creeks.



Source: Port Waratah Coal Services (1996)

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FIGURE 4-1
Historical Development of Kooragang Island

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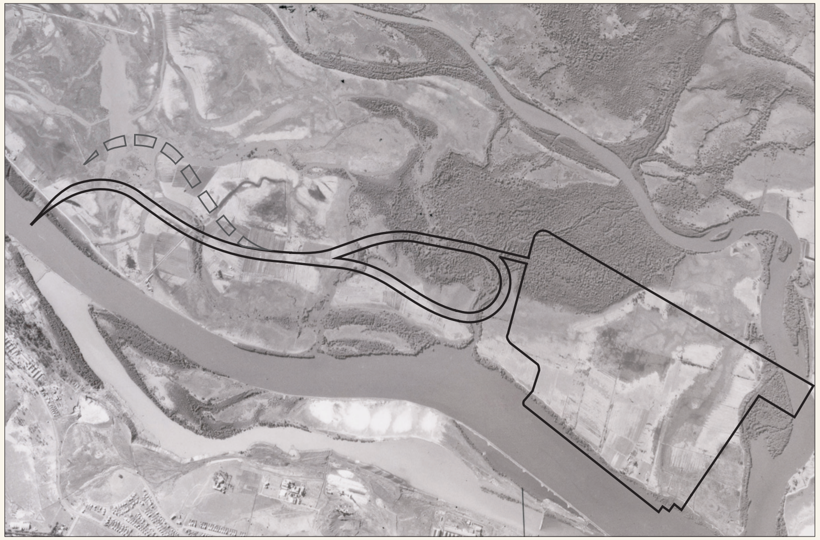
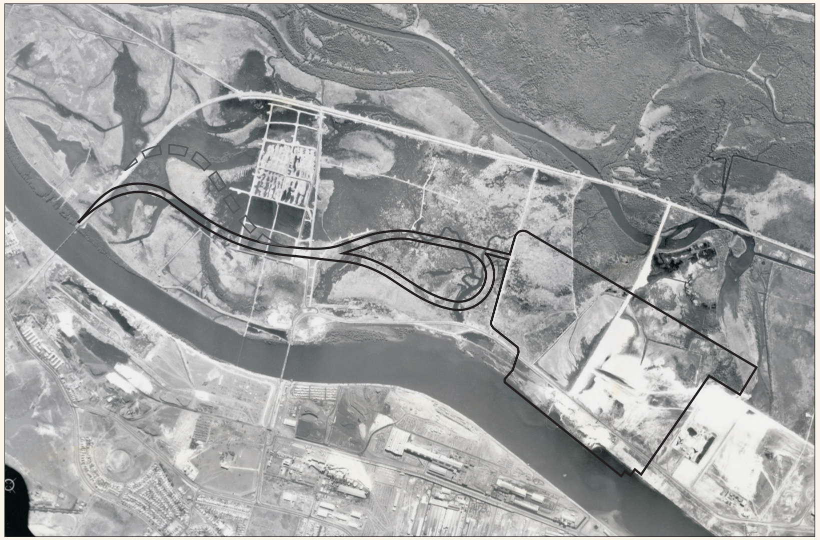


Project Site 1954



Project Site 1975

Project Site 1993

Project Site 2001

LEGEND

Approximate Extent of Project Key Components

High Capacity Optional Inlet Rail Spur and Rail Sidings

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Source: Department of Lands (2006); NCIG (2006)

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FIGURE 4-2
Historical Aerial Photographs
of Kooragang Island

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The topography of Kooragang Island, including the Project site, is generally flat and low lying. Elevations within the Project site vary from approximately 0.7 m to 12 m AHD (Figure 4-3). There are a number of depressions that intermittently fill with surface runoff. The most notable of these depressions are Big Pond, which is located in the north-west of the Project coal storage area and Deep Pond, the southern end of which would be traversed by the Project northern rail spur should it be required when the Project is fully developed to 66 Mtpa (Figure 4-3).

Soils

The soils of Kooragang Island generally reflect those placed there by land reclamation operations. The natural soil profile across Kooragang Island (below fill materials) generally consists of an upper clay layer (soft silty sandy clay), a sandy layer (loose to dense sand), a lower clay layer (stiff to very stiff sandy silty clay), soft rock layers (siltstone and mudstone) and hard rock layers (sandstone) (Connell-Hatch, 2005). Due to the presence of the various fill materials and the historical flow paths of the Hunter River and its tributaries, the depth of each of the soil layers varies significantly over the Project site (*ibid.*). Table 4-1 shows the varying depths of the soil layers across the Project site.

Acid Sulphate Soils

The Department of Land and Water Conservation (DLWC) (1997) *Acid Sulphate Soil – Planning Mapping* identifies five classes of land based on the probability of the occurrence of acid sulphate soils, for planning purposes (Section 3.3.2). The majority of the Project site is considered to be Class 2 on the Potential Acid Sulphate Soils Planning Map (DLWC, 1997). Areas identified as consisting of Class 2 soils require development consent for any works below the ground surface or for works that may lower the groundwater table. URS (2000a) undertook an on-site testing programme and suggested that potential acid sulphate soils (PASS) are present approximately 3 to 3.5 m below ground level within the Project coal storage area.

Class 1 land within the Project site is generally restricted to the Hunter River and foreshore. The south arm of the Hunter River (including the dredge material) is generally classified as Class 1 land (DLWC, 1997). Areas identified as consisting of Class 1 soils require development consent for any works. Soil testing conducted to date in relation to dredging operations on the south arm of the Hunter River suggests that limited amounts of the proposed dredge material are PASS (Waterways Authority, 2003).

The Land Contamination and Groundwater Assessment (Appendix D) includes consideration of acid sulphate soils.

Table 4-1
Project Site Soil Characterisation

Soil Type	Coal Storage Area		Rail Infrastructure Corridor	
	Description	Thickness (m)	Description	Thickness (m)
Fill	Various (including dredged material and blast furnace slag)	0.5 - 3 m	Various (including coal washery rejects and by-products of steel manufacturing)	0 - 10 m
Upper Clay	Very soft to soft silty sandy clay	0 - 15 m	Soft to firm silty, sandy clay	1 - 13.5 m
Alluvial Sand	Loose transition layer overlying dense to very dense sands	2 - 30 m	Sand/gravel with silt/clay lenses	10 - 20 m
Lower Clay	Stiff to very stiff sandy silty clay	Not logged	Stiff to very stiff sandy silty clay	5 - 8 m
Soft Rock	Siltstone, mudstone, coal, shale and sandstone	3 - 8 m	Siltstone, mudstone and coal	10 - 30 m
Hard Rock	Sandstone	Not determined	Sandstone	15 - 45 m

Source: after Connell-Hatch (2005) and Appendix D

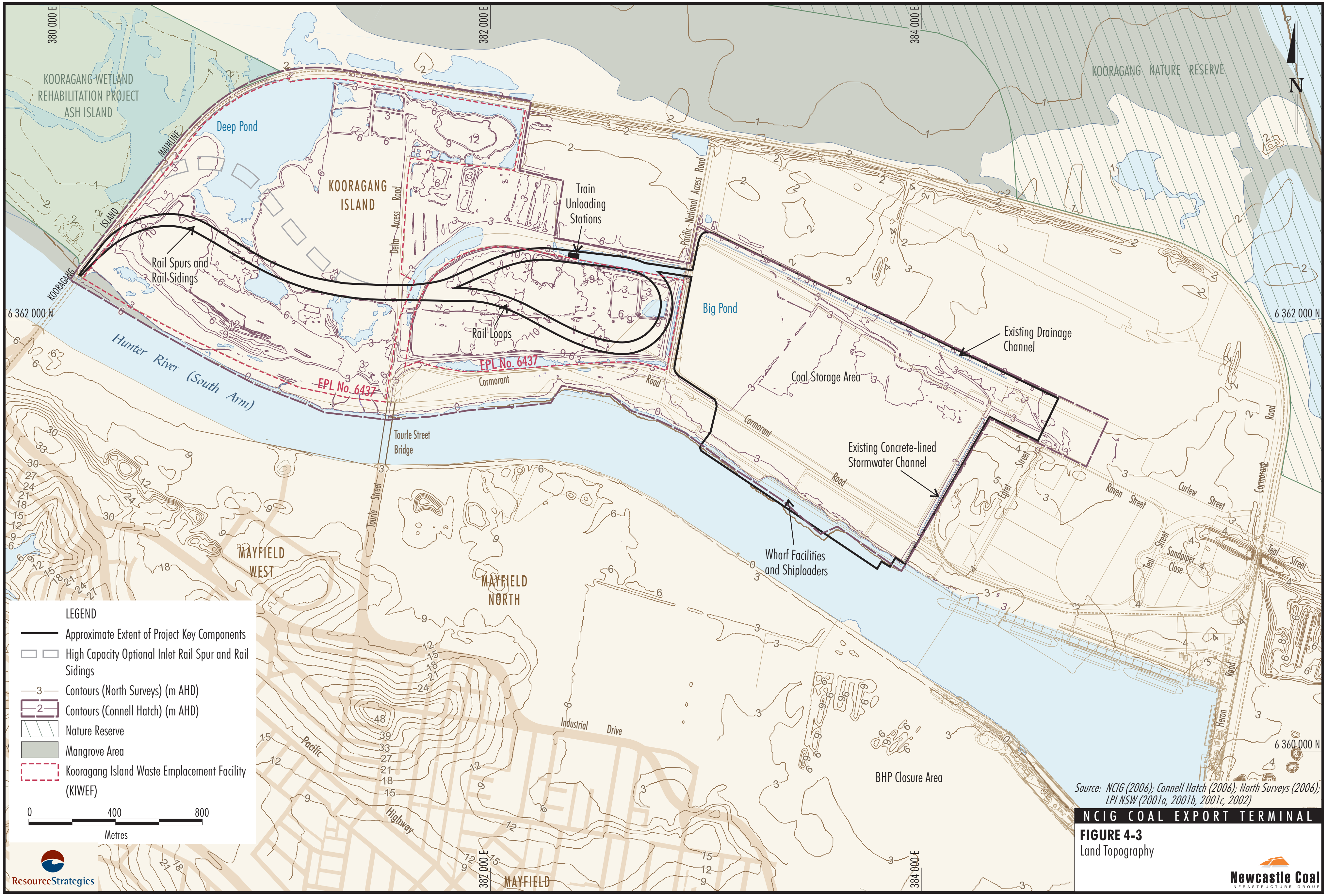

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FIGURE 4-3
Land Topography

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4.1.2 Potential Impacts

In relation to land resources the Project has the potential to alter:

- landuse;
- topography and landscape features;
- acid status of PASS; and
- soils and erosion potential.

These aspects are described below. Applicable environmental mitigation measures are provided in the following sub-section. Potential land contamination issues are described in Section 4.7.

Landuse

Historical landuses of the Project site include grazing, land reclamation and the disposal of dredge spoil and industrial waste (Section 4.1.1). Given that the majority of the Project site is zoned for industry, impacts on landuse would be minimal. The potential impacts on landuse would include the capping of sections of the KIWEF as part of the construction of the Project rail infrastructure corridor. It is considered that the capping of these sections of the KIWEF would have a beneficial effect on the future landuse potential of the Project site.

Topography and Landscape Features

The main modifications to the existing topography that would result from the Project relate to:

- construction of coal stockpile pads and berms in the coal storage area (Section 2.5.2);
- construction of embankments for rail infrastructure (Section 2.4.1);
- construction of the wharf facilities (Section 2.7.1);
- construction of an earth bund between Cormorant Road and the coal storage area (Section 2.5.3); and
- construction/installation of the Project infrastructure components.

It is considered that the above impacts would be of a scale and nature consistent with the surrounding landuse, topography and landscape features. A Visual Assessment for the Project is presented in Appendix H and Section 4.5.

Erosion and Sediment Potential

The Project construction activities have the potential to increase erosion and sediment movement due to the temporary disturbance of soils. These potential impacts and mitigation measures are described in Section 4.6.2.

Acid Sulphate Soils

PASS material is present below portions of the Project site (URS, 2000a) (Section 4.1.1). Project elements have been designed to minimise excavations. Limited excavations would be required during the construction of the Project, including (NCIG, 2006a):

- construction of sections of the rail infrastructure corridor;
- foundations for the train unloading stations; and
- development of surface water management infrastructure.

Excavations have the potential to intercept PASS material.

With respect to the placement of dredged materials on the Project site, limited amounts of the proposed dredging material has been classified as PASS. It is expected that the bulk of the dredged material would act as a buffer to PASS when they are stockpiled on the surface (Waterways Authority, 2003). Further, the only significant excavation works to be undertaken at the Project wharf facilities are dredging activities under the Port Consent (Section 3.6.1).

4.1.3 Mitigation Measures, Management and Monitoring

Landuse

The Project would be located on land administered by the RLMC, the Maritime Services Board of NSW and the Minister for Public Works and Services (Section 1.1.4). NCIG would continue to engage these authorities to accommodate future landuses surrounding the Project. To date this has been achieved through Project design where practicable. An example of this includes the Project rail infrastructure corridor which includes a rail overpass of the Delta access road to facilitate continued access to the northern sections of the KIWEF site. In addition, vehicular access would be available to the inside of the Project rail loops.

NCIG worked closely with the RLMC and ARTC to achieve efficient use of lands whilst still working within necessary rail geometry constraints (Sections 3.7.1 and 3.9.3).

NCIG would develop a site exit strategy prior to decommissioning and closure of the Project (Section 5). The site exit strategy would be developed in consultation with the relevant government authorities and other stakeholders. The site exit strategy would include consideration of the post closure retention of rail and wharf infrastructure to promote future development of the port and industry area on Kooragang Island.

Soils and Erosion Potential

Specific mitigation measures to control soil erosion and sediment migration would include:

- minimising surface disturbance and restricting access to undisturbed areas;
- use of erosion and sediment control structures (e.g. silt fences, sediment ponds and/or table drains) to permit the settling of solids, minimise sediment migration, divert surface water around disturbed areas and to control runoff velocity; and
- installation of a silt curtain (typically woven or non-woven polypropylene skirts with float and ballast assemblies) in the south arm of the Hunter River during construction of the shipping berth batters, wharf structure and during piling operations.

Erosion and sediment control measures for the Project would be developed and documented in an Erosion and Sediment Control Plan (ESCP). The ESCP would be a component of the SWMP (Section 4.6). The ESCP would be prepared in a progressive manner prior to the development of each Project component involving land disturbance. The measures presented in the ESCP would aim to control soil erosion and sediment generation proximal to the source and thereby minimise the potential for Project activities to adversely affect downstream water quality.

The ESCP would be prepared in general accordance with the manual *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004). The design capacity of erosion and sediment control structures would be determined in consultation with relevant authorities based on catchment area, soil types, design life and associated environmental risk.

The ESCP would be revised as required in consultation with relevant authorities. On-site surface water management is discussed in Section 4.6.

Monitoring

Erosion and sediment control structures would be inspected monthly and following significant rainfall events (i.e. greater than 20 mm in 24 hours). The structures would be assessed for structural stability and effectiveness in controlling erosion and sediment migration. Appropriate remedial works would be implemented as required.

Acid Sulphate Soils

The presence or otherwise of acid sulphate soils would be identified during the surface and sub-surface soil sampling and analysis programme (Section 4.7.2). Acid sulphate soils excavated during construction of the Project would be managed in accordance with the process outlined in Section 4.7.2.

Materials that are identified as not being suitable for use as fill material on site would be excavated and removed from the site to adjacent RLMC owned land. The material would be placed in encapsulated cells and capped with an appropriate cover layer in accordance with Benchmarks 1 and 2 in the *Environmental Guidelines: Solid Waste Landfills* (EPA, 1996), or removed from the site for treatment at a licensed facility (Section 4.7.2).

A Soil and Excavation Management Plan (SEMP) would be developed for the Project and would describe the management procedures for acid sulphate soils should they occur on the site. Measures such as lime dosing of soils would be undertaken if necessary.

4.2 METEOROLOGY

4.2.1 Existing Environment

Meteorological data were collected from four meteorological monitoring stations administered by the Bureau of Meteorology *viz.* Nobbys Signal Station (Station 061055), Maryville (Station 061223), University of Newcastle (Station 061390) and the Williamtown Royal Australian Air Force (RAAF) Base (Station 061078). The locations of these monitoring stations are shown on Figure 4-4. These monitoring stations provide representative climatic data for the Project site and surrounds. The details of these monitoring stations are provided in Table 4-2.

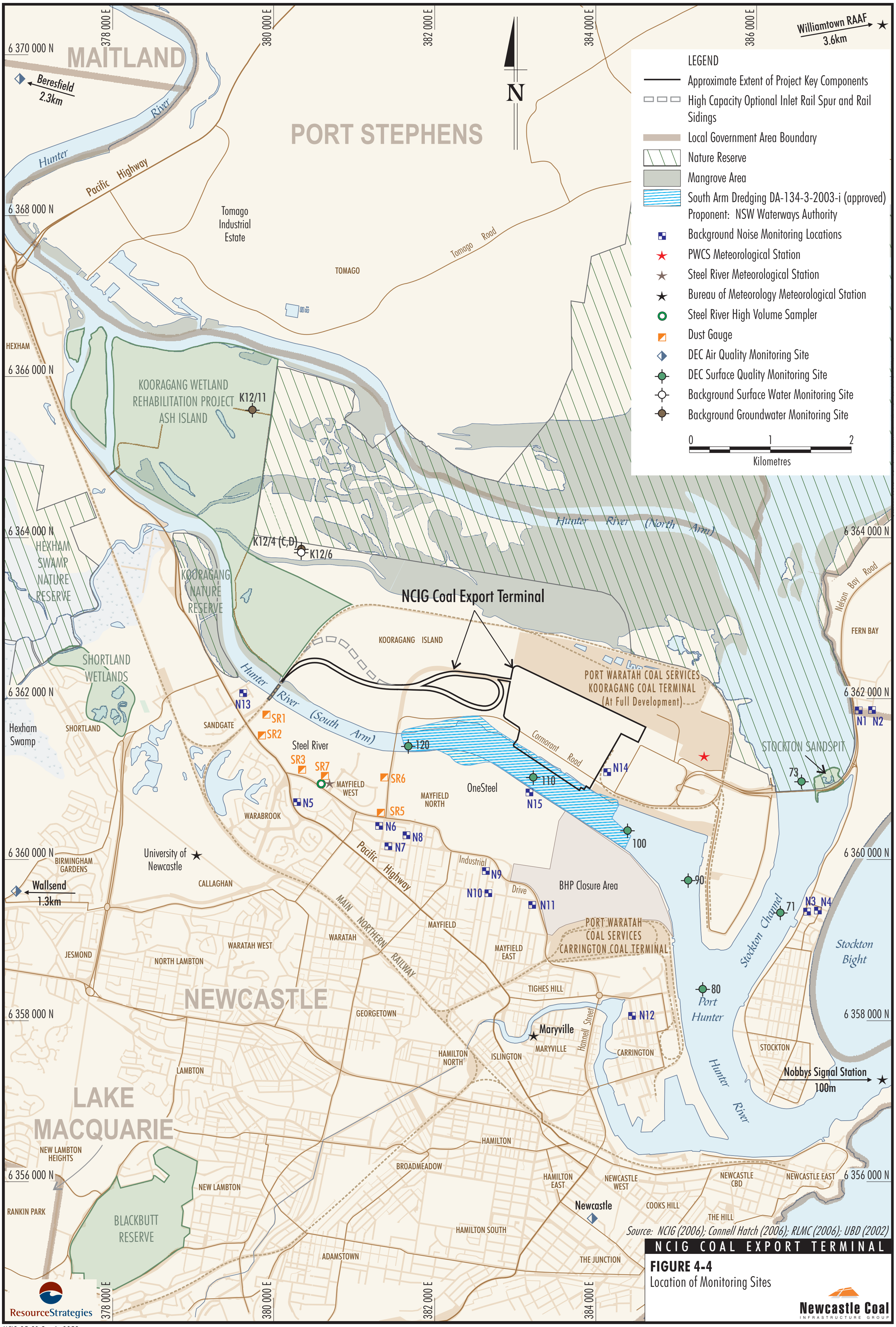

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FIGURE 4-4
Location of Monitoring Sites

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Table 4-2
Bureau of Meteorology Monitoring Station Locations and Recording Periods

Station Name	Station Number	Location	Latitude (degrees S)	Longitude (degrees E)	Elevation (m) AHD	Period of Record
Nobbys Signal Station	061055	Approximately 6 km south-east of the Project	32.9185	151.7985	33.0	1862 – 2006
Maryville	061223	Approximately 4 km south of the Project	32.9131	151.7500	8.0	1964 – 1993
University of Newcastle	061390	Approximately 4 km south-west of the Project	32.8925	151.7056	21.0	1998 – 2006
Williamtown RAAF	061078	Approximately 12 km north-east of the Project	32.7939	151.8386	9.0	1942 – 2006

Source: Bureau of Meteorology (2006)

Meteorological data were also obtained from a monitoring station at the Steel River Industrial Estate, located on the southern bank of the south arm of the Hunter River and from the PWCS Kooragang Coal Terminal monitoring station (Figure 4-4).

Six years (2000 to 2005 inclusive) of meteorological data were obtained from the Steel River Industrial Estate monitoring station which records wind speed, wind direction and sigma-theta (the rate of change of wind direction) at ten minute intervals.

Meteorological data collected from the PWCS monitoring station included wind speed, wind direction, sigma-theta, temperature, rainfall and relative humidity at ten minute intervals for 2004 and 2005.

Data collected from the Bureau of Meteorology monitoring stations is summarised in Table 4-3. Relevant data from the Bureau of Meteorology, Steel River and the PWCS monitoring stations are discussed below.

Rainfall

Rainfall records are available from a number of locations in close proximity to the Project site, including Nobbys Signal Station, Maryville, University of Newcastle and Williamtown RAAF. The annual average rainfall at these stations is approximately 1,137 mm (Nobbys Signal Station), 1,112 mm (Maryville), 1,049 mm (University of Newcastle) and 1,120 mm (Williamtown RAAF).

Generally the rainfall records indicate moderate seasonality, with higher rainfall totals being recorded in the late summer and autumn months and lower rainfall in the late winter and spring months (Table 4-3).

Analysis of the available data (based on 140 years of records) indicates a long-term annual average rainfall of approximately 1,068 mm at the Project site (NCIG & Connell-Hatch, 2006).

Temperature

The data presented in Table 4-3 indicate that regional temperatures are warmest from November through March and coolest in the winter months of June, July and August. Average daily maximum temperatures peak in January (25.6°C, 27.6°C, 29.0°C and 27.9°C) for Nobbys Signal Station, Maryville, University of Newcastle and Williamtown RAAF, respectively), while average daily minimum temperatures are lowest in July (8.4°C, 7.7°C, 7.1°C, and 6.3°C) for Nobbys Signal Station, Maryville, University of Newcastle and Williamtown RAAF, respectively).

Relative Humidity

Relative humidity records from all sites exhibit a relatively uniform seasonal pattern (Table 4-3). Average morning (9 am) relative humidity recorded at Nobbys Signal Station, Maryville, University of Newcastle and Williamtown RAAF was lowest in October (68.3%, 62.5%, 60.3% and 63.8%, respectively). The highest recorded average morning (9 am) relative humidity at the stations occurred in February for Nobbys Signal Station (79.7%), May and June (77.2%) for Maryville, April for University of Newcastle (79.7%) and June for Williamtown RAAF (79.9%).

Average afternoon (3 pm) monthly relative humidity ranged from 56.1 to 74.1% for Nobbys Signal Station, 52.9 to 65.9% for Maryville, 46.6 to 62.8% for University of Newcastle and 50.6 to 61.9% for Williamtown RAAF.

Table 4-3
Meteorological Data Summary Bureau of Meteorology

Month	Relative Humidity Monthly Average (%)								Average Daily Temperature (°C)								Average Monthly Rainfall (mm)				Average Monthly Evaporation (mm)	
	Nobbys Signal Station		Maryville		University of Newcastle		Williamtown RAAF		Nobbys Signal Station		Maryville		University of Newcastle		Williamtown RAAF		Nobbys Signal Station	Maryville	University of Newcastle	Williamtown RAAF	Maryville	Williamtown RAAF
	9 am	3 pm	9 am	3 pm	9 am	3 pm	9 am	3 pm	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.						
January	76.4	72.1	71.9	64.4	71.3	55.8	71.7	59.3	25.6	19.1	27.6	19.5	29.0	19.1	27.9	18.0	89.9	113.1	57.7	99.9	186.8	212.5
February	79.7	74.1	75.6	65.9	78.3	62.8	75.8	61.9	25.4	19.3	27.4	19.6	28.1	19.3	27.4	18.0	107.2	115.3	163.7	121.1	156.1	174.3
March	78.6	71.6	74.3	65.2	77.8	61.3	76.2	61.2	24.7	18.2	26.2	17.9	26.1	17.0	26.1	16.3	121.4	129.3	105.4	123.2	142.0	149.9
April	77.8	66.0	74.0	62.9	79.7	62.7	76.1	58.7	22.8	15.3	23.9	15.0	23.9	14.2	23.7	13.2	115.2	111.2	122.5	99.4	105.1	113.8
May	79.0	64.5	77.2	63.5	78.0	59.5	78.9	59.6	19.9	11.9	20.6	11.9	20.8	10.6	20.2	10.1	118.8	98.2	112.6	116.9	73.1	82.5
June	78.8	63.2	77.2	62.5	77.7	56.0	79.9	60.2	17.5	9.6	17.8	9.2	18.8	8.4	17.6	7.8	115.0	125.6	67.8	116.2	60.1	74.4
July	76.6	59.1	73.9	57.1	76.2	53.2	76.8	54.9	16.7	8.4	17.4	7.7	17.9	7.1	17.0	6.3	95.7	51.3	48.7	71.8	70.1	80.5
August	72.7	56.1	68.6	52.9	70.1	48.6	71.4	51.1	18.0	9.2	18.8	8.3	19.5	8.0	18.5	6.8	75.3	57.4	60.7	77.5	91.2	108.9
September	69.7	58.4	63.2	54.1	65.4	46.6	66.0	50.6	20.1	11.4	21.1	10.6	22.6	10.7	21.1	9.0	73.1	53.9	56.0	57.9	120.0	139.6
October	68.3	63.5	62.5	59.1	60.3	49.6	63.8	53.8	22.1	14.0	23.3	13.6	24.4	13.2	23.5	12.0	73.7	85.1	66.5	75.9	149.4	172.1
November	71.6	68.0	67.3	61.3	69.7	58.3	65.4	54.9	23.5	16.1	24.6	15.7	25.3	15.5	25.4	14.2	70.1	81.4	121.5	79.8	163.9	189.8
December	74.5	71.1	68.6	61.6	69.5	58.0	67.5	56.0	24.9	18.0	27.0	18.3	27.8	17.9	27.3	16.5	81.7	90.0	66.3	80.1	195.7	227.6
Annual Average	**75.3**	**65.7**	**72.1**	**60.9**	**71.5**	**54.3**	**72.6**	**56.9**	**21.8**	**14.2**	**23.0**	**14.0**	**23.8**	**13.2**	**23.0**	**12.4**	-	-	-	-	-	-
Annual Average Total																	**1,137**	**1,112**	**1,049**	**1,120**	**1,514**	**1,726**

Source: Bureau of Meteorology (2006)

Wind Speed and Direction

Wind speed and direction data were obtained from the Steel River Industrial Estate during the years 2000 to 2005. Figure 4-5 provides average annual and seasonal wind roses compiled from these data (Appendix B).

Annually, the most common winds are from the north-west and west north-west. Winds from the east are also common (Appendix B). Easterly winds are predominant during the summer, while west north-west winds are common in the winter (Appendix B).

The pattern of winds measured at the PWCS monitoring station at Kooragang Coal Terminal is consistent with the wind pattern measured at the Steel River Industrial Estate monitoring station (Appendix B).

Evaporation

Evaporation records from Maryville and Williamtown RAAF indicate a distinct seasonality, with higher evaporation rates being recorded in the summer months and lower evaporation occurring in the winter months (Table 4-3). Average monthly evaporation at Maryville and Williamtown RAAF was highest in December (195.7 mm and 227.6 mm, respectively). The lowest recorded average monthly evaporation at Maryville and Williamtown RAAF was in June (60.1 mm and 74.4 mm, respectively).

4.2.2 Monitoring

An automated meteorological monitoring station would be installed on the Project site to record temperature, relative humidity, net solar radiation, rainfall, wind speed, wind direction and sigma theta (the rate of change of wind direction). Meteorological data would be continuously monitored and the data averaged over 10 minute periods.

Meteorological monitoring would form a key component of the Project environmental monitoring programmes and would be integrated with the dust suppression system (Section 4.4.3).

4.3 NOISE

A Construction, Operation and Road Transport Noise Impact Assessment has been undertaken by Heggies Australia (2006) in accordance with the requirements of the *NSW Industrial Noise Policy* (INP) (EPA, 2000), *Environmental Noise Control Manual* (EPA, 2004a) and *Environmental Criteria for Road Traffic Noise* (EPA, 1999), and is presented in Appendix A. The assessment includes the following components:

- noise impact assessment for construction of the Project;
- noise impact assessment for the Project operations;
- road noise impact assessment; and
- construction vibration impact assessment.

4.3.1 Existing Environment

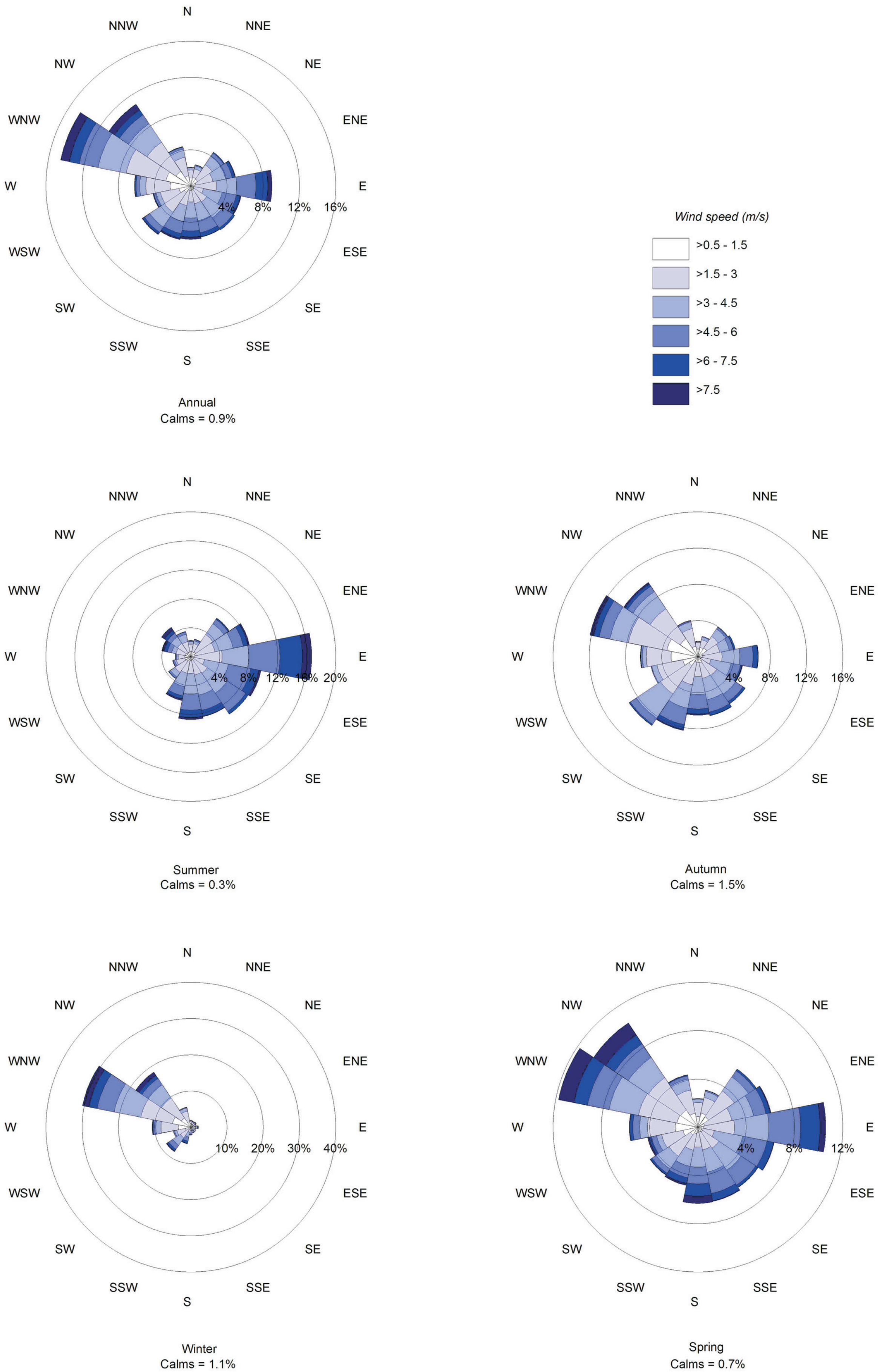
Recorded and assessed noise levels presented in Appendix A and summarised below are expressed in A-weighted decibels (dBA). The logarithmic dBA scale simulates the response to the human ear, which is more sensitive to high frequency sounds and less sensitive to lower frequency sounds. Table 4-4 provides information on common noise sources in dBA for comparative reference.

Hearing “nuisance” for most people begins at noise levels of about 70 dBA, while sustained (i.e. eight hours) noise levels of 85 dBA can cause hearing damage.

Measured and predicted noise levels are expressed as the equivalent continuous sound pressure level (L_{Aeq}), which is a constant sound level that is equal in energy to the fluctuating levels recorded during the monitoring period.

Project Background Noise Monitoring

Background noise surveys were conducted in April 2006 to characterise and quantify the existing acoustic environment in the vicinity of the Project. Ten unattended noise loggers were positioned at representative locations (N1 to N7 and N13 to N15) (Figure 4-4) between 3 April and 16 April 2006.



Source: Holmes Air Sciences (2006)

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FIGURE 4-5

Annual and Seasonal Steel River Wind Roses (2000-2005)

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NCIG-05-01 Sect4_007B

Table 4-4
Relative Scale of Various Noise Sources

Noise Level (dBA)	Relative Loudness	Common Indoor Noise Levels	Common Outdoor Noise Levels
110-130	Extremely noisy	Rock band	Jet flyover at 1,000 m
100	Very noisy	Internal demolition work (jackhammer)	Petrol engine lawn mower at 1 m
90	Very noisy	Food blender at 1 m	Diesel truck at 15 m
80	Loud	Garbage disposal at 1 m, shouting at 1 m	Urban daytime noise
70	Loud	Vacuum cleaner at 3 m, normal speech at 1 m	Commercial area heavy traffic at 100 m
60	Moderate to quiet	Large business office	-
50	Moderate to quiet	Dishwasher next room, wind in trees	Quiet urban daytime
40	Quiet to very quiet	Small theatre, large conference room (background), library	Quiet urban night-time
30	Quiet to very quiet	Bedroom at night, concert hall (background)	Quiet rural night-time
20	Almost silent	Broadcast and recording studio	-
0-10	Silent	Threshold of hearing	-

Source: after US Department of Interior, Robinson Project EA (1994) and Richard Heggie Associates (1995)

Operator-attended daytime, evening and night-time surveys were also conducted at all ten noise logging locations to supplement the unattended measurements and to assist in identifying the character and duration of ambient noise sources. In addition to the April 2006 ambient noise surveys, noise monitoring was reported by Heggies Australia in 2003 to establish background levels and measure industrial noise at one representative location in Carrington (N12) and at four representative locations in Mayfield (N8 to N11) (Appendix A).

Industrial noise is a feature of the night-time noise environment at all residential receiver areas in the vicinity of the Project and is particularly audible during lulls in transport, domestic and natural sources of noise (Appendix A). A description of industrial noise observed at these residential locations at night-time is provided below. The discussion below focuses on night-time industrial noise as some locations experience noise levels that approach the maximum amenity criterion of 50 dBA $L_{Aeq(period)}$ under specific weather conditions at night-time.

Industrial noise levels for the key localities were estimated in accordance with the methodologies described in the NSW INP. Industrial noise levels at the Steel River Industrial Estate are based on field observations made by Heggies Australia (Appendix A).

Fern Bay (West)/Stockton (West) (N1 and N3): Existing night-time industrial noise generally emanates from Kooragang Island and was estimated as 48 dBA at both receiver areas (Appendix A). The operator-attended surveys indicated that industrial noise is at least 5 dBA less in the absence of westerly winds and/or temperature inversions (Appendix A).

Fern Bay (East)/Stockton (East) (N2 and N4): Existing night-time industrial noise from Kooragang Island was estimated as 43 dBA to 44 dBA during noise enhancing conditions (e.g. westerly winds) (Appendix A). Industrial noise therefore attenuates by approximately 4 to 5 dBA from west to east at Fern Bay and Stockton. Industrial noise is at least 5 dBA less in the absence of westerly winds and/or temperature inversions (Appendix A). Ocean noise is also a feature of the area, particularly during north-easterly breezes.

Warabrook/Mayfield West/Mayfield/Carrington (N5 to N13): Existing night-time industrial noise generally emanates from the industrial areas located to the immediate north of these receiver areas and was estimated as 42 dBA to 44 dBA (Appendix A). Due to the relatively close proximity of existing industrial developments to the receiver areas, noise enhancement due to weather effects is less significant in comparison to that experienced in localities to the east of Kooragang Island (Fern Bay and Stockton). Therefore, the industrial noise contribution is relatively more constant (Appendix A).

Rating Background Level

Noise data from 2003 and 2006 were processed in accordance with the requirements of the NSW INP to determine the background noise levels for the Project acoustic assessment (Table 4-5).

The rating background level (RBL) is a calculated median background level representing each assessment period (day/evening/night) over the whole monitoring period. The RBL measurement methodology and analytical procedures are described in further detail in Appendix A. The locations of noise sensitive receivers (e.g. residential areas, schools, etc.) are provided in Appendix A. The locations of noise monitoring sites for which RBLs have been determined are shown on Figure 4-4.

4.3.2 Potential Impacts

Construction Noise Criteria

An assessment of potential noise impacts from Project construction works was undertaken with regard to the Environmental Noise Control Manual (ENCM) (EPA, 1994). The ENCM provides noise limits for construction periods of up to 26 weeks. As the duration of the construction works is greater than 26 weeks, the DEC suggests that the construction noise emission should generally not exceed the background level by more than 5 dBA. This approach has been adopted for the Project. Therefore for residential receivers, Project construction noise criteria are equal to the intrusive criteria which apply for Project operations (see the discussion below).

Operational Noise Criteria

In accordance with NSW INP objectives, background noise levels for the Project site and surrounds have been characterised (Table 4-5). Intrusive and amenity noise assessment criteria, which form the basis for impact assessment and determining mitigation requirements, have been derived for the Project based on these measured background levels (Table 4-5). Intrusive criteria for noise sensitive receivers are calculated by adding 5 dBA to the RBL, whilst the amenity criteria are a more complex calculation which has been performed using algorithms in the NSW INP (Appendix A). Project-specific noise assessment criteria derived from this approach for each receiver area are outlined in Table 4-6. Receiver areas are shown on Figure 4-4.

In those cases where the INP Project-specific assessment criteria in Table 4-6 are exceeded, it does not necessarily follow that all people exposed to the noise would find the noise noticeable or unacceptable. In subjective terms, exceedances of the INP Project-specific assessment criteria can be generally described as follows:

- negligible noise level increase (less than 1 dBA) (not noticeable by all people);
- marginal noise level increase (between 1 dBA and 2 dBA) (not noticeable by most people);
- moderate noise level increase (between 3 dBA and 5 dBA) (not noticeable by some people but may be noticeable by others); and
- appreciable noise level increase (greater than 5 dBA) (noticeable by most people).

Table 4-4 presents a qualitative description of noise levels from various common noise sources for comparative reference.

Noise Modelling

An acoustic model was developed that simulates Project components and noise source information (i.e. sound levels and locations). The sources of noise identified for the Project included:

- coal trains on the rail loops;
- rail unloading stations;
- conveyors;
- coal stockyard stackers/reclaimers; and
- shiploading infrastructure.

The model also considers meteorological effects, surrounding terrain, aspects of the built environment (i.e. existing buildings), distance from source to receiver, and noise management and mitigation measures (i.e. at-source noise mitigation measures adopted by NCIG).

Meteorological effects included in the modelling are those characterised as prevailing in accordance with INP assessment methodologies. The definition of prevailing conditions included statistical analysis of meteorological data (including consideration of wind speed and direction, as well as temperature lapses and inversions).

The meteorological parameters used in modelling noise emissions are shown in Table 4-7 and are based on the default inversion and wind speeds presented in Section 5 of the NSW INP (EPA, 2000) and the analysis of the PWCS Kooragang Coal Terminal meteorological data set (Appendix A).

Table 4-5
Noise Environment for Project Assessment Purposes (dBA re 20 μPa)

Receiver Area	Project Noise Monitoring Site	Rating Background Level (dBA)			Measured $L_{Aeq(period)}$ All Noise Sources (dBA)			Estimated $L_{Aeq(period)}$ Industrial Noise Only (dBA)[2]		
		7.00 am to 6.00 pm	6.00 pm to 10.00 pm	10.00 pm to 7.00 am	7.00 am to 6.00 pm	6.00 pm to 10.00 pm	10.00 pm to 7.00 am	7.00 am to 6.00 pm	6.00 pm to 10.00 pm	10.00 pm to 7.00 am
Fern Bay (West)	N1	50	42	44	60	55	54	<54	46	48
Fern Bay (East)	N2	40	44	42	48	46	46	<54	42	43
Stockton (West)	N3	42	44	44	63	57	59	<54	47	48
Stockton (East)	N4	41	43	43	55	50	49	<54	43	44
Warabrook/Mayfield West	N5, N6	45	46	41	61	56	55	<54	45	43
Mayfield	N7, N8, N9, N10, N11	46	47	43	63	59	56	<54	45	44
Carrington	N12	42	41	37	62	67	57	46	45	42
Sandgate	N13	48	45	40	57	54	55	<59	46	43
Steel River[1]	-	-	-	-	-	-	-	<59	<59	<59
Kooragang Island	N14	51	51	47	61	56	55	<64	53	51
Mayfield North	N15	56	57	57	60	59	59	<64	57	57

Source: Appendix A
1 Industrial noise levels generated from NSW INP commercial amenity criteria based on field observations by Heggies Australia.
2 Industrial noise levels estimated according to NSW INP methodology.

Table 4-6
Project-Specific Noise Assessment Criteria (dBA re 20 μPa)

Receiver Area	Noise Sensitive Receiver Type	Project-Specific Noise Assessment Criteria (dBA)					
		Intrusive $L_{Aeq(15\ minute)}$			Amenity $L_{Aeq(period)}$		
		Day[1]	Evening[1]	Night-time[1]	Day[1]	Evening[1]	Night-time[1]
Fern Bay (West)	Residential	55	47	49	60	48	38
Fern Bay (East)	Residential	45	49	47	60	50	41
Stockton (West)	Residential	47	49	49	60	47	38
Stockton (East)	Residential	46	48	48	60	50	39
Warabrook/Mayfield West	Residential	50	51	46	60	48	41
Mayfield	Residential	51	52	48	60	48	39
Carrington	Residential	47	46	42	60	48	43
Sandgate	Commercial[2]	Intrusive noise not applicable[3]			65	65	65
Mayfield West	Steel River	Intrusive noise not applicable[3]			65	65	65
Kooragang Island	Industrial	Intrusive noise not applicable[3]			70	70	70
Mayfield North	Industrial	Intrusive noise not applicable[3]			70	70	70
Any	School	Intrusive noise not applicable[3]			External 45 when in use		
Any	Hospital	Intrusive noise not applicable[3]			External 50 when in use		

Source: Appendix A
1 Daytime 7.00 am to 6.00 pm, Evening 6.00 pm to 10.00 pm, Night-time 10.00 pm to 7.00 am.
2 Receiver type is commercial due to zoning as Urban Services 4(A) in the *Newcastle Local Environmental Plan, 2003*.
3 Intrusive criteria apply to residential receivers only.

Table 4-7
Relative Calm and INP Noise Enhancing Meteorological Modelling Parameters

Period	Meteorological Parameter	Air Temp (°C)	Relative Humidity (%)	Wind Direction and Speed	Temperature Gradient
Daytime	Calm	20	70	Nil	Nil
Evening	Wind only[1]	15	80	ENE - 3 m/s	Nil
Night-time	Wind only[1]	10	90	WNW - 3 m/s	Nil
	Inversion only[2]	10	90	Nil	3°C/100 m
	Inversion and Drainage[3]	10	90	WNW - 2 m/s	3°C/100 m

Source: Appendix A
1 INP default wind speed 3 m/s.
2 INP default temperature inversion 3°C/100 m.
3 INP default inversion 3°C/100 m plus 2 m/s drainage flow to receiver areas east of the Project only (i.e. Fern Bay and Stockton).

A general description of meteorology in the vicinity of the Project is provided in Section 4.2.

Appendix A presents point source noise calculations for the Project. Point sources for which noise levels are presented include:

- background noise monitoring locations (Figure 4-4) representing relevant receiver areas;
- schools in localities proximal to the Project;
- hospitals in localities proximal to the Project; and
- selected industrial receivers on Kooragang Island.

Noise Emission Scenarios

Predictive noise emission modelling has been undertaken for four representative snapshots in the Project life, based on the planned Project development. Operational activities would be undertaken 24 hours per day, seven days per week and would include noise generated by train unloading operations, stacking/reclaiming and shiploading (Section 2.3).

Construction

The Project would include the construction and commissioning of rail infrastructure, the coal storage area, wharf facilities and shiploaders. An initial 33 month construction schedule is expected for a Project capacity of 33 Mtpa. Construction activities with the potential to be audible at surrounding residential areas would be undertaken during daytime hours up to seven days per week. The main Project elements that would be constructed are described in Section 2. Dredging operations (as described in Section 3.6.1) and the associated deposition of dredged material on the Project site would be undertaken up to 24 hours per day. The movement of oversize vehicles to and from the Project site may also be undertaken outside of daytime hours to minimise potential impacts on existing traffic flows on Cormorant Road (Section 4.11).

The timing of further development of the Project capacity up to 66 Mtpa would depend on coal market demand. Construction activities with the potential to be audible at surrounding residential areas associated with further progressive development of the Project from a capacity of 33 Mtpa to 66 Mtpa would also be generally undertaken during daytime hours up to seven days per week concurrently with operation of the 33 Mtpa Project.

Both of the construction scenarios above were acoustically modelled and are described in Appendix A.

Operation

Operations at a capacity of 66 Mtpa are considered to be worst-case with respect to noise emissions, as opposed to the initial 33 Mtpa Project operation. Two operational scenarios at 66 Mtpa capacity were assessed in Appendix A. These scenarios were developed to be representative of worst-case noise emissions for noise sensitive receivers to the east and west, respectively. Mobile equipment such as stacker/reclaimers and shiploaders and the orientation of trains on the rail loop are located in the model with a bias to the east (Operation – East 66 Mtpa) or the west (Operation – West 66 Mtpa).

Predicted Noise Emissions

Predicted Project construction noise emissions are below the relevant assessment criteria for all noise sensitive receivers (Appendix A).

Predicted Project operational intrusive and amenity noise emissions are below the relevant assessment criteria for all noise sensitive receivers under all scenarios assessed (Appendix A).

The outer envelope (i.e. east and west combined) night-time intrusive and amenity noise contours under inversion and drainage flow (i.e. 2 m/s wind towards receivers, where applicable [Table 4-7]) are presented on Figure 4-6 and 4-7 respectively. These contours were developed by merging the contours generated from the two operational scenarios described above, to graphically represent the overall worst-case noise emission envelope.

The noise contours shown on Figures 4-6 and 4-7 may, in some cases, differ from the values that have been individually calculated for noise sensitive receiver locations presented in detail in Appendix A, particularly where topographic effects are prominent. This is because the generation of the noise contours involves numerical interpolation of noise level arrays with a graphical accuracy of up to approximately ±2.5 dBA.

Cumulative Noise Assessment

The INP provides cumulative noise assessment guidelines that address existing and successive industrial development by setting acceptable and maximum cumulative $L_{Aeq(period)}$ amenity levels for all industrial (i.e. non-transport related) noise in an area.

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FIGURE 4-6
Predicted Project Night-Time L Aeq (15 minute) Intrusive Noise Contours
Combined East and West Scenarios

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FIGURE 4-7

Predicted Project Night-Time $L_{Aeq\ (9\ Hour)}$ Amenity Noise Contours Combined East and West Scenarios

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An assessment was undertaken by Heggies Australia in accordance with the INP, to cumulatively assess the Project and approved developments (including those not yet fully developed) in the vicinity of the Project with respect to the amenity criteria. Table 4-8 describes the industrial developments that were considered in the cumulative noise assessment and the cumulative air quality assessment (Section 4.4.2).

The night-time cumulative amenity noise levels are calculated based on: the existing industrial noise sources; noise from approved developments; and the predicted Project operational noise amenity levels. The calculated night-time cumulative amenity noise levels are presented in Table 4-9. Acceptable and maximum amenity criteria for each residential receiver area are also presented.

The discussion below focuses on night-time industrial noise as some locations experience noise levels that approach the maximum amenity criterion of 50 dBA $L_{Aeq(period)}$ under adverse weather conditions.

Fern Bay (West)/Stockton (West)

Existing night-time industrial noise at this locality generally emanates from Kooragang Island and was estimated as 48 dBA at both receiver areas. Table 4-9 indicates that cumulative noise amenity levels are predicted to increase by approximately 1 dBA and remain below the maximum noise amenity level of 50 dBA. Industrial noise is at least 5 dBA less in the absence of westerly winds and/or temperature inversions (Section 4.3.1) and therefore cumulative noise levels would be just below the acceptable noise amenity level of 45 dBA during these conditions.

Fern Bay (East)/Stockton (East)

Existing night-time industrial noise (generally from Kooragang Island) was estimated as 43 dBA to 44 dBA during noise enhancing conditions. Cumulative noise amenity levels are predicted to increase by approximately 1 dBA and remain within the acceptable noise amenity level of 45 dBA (Table 4-9). As for Fern Bay (West) and Stockton (West) above, industrial noise is at least 5 dBA less in the absence of westerly winds and/or temperature inversions (Section 4.3.1).

Warabrook/Mayfield West/Carrington

Existing night-time industrial noise generally emanates from the industrial areas located to the immediate north of the receiver areas and was estimated as 42 dBA to 43 dBA. Cumulative noise amenity levels are predicted to increase by approximately 1 dBA to 2 dBA and remain within the acceptable noise amenity level of 45 dBA (Table 4-9).

Mayfield

Existing night-time industrial noise generally emanates from the industrial areas located to the immediate north of the receiver area and was estimated as 44 dBA. Cumulative noise amenity levels are predicted to increase by approximately 3 dBA and remain below the maximum noise amenity level of 50 dBA (Table 4-9).

Based on the above, the acceptable INP amenity criteria for Fern Bay (West) and Stockton (West) would continue to be exceeded (i.e. the existing noise environment exceeds this criteria), however the degree of exceedance would increase marginally by approximately 1 dBA and would remain below the maximum INP amenity criteria. In Mayfield, the acceptable INP amenity criteria is predicted to be exceeded by approximately 2 dBA, but compliance with the maximum criteria would be achieved. For each of the cases discussed above the likelihood of all existing, approved and proposed developments listed in Tables 4-8 and 4-9 being developed and subsequently emitting maximum noise emission at the same time is considered to be remote and therefore this assessment is considered to be conservative (Appendix A).

Rail Transportation Noise

The ARTC operates the Hunter Valley Coal Rail Network in NSW. Noise emissions from the railway are regulated by ARTC's EPL 3142. The intent of the relevant EPL conditions is to control airborne noise by two principal means:

- Noise limits.
- Management of noise via Pollution Reduction Programs (PRPs).

Table 4-8
Description of Approved Developments Included in the Cumulative Noise and Air Quality Assessments

Name of Development	Proponent	Description	Current Status
Kooragang Coal Terminal	PWCS	Coal export terminal.	Currently operating at 64 Mtpa (Stages 1, 2 and 3A). Stage 3 remainder – not yet fully developed.
Cargill Oilseed Processing Facility	Cargill Australia Ltd	Oilseed processing facility.	Stage 1 – operating. Stage 2 – not yet fully developed.
Proposed Extension of Shipping Channels in the Port of Newcastle	NSW Waterways Authority	Dredging project (south arm of the Hunter River).	Not yet fully developed (temporary).
Multi-Purpose Terminal	BHP Company Limited	Bulk export terminal.	Not yet developed.

Source: Appendix A

Table 4-9
Night-time Cumulative Noise Assessment (dBA re 20 µPa)

Receiver Area	Existing Industry Measured	PWCS Stage 3 Remainder (Adverse)[1]	Cargill Stage 2 (Adverse)	Extension of Shipping Channels (Adverse)	Multi-Purpose (Limits)	NCIG Project (Adverse)[2]	Cumulative Sum (Adverse)	INP Amenity Criteria	
								Acceptable	Maximum
Fern Bay (West) - Residential	48	34	33	30	30	36	49	45	50
Fern Bay (East) - Residential	43	29	28	25	30	36	44		
Stockton (West) - Residential	48	35	33	35	30	35	49		
Stockton (East) - Residential	44	31	28	30	30	35	45		
Warabrook/ Mayfield West - Residential	43	32	25	33	30	39	45		
Mayfield Residential	44	31	28	39	36	38	47		
Carrington Residential	42	24	25	30	34	31	43		

Source: Appendix A
1 PWCS noise contribution based on estimated emissions from Stage 3 expansion.
2 Average adverse noise predictions for each locality.

EPL 3142: Condition L6 - Noise Limits

Maximum locomotive source noise levels and tonality criteria for stationary and in-service test conditions are specified in EPL 3142 Condition L6 Noise Limits. EPL 3142 Condition L6 does not nominate airborne noise limits at receiver locations but notes that:

> *It is an objective of this licence to progressively reduce noise levels of railway operations to appropriate goals through the implementation of Pollution Reduction Programs (PRPs).*

EPL 3142: Condition U1 – Noise Management for Existing Activities and Infrastructure

EPL 3142 Condition U1 Noise Management for Existing Activities and Infrastructure requires the preparation of PRPs in accordance with Conditions U1.2, U1.3 and U1.4.

Condition U1.1 sets out noise objectives of PRPs as stated below. The noise goals are specified in terms of daytime $L_{Aeq(15hour)}$ and night-time $L_{Aeq(9hour)}$ equivalent continuous noise levels (log-averaging rail noise energy levels over the respective time periods) as well as a maximum passby noise level (L_{Amax}).

> *U1.1 Objectives of PRPs*
>
> *In developing the PRPs, the licensee must work towards the goals of 65 dB(A)Leq, (daytime - 7.00 am-10.00 pm), 60 dB(A)Leq, (night-time – 10.00 pm-7.00 am) and 85 dB(A) (24hr) max passby noise, at one metre from the facade of affected residential properties. If it is not possible for these goals to be reached by feasible and reasonable mitigation measures, the PRP must aim, through feasible and reasonable measures to:*
>
> - *reduce operational rail noise emissions and the associated noise impact on the community where traffic levels are anticipated to remain constant; or*
> - *stabilise operational rail noise emissions and the associated noise impact on the community where traffic levels are anticipated to increase.*

The goals do not represent unobtrusive noise levels. Rather, the objectives recognise that rail operations are inherently noisy and represent a compromise between what may be desirable from a community point of view (ie. maintaining amenity) and what is necessary to enable trains to operate (Appendix A).

The stated objectives of the PRP provide guidance for noise regulation for the Hunter Valley rail network (Appendix A).

Hunter Valley Coal Rail Network

In addition to the above, the following points can be made in relation to the Hunter Valley Coal Rail Network:

- The ARTC released "*2006-2011 Hunter Valley Coal Network Capacity Improvement Strategy*" in April 2006. The following points of relevance to the Project can be inferred from the ARTC publication:
  - The ARTC has outlined a series of rail upgrade projects necessary to keep track capacity ahead of the projected growth in coal exportation.
  - The ARTC's planning accounts for the capacity of the Project.
- The ARTC has already engaged in the process of planning and statutory approvals for rail capacity upgrade projects. Where relevant, noise impacts resulting from rail capacity upgrades will be assessed by the ARTC as part of the assessment and approval of these projects.
- Where relevant, each of the upgrades referred to in the ARTC publication would each be subject to an environmental assessment process under the *Environmental Planning and Assessment Act, 1979* and ultimately regulation by the DEC via an EPL.
- The environmental assessment for each phase of physical upgrade in the rail network capacity would provide the ARTC with the opportunity to develop noise mitigation works.

Train movements on the ARTC rail network are not part of the Project and are not assessed in this EA. Noise associated with the operation of trains on the Project rail infrastructure corridor is assessed in this EA.

Road Transportation Noise

Based on the EPA's "*Environmental Criteria for Road Traffic Noise*" policy (ECRTN) dated May 1999, Nelson Bay Road, Cormorant Road and Industrial Drive are classified as "arterial roads" (Appendix A). The applicable traffic noise goals are presented in Table 4-10.

Table 4-10
NSW Environmental Criteria for Road Traffic Noise

Receiver Area (Road)[1]	Policy	Descriptor	Traffic Noise Goal
• Fern Bay (Nelson Bay Road) • Kooragang Island (Cormorant Road) • Warabrook/Mayfield (Industrial Drive)	Land use developments with the potential to create additional traffic on existing freeways/arterials	Daytime[2] $L_{Aeq(15hour)}$	60 dBA
		Night-time[3] $L_{Aeq(9hour)}$	55 dBA

Source: Appendix A
1 Refer to Figure 4-4.
2 7:00 am to 10:00 pm.
3 10:00 pm to 7:00 am.

The ECRTN establishes that in cases where the nominated traffic noise goals are already exceeded, traffic associated with the development should not lead to an increase in the existing traffic noise of more than 2 dBA.

Table 4-11 shows the anticipated construction and operating traffic flows and the percentage increase arising from Project-related traffic.

The maximum Project-related incremental increase in daytime traffic flow occurs during the construction period along Cormorant Road. The anticipated 3% increase in vehicle movements corresponds to a negligible 0.1 dB increase in the existing daytime $L_{Aeq(15hour)}$ noise level (Appendix A).

Similarly, the maximum Project-related incremental increase in night-time traffic flow also occurs along Cormorant Road during the construction period. The anticipated 12% increase in vehicle movements corresponds to a 0.5 dB increase in the existing night-time $L_{Aeq(9hour)}$ noise level and is also considered negligible (Appendix A).

Operational Project traffic flows are significantly lower than during the construction period. Therefore, the increase in road noise during operation of the Project would be lower than for construction.

Construction Vibration

Up to four piling rigs are anticipated to be required during construction of the rail, coal storage and wharf facilities (Appendix A). Relevant damage and annoyance criteria based on German Standard DIN 4150-3 1999 "*Structural Vibration Part 3: Effects of Vibration on Structures*" and the DEC (2006) interim guideline "*Assessing Vibration: A Technical Guideline"* are reviewed in Appendix A and summarised in Table 4-12.

The buffer distances predicted to achieve compliance with the range of damage and annoyance risk criteria are presented in Table 4-13. The buffer distances are based on the operation of a single hydraulic hammer rated at 5 tonne-metres (t-m) driving 450 mm concrete piles at both 50% and 100% piling capacity. As the vertical criterion is equal to, or lower than the horizontal criterion in all cases (Table 4-12), buffer distances are provided in Table 4-13 with respect to the vertical criterion only.

Based on the predicted buffer distances from single hydraulic hammering, it is concluded that the damage and annoyance risk to all residential receivers is negligible as the nearest dwellings are well beyond 180 m from the locations of potential piling activities (Appendix A). Similarly, the damage risk to the nearest commercial and industrial receivers is also considered negligible as the nearest buildings are well beyond 12 m from the locations of potential piling activities. The risk of annoyance to the occupants of offices and workshops is also minimal at all but the very nearest adjacent industrial neighbours to the east of the Project site (Appendix A). However, the annoyance risk to the closest office and workshops would be temporary (i.e. only during the construction piling activities).

4.3.3 Mitigation Measures, Management and Monitoring

Project Noise Mitigation Measures

During the noise impact assessment, a number of iterative steps were taken to develop noise mitigation measures for the Project, including:

- preliminary noise modelling to identify potential areas of affectation;
- further modelling incorporating various noise mitigation measures to assess their relative effectiveness;

Table 4-11
Predicted Traffic Flows

Location	Time Period	Predicted 2007	Project Construction[1]	Total	Predicted 2017	Project Operations[1]	Total
Nelson Bay Road	Daytime 7:00 am to 10:00 pm	16,744	109 (1%)	16,853	18,370	5 (<1%)	18,375
Cormorant Road		21,803	586 (3%)	22,389	23,864	53 (<1%)	23,917
Industrial Drive		27,687	293 (1%)	27,980	30,320	26 (<1%)	30,346
Nelson Bay Road	Night-time 10:00 pm to 7:00 am	2,791	65 (2%)	2,856	3,062	2 (<1%)	3,064
Cormorant Road		3,540	398 (12%)	3,938	3,884	30 (1%)	3,914
Industrial Drive		4,521	199 (4%)	4,720	4,960	15 (<1%)	4,975

Source: Appendix A
[1] Numbers shown in brackets (e.g. (1%)) represent estimated percentage increase in traffic flows arising from Project-related traffic.

Table 4-12
Vibration Velocity Damage and Annoyance Risk Criteria

Receiver Area	Damage Risk (mm/s)		Annoyance Risk (mm/s)	
	Horizontal	Vertical	Horizontal	Vertical
Residential/Dwellings	15	5	1.2	0.45
Commercial/Offices	40	20	1.6	0.6
Industrial/Workshops	40	20	3.2	1.2
Mechanical (On/Off)*	20/5	20/5	-	-
Electronics/Computers	5	5	-	-
Subsurface/Pipework	50-100	50-100	-	-

Source: Appendix A
* Use of machinery on/use of machinery off.

Table 4-13
Required Buffer Distance from Impact Piling

Receiver Area	Required Buffer Distance to Achieve Damage Risk Criteria (m)		Required Buffer Distance to Achieve Annoyance Risk Criteria (m)	
	Vertical 50%	Vertical 100%	Vertical 50%	Vertical 100%
Residential/Dwellings	80	100	150	180
Commercial/Offices	9	12	130	150
Industrial/Workshops	9	12	100	120
Mechanical (On/Off)	9/80	12/100	-	-
Electronics/Computers	9	12	-	-
Subsurface/Pipework	2	3	-	-

Source: Appendix A

- consideration of various combinations of noise mitigation measures to minimise the potential noise affectation zone; and
- adoption by NCIG of a range of noise mitigation measures that significantly reduce Project noise emissions.

The noise mitigation and management measures included in the predictive modelling and which would be adopted for the Project, include:

- Fixed plant and mobile equipment would be commissioned and maintained to remain below specified maximum operating L_{Aeq} sound power levels detailed in Appendix A.
- An earth bund approximately 1,500 m in length would be constructed on the northern side of Cormorant Road. The bund would be located east of the Pacific National access road between the coal storage area and Cormorant Road. The bund would essentially be an extension of, and of a similar height to, the existing southern embankment of the KIWEF.

In addition, following initial noise modelling and conduct of the Project Environmental Risk Analysis (Section 3.8 and Appendix J), a further noise propagation control was identified comprising a purpose-built acoustic barrier approximately 600 m in length, 5 m above rail level and with an offset distance no greater than 3 m from the outer rail.

The implementation of the acoustic barrier would be dependant on the actual progressive development of the Project capacity (i.e. the acoustic barrier need only be installed as the capacity of the Project approaches 66 Mtpa, in order to facilitate compliance with the relevant Project noise criteria). Further details regarding the acoustic barrier are provided in Appendix A.

Noise Monitoring Programme

A Noise Monitoring Programme (NMP) would be developed for construction and operation of the Project. The NMP would describe the following elements:

- noise monitoring to be undertaken for the Project (i.e. monitoring locations, frequencies, parameters and specifications);
- Project noise mitigation measures;
- a protocol for the ongoing management of noise;
- procedures to be followed in the event of an exceedance of criteria should they occur; and
- complaint response protocols.

The NMP would detail specific actions for responding to exceedances of criteria and complaints should they occur. The results of the NMP would be used to optimise noise controls, validate the noise modelling predictions and would be reported to relevant authorities via the Annual Environmental Management Report (AEMR) (Section 5).

Exceedances of Criteria

In the event of an exceedance of Project-specific criteria (Table 4-6) during construction or operations, and depending on the degree of exceedance, additional noise mitigation and management measures would include:

- additional targeted noise monitoring on-site and within the community;
- prompt response to any community issues of concern;
- refinement of on-site noise operating procedures, where practicable; and
- consideration of additional acoustical controls on noise sources.

Noise Monitoring

The Project noise monitoring would comprise quarterly attended and unattended monitoring. Quarterly monitoring would be conducted at up to six locations. Noise monitoring would be conducted in accordance with AS 1055-1997 *Acoustics – Description and Measurement of Environmental Noise* and the INP. The locations proposed for monitoring are described in Section 5.

NCIG intends to pursue opportunities to integrate its monitoring networks with the PWCS monitoring network. Where practicable, this would include the sharing of data.

Construction Vibration

Monitoring of construction vibration would be undertaken at adjacent industrial receivers within 180 m of piling activities to assess compliance with relevant criteria (Section 5). Vibration monitoring would be documented in the Construction Environmental Management Plan (CEMP). Vibrational peak particle velocity (mm/s) would be measured in accordance with relevant standards. The CEMP would incorporate mechanisms for responding to vibration-related complaints.

4.4 AIR QUALITY

An Air Quality Impact Assessment for construction and operation of the Project has been undertaken by Holmes Air Sciences (2006) and is presented in Appendix B. The assessment was conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005a).

4.4.1 Existing Environment

As a component of the Air Quality Impact Assessment, background air quality data was collected and reviewed. Background air quality data was collected from the DEC monitoring stations at Beresfield, Newcastle and Wallsend and from the Steel River Industrial Estate. The locations of these sites are shown on Figure 4-4. The following section provides an overview of background air quality for the relevant parameters.

Air Quality Criteria

Dust Deposition

The DEC amenity criteria for dust deposition seek to limit the maximum increase in the mean annual rate of dust deposition from a new development to 2 grams per square metre per month (g/m^2/month) and total dust deposition (i.e. including background air quality) to 4 g/m^2/month.

Concentrations of Suspended Particulate Matter

Exposure to suspended particulate matter can be associated with health and amenity impacts. The likely risk of these impacts depends on a range of factors including the size, chemical make-up and level of the particulate matter and the general health of the person (NSW Health & NSW Minerals Council, 2006).

Such particles (total suspended particulates (TSP)) are typically less than 50 micrometers (µm) in size and can be as small as 0.1 µm. Fine particles less than 10 µm are referred to as PM_{10}. Suspended particulate matter criteria, standards and goals used in the assessment comprise:

- The National Environment Protection Measure (NEPM) 24-hour reporting standard for PM_{10} of 50 µg/m^3 (with five exceedances allowed per year) and the DEC 24-hour PM_{10} assessment criterion of 50 µg/m^3 (for concentrations due to the Project alone).
- The DEC annual assessment criterion for PM_{10} of 30 µg/m^3 has been interpreted as a concentration that should be met within the region (concentrations due to the Project and background).
- The National Health and Medical Research Council's (NHMRC) annual goal for TSP of 90 µg/m^3 (which has been interpreted as the assessment criterion for TSP concentrations due to the Project and background air quality).

Details of the air quality criteria for concentrations of particulate matter are provided in Table 4-14.

Table 4-14
Air Quality Standards/Assessment Criteria for Particulate Matter Concentrations

Pollutant	Standard/Goal/Criterion	Agency
Total Suspended Particulate Matter (TSP)	90 µg/m^3 (annual mean)	NHMRC
Particulate Matter < 10 µm (PM_{10})	50 µg/m^3 (24-hour average – maximum)	DEC assessment criterion
	30 µg/m^3 (annual mean)	DEC assessment criterion
	50 µg/m^3 (24-hour average, 5 exceedances permitted per year)	NEPM reporting standard

Source: Appendix B

Dust Deposition

Dust deposition data were obtained from six sites (SR1 to SR3 and SR5 to SR7) at the Steel River Industrial Estate for the period from January 2003 to January 2006 (Figure 4-4).

Dust deposition results for these six sites are presented in Table 4-15. The dust deposition rate over the period of record averaged across all sites was 1.6 g/m^2/month. The average monthly dust deposition rate for all sites was below the DEC goal of 4 g/m^2/month (Appendix B). Based on these data, it has been conservatively assumed that the annual average background dust deposition rate is 2 g/m^2/month (Appendix B).

Suspended Particulates

Particulate Matter Less than Ten Microns in Size

PM_{10} data were obtained from three DEC monitoring stations (Beresfield, Newcastle and Wallsend) (Figure 4-4). These three monitoring stations measured concentrations of PM_{10} by either high volume air sampler (HVAS) or tapered element oscillating microbalance (TEOM) analyser during the years 2000 to 2005. A summary of the PM_{10} monitoring results for the DEC sites is presented in Table 4-16.

The annual average PM_{10} concentration at Beresfield was 21 µg/m^3 for both the HVAS (January 2000 to December 2003) and TEOM (January 2000 to June 2005).

At the Newcastle monitoring station, the annual average PM_{10} concentration measured by the HVAS was 23 µg/m^3 (January 2000 to December 2003 and January 2005 to June 2005) and the TEOM measured an annual average PM_{10} concentration of 22 µg/m^3 (October 2004 to June 2005).

The annual average PM_{10} concentrations measured by the HVAS at Wallsend was 18 µg/m^3 (January 2000 to December 2003) and the TEOM measured an annual average PM_{10} of 18 µg/m^3 (January 2000 to June 2000 and November 2000 to June 2005).

Based on these data, it has been assumed that the annual average background PM_{10} concentration is 21 µg/m^3 (Appendix B).

The annual average PM_{10} concentrations for complete years at the three DEC monitoring stations were below the DEC air quality goal of 30 µg/m^3.

The monthly maximum 24-hour average PM_{10} concentrations at all three DEC monitoring stations have exceeded the DEC goal of 50 µg/m^3 on 36 occasions during the years 2000 to 2005. The highest 24-hour average PM_{10} concentrations were generally measured in spring and summer (Appendix B).

Total Suspended Particulates

TSP levels can be inferred from the PM_{10} monitoring data (Appendix B). The annual average inferred TSP background concentration based on the annual average PM_{10} concentration (21 µg/m^3) is 53 µg/m^3 (Appendix B).

Appendix B includes a review of data obtained from the PWCS Kooragang Coal Terminal meteorological station. This review concluded that the TSP background concentration used for this assessment is conservative and the PM_{10} background concentration is comparable with the PWCS data (Appendix B).

4.4.2 Potential Impacts

The Air Quality Impact Assessment considered the air quality emissions likely to be generated by the Project and the predicted impact of these emissions in combination with existing background air quality in the vicinity of the Project (Appendix B). Cumulative emissions with other approved developments (including those not yet fully developed) in the vicinity of the Project were also considered (Table 4-8). Emissions associated with operation of the Project would be primarily derived from coal dust emissions from transfer points, stacking/reclaiming, loading/unloading and wind blown emissions (particularly from the surfaces of coal stockpiles) as well as a relatively small contribution from diesel train exhausts.

The potential air quality impacts of the Project were modelled for a coal export capacity of both 33 Mtpa and 66 Mtpa (Appendix B). This modelling showed that the predicted air quality emissions with the Project at a 66 Mtpa capacity are greater than at 33 Mtpa. Therefore, the potential air quality impacts of the Project at 66 Mtpa are discussed below.

A full description of the dispersion model and the emissions inventory (including the locations of fixed and mobile dust sources) is provided in Appendix B. The results of dispersion modelling are presented graphically as isopleths in Appendix B. The predicted air quality concentrations for each locality presented below are based on the closest residence to the Project in each locality.

Table 4-15
Average Dust Deposition Rates (g/m²/month)

	Dust Monitoring Site																	
	SR1			SR2			SR3			SR5			SR6			SR7		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
January	1.5	1.6	1.2	1.5	1.5	-	1.8	2.1	1.5	1.5	2.6	2.4	3.4	2.1	1.4	2.6	-	4.8
February	-	1.1	2.9	-	0.7	2.1	-	1.2	1.6	-	0.8	1.7	-	0.9	2.4	-	3.9	2.7
March	0.5	1.1	1.0	0.5	0.9	1.0	1.3	-	2.1	0.7	0.9	1.1	1.1	-	2.0	3.5	-	1.0
April	0.8	1.6	-	0.9	-	0.7	0.8	1.6	1.2	0.7	1.5	0.8	0.5	1.7	1.6	0.9	1.8	0.8
May	-	0.7	0.9	-	0.8	1.0	-	0.7	1.6	-	0.5	1.0	-	0.8	1.5	-	0.7	0.9
June	1.5	1.4	2.1	1.2	0.7	3.1	0.7	1.0	1.3	0.6	0.6	0.9	0.9	0.1	1.8	3.0	0.7	1.3
July	1.6	1.0	0.7	1.2	1.4	2.2	1.6	1.4	1.0	1.1	1.1	0.4	1.3	1.3	0.7	4.9	1.2	0.5
August	0.9	-	1.4	0.3	-	0.8	0.3	1.1	1.1	0.1	0.9	1.0	0.3	1.3	1.0	3.4	1.1	1.8
September	1.2	3.3	1.2	2.2	-	1.1	0.8	1.8	1.7	0.6	1.1	1.6	1.0	1.3	2.1	5.6	-	2.1
October	0.9	2.4	1.9	0.7	1.9	1.6	1.0	-	2.4	0.5	2.0	1.4	1.3	2.2	2.1	4.1	27.5*	4.8
November	1.3	1.2	1.4	1.5	1.7	1.3	1.5	1.6	2.8	1.0	1.2	1.5	1.8	2.0	2.3	-	1.8	1.8
December	1.5	1.9	1.5	7.2	1.5	1.5	2.2	1.9	2.5	0.9	2.1	2.0	1.9	2.7	5.0	6.7	2.4	2.6
Average	**1.2**	**1.6**	**1.5**	**1.7**	**1.2**	**1.5**	**1.2**	**1.4**	**1.7**	**0.8**	**1.3**	**1.3**	**1.4**	**1.5**	**2.0**	**3.9**	**1.7**	**2.1**

Source: Appendix B

* Construction activities conducted nearby, therefore not indicative of background air quality and excluded from the calculation of averages.

Table 4-16
Monthly PM_{10} Rates ($\mu g/m^3$)

	Beresfield ($\mu g/m^3$)				Newcastle ($\mu g/m^3$)				Wallsend ($\mu g/m^3$)			
	HVAS		TEOM		HVAS		TEOM		HVAS		TEOM	
	Average[1]	Maximum[1]	Average[2]	Maximum[3]	Average[4]	Maximum[1]	Average[5]	Maximum[5]	Average[1]	Maximum[1]	Average[6]	Maximum[3]
January	24	44	21	59	28	45	22	85	22	34	23	89
February	21	35	21	53	27	40	26	189	17	32	21	49
March	23	53	20	59	25	43	20	93	20	33	18	41
April	16	31	19	48	22	32	24	149	13	19	16	34
May	17	30	20	44	20	26	21	93	14	26	16	38
June	18	31	19	51	24	34	21	91	17	28	15	51
July	20	34	19	47	16	24	-	-	15	28	15	30
August	17	35	19	36	17	26	-	-	15	23	17	31
September	22	41	22	52	22	41	-	-	19	34	18	44
October	23	82	25	149	23	72	20	26	19	76	20	105
November	28	81	24	83	26	57	22	44	22	54	20	60
December	22	58	25	166	26	68	25	47	21	52	23	157
Average	**21**	**82**	**21**	**166**	**23**	**72**	**22**	**189**	**18**	**76**	**18**	**157**

Source: after Appendix B
[1] Data collected during January 2000 to December 2003.
[2] Data collected during January 2000 to June 2005.
[3] Data collected during January 2002 to June 2005.
[4] Data collected during January 2000 to December 2003 and January 2005 to June 2005.
[5] Data collected during October 2004 to June 2005.
[6] Data collected during January 2000 to June 2000 and November 2000 to June 2005.
TEOM Tapered element oscillating microbalance
HVAS High volume air sampler

Construction

The Project would involve the construction and commissioning of rail infrastructure, the coal storage area, wharf facilities and shiploaders. An initial 33 month construction schedule is expected for a Project capacity of 33 Mtpa. The timing of further development of the Project capacity up to 66 Mtpa would depend on coal market demand.

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities, which would be undertaken in a progressive manner. It is considered that air quality impacts during construction would be less than that during Project operations (Appendix B). Construction activities would generally be limited to daytime resulting in lower emissions from vehicle movements and material handling. Based on this combined with the sporadic nature of dust emissions from construction activities, modelling of a construction scenario is not required.

Dust emissions during construction are expected to be readily controlled using water sprays (i.e. water trucks) and other standard dust control measures used at construction sites (Appendix B). The specific construction activity with the greatest potential for dust emissions would be construction of the coal storage areas, given that this activity takes place for the longest period of time and involves the largest exposed surface area in comparison with other construction activities (Appendix B). However, the placement of dredged sands as engineering fill during construction of the coal storage area would involve minimal dust generation as dredged sands would be initially wet and would be subject to watering thereafter.

Construction activities would be undertaken on areas of land within the KIWEF (Section 2.4.1). Management measures have been designed to minimise the potential for construction activities to result in contaminated particulates becoming airborne and are presented in Section 4.7.2.

Dust Deposition - Operations

In accordance with the DEC's dust deposition criteria, dust deposition impacts from the Project in isolation and the Project including background air quality were assessed. The annual average background dust emission rate is 2 g/m^2/month (Section 4.4.1).

Figure 4-8 shows the predicted annual average dust deposition rates resulting from the Project. Incremental increases in annual average dust deposition due to the Project only are not predicted to be above the applicable 2 g/m^2/month DEC amenity criterion at any receiver (including industrial receivers on Kooragang Island).

Annual average dust deposition due to the Project plus background was not predicted to be above the applicable 4 g/m^2/month DEC amenity criterion at any receiver in the vicinity of the Project (including industrial receivers on Kooragang Island).

Suspended Particulate Matter - Operations

Concentrations of suspended particulate matter were calculated as 24-hour average and annual average PM_{10} concentrations and annual average TSP concentrations for comparison against the applicable criteria (Table 4-14). The maximum 24-hour average PM_{10} criteria is assessed for the Project alone, whilst the annual average PM_{10} and TSP assessment criterion/standards relate to Project emissions in addition to background concentration levels (Appendix B).

On the basis of baseline air quality monitoring data collated, the background annual average PM_{10} concentration for the Project site is 21 $\mu g/m^3$ (Section 4.4.1). The inferred annual average TSP background level is 53 $\mu g/m^3$ (Section 4.4.1).

Maximum 24-hour average PM_{10}

Figure 4-9 shows the predicted maximum 24-hour average PM_{10} concentrations resulting from the Project.

Maximum 24-hour average PM_{10} concentrations were not predicted to exceed the DEC assessment criterion (Project only) of 50 $\mu g/m^3$ at any receiver (including industrial receivers on Kooragang Island) (Appendix B).

The background air quality data indicated that there are occasional exceedances of 24-hour average PM_{10} criteria (Section 4.4.1). *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005a) recommends that for areas where there are already exceedances of the 50 $\mu g/m^3$ criterion, there should be no additional exceedances of 24-hour average PM_{10} air quality criteria due to a new project.

Source: NCIG (2006); Connell Hatch (2006); RLMC (2006); UBD (2002); Holmes Air Sciences (2006)

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FIGURE 4-8
Predicted Annual Average Dust Deposition Concentrations (g/m²/month) from the Project

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FIGURE 4-9
Maximum 24-Hour Average PM$_{10}$ Concentrations (µg/m^3) from the Project

An assessment was performed by predicting 24-hour average PM_{10} concentrations (including the Project) and matching these predictions with contemporaneous TEOM PM_{10} monitoring data (using the Beresfield DEC monitoring data). This assessment concluded that there would be no additional exceedances of the of 24-hour average PM_{10} criteria due to the incremental effect from the Project.

Annual Average PM_{10}

Predicted annual average PM_{10} (Project plus background) concentrations were not predicted to be above the DEC assessment criterion at any receiver (including industrial receivers on Kooragang Island).

Annual Average TSP

Annual average TSP (Project plus background) concentrations were not predicted to be above the NHMRC goal at any receiver (including industrial receivers on Kooragang Island).

Cumulative Impacts - Operations

In accordance with the Project EARs (Section 1.2), potential cumulative impacts due to the Project coupled with background air quality and potential impacts from approved developments (including those not yet fully developed) in the vicinity of the Project were assessed (Appendix B). The approved developments detailed in Table 4-8 were considered in the cumulative assessment and their potential air quality emissions are discussed below.

Dust emissions from the PWCS Kooragang Coal Terminal would be expected to incrementally increase following the commissioning of the expansion from the existing capacity (64 Mtpa) to the maximum consented capacity of 77 Mtpa.

Due to the nature of the Cargill Oilseed facility operation, the Environmental Assessment (HLA, 2005) for its expansion did not consider particulate matter in the air quality assessment (i.e. the assessment only modelled organic pollutants) as the expansion is not expected to increase dust emissions in the locality (*ibid.*).

Dust emissions from the Multi Purpose Terminal are expected to be predominantly from the construction of the facility and from the associated demolition of existing infrastructure associated with the former BHP steelworks site (URS, 2000b).

The accompanying Environmental Impact Statement (EIS) (*ibid.*) states that the construction activities would be temporary and that an Environmental Management Plan (EMP) would be prepared. The EMP would include dust mitigation measures to minimise potential off-site impacts such that acceptable levels are maintained (*ibid.*).

The South Arm Dredging Operations EIS (GHD, 2003) included a number of recommendations for mitigating potential dust impacts from the operations, including covering/spraying of exposed surfaces, stabilising long-term stockpiles, sealing access roads and removing soil from trucks entering and leaving site. The EIS concluded that with the implementation of these mitigation measures, dust impacts would not be significant (*ibid.*).

Based on the above, the approved expansion of the PWCS Kooragang Coal Terminal was included quantitatively in the assessment of cumulative air quality impacts (Appendix B). Appendix B presents an assessment of the cumulative air quality impacts in consideration of the Project and PWCS Kooragang Coal Terminal operations. This was done by assuming that the consented increase in PWCS operations (13 Mtpa) would result in a similar rate of air quality emissions per million tonnes of coal exported to the predicted NCIG air quality emissions. To represent the consented PWCS operations, an additional 13 Mtpa was added to NCIG's 66 Mtpa predicted maximum emissions, representing an increase of approximately 20%.

With respect to the key annual criteria, namely annual average PM_{10}, TSP and dust deposition, the predicted increase in emissions at the nearest receiver areas of Mayfield, Stockton and Fern Bay are as follows (Appendix B):

- annual average PM_{10} - 0.2 to 0.5 $\mu g/m^3$ (criterion 30 $\mu g/m^3$);
- annual average TSP - 0.2 to 1 $\mu g/m^3$ (criterion 90 $\mu g/m^3$); and
- annual average dust deposition – 0.02 to 0.05 g/m^2/month (criterion 2 g/m^2/month).

With consideration of the background air quality (i.e. PM_{10} of 21 $\mu g/m^3$, TSP of 53 $\mu g/m^3$ and dust deposition of 2 g/m^2/month), the criteria for annual average PM_{10}, TSP and dust deposition (Table 4-14) would not be exceeded at the nearest residential receivers as a result of the approved expansion of PWCS Kooragang Coal Terminal (Appendix B).

With respect to the 24-hour PM_{10} concentrations, a 20% increase in the model predictions would not present additional instances where the total cumulative impacts (including the consented expansion of the PWCS Kooragang Coal Terminal operations) are above the 50 µg/m^3 goal at the nearest residential receivers (Appendix B).

Greenhouse Gas

An assessment of Project greenhouse gas emissions is provided in Appendix B. The outcomes of this assessment are summarised below.

Potential Impacts

The major source of greenhouse gas emissions from the Project development would be generated indirectly by the use of electricity to power the coal storage conveyors and stacker reclaimers, shiploading machines and associated equipment. In addition, minor emissions would occur from the combustion of diesel and petrol in mobile equipment on-site.

An assessment of the Project greenhouse gas emissions was conducted using empirical emission factors provided by the Australian Greenhouse Office (AGO) (2005) (Appendix B). The emission estimates for construction and operation of the Project are as follows:

- Construction – 1,782 t $CO_{2\text{-}e}$/year.
- 66 Mtpa operations – 69,760 t $CO_{2\text{-}e}$/year.

The estimated maximum operational annual greenhouse gas emission of 69,760 t $CO_{2\text{-}e}$/year during peak operations can be compared with the estimated total $CO_{2\text{-}e}$ emissions for Australia in 2003 of 550,000,000 t $CO_{2\text{-}e}$ calculated using the Kyoto protocol calculation methods (AGO, 2005).

Odour

The main potential sources of odour emissions from the Project would include:

- dredged materials sourced from the south arm of the Hunter River in accordance with the Port Consent (Section 3.6.1) that are used as fill for construction of Project elements (Sections 2.4.1, 2.5.1 and 2.7.1); and
- odour resulting from spontaneous combustion events.

Dredged Materials

Project construction would include the use of dredged materials from the south arm of the Hunter River as preload and engineering fill for construction of the coal storage area, rail infrastructure corridor and wharf facilities. Dredged material would be pumped via a dedicated pipe from the dredging operations to the Project coal storage area for drainage and use as preload (Section 2.5.1). The dredging operations would be undertaken in accordance with the Port Consent (Section 3.6.1).

The Environmental Odour Laboratory at the University of New South Wales prepared an odour impact assessment for the Port Consent EIS (Appendix B). This study assessed odour emissions and potential impacts from the dredging operations. It was concluded from the assessment that odour impacts at nearest sensitive receivers would be maintained at acceptable levels. Given that the proposed dredging activities would be undertaken in accordance with the Port Consent, odour from the dredged materials would not be expected to be a significant air quality issue (Appendix B). In addition, the Port Consent requires that an Odour Monitoring Program be prepared prior to the commencement of dredging operations.

Spontaneous Combustion

Self-heating of coal can give rise to smouldering fires in stockpiles, which can lead to odorous emissions (Appendix B). The potential for self-heating of stockpiled coal would be reduced through the use of water sprays and prudent stockpile management. In addition, a Spontaneous Combustion Management Plan would be prepared.

Based on the low frequency of spontaneous combustion events at ports, the distance to the nearest sensitive receivers and available management/response measures, it is considered that the Project is unlikely to cause any adverse odour impacts due to such events (Appendix B).

4.4.3 Mitigation Measures, Management and Monitoring

Construction

Air quality controls during construction of the Project would include the following:

- areas to be disturbed would be minimised as far as practicable;
- exposed surface areas would be stabilised as quickly as practicable;
- soils would be removed from trucks entering and leaving the Project site; and
- exposed surface areas and traffic areas would be watered using water trucks (or similar) to minimise the generation of dust.

With respect to the potential for liberation of contaminated dust (Section 4.4.2) a SEMP would be prepared for this Project (Section 4.7.2). The SEMP would describe the measures to manage potentially contaminated soils and dust generation/volatilisation potential. These measures would include (Appendix D):

- using water sprays to control dust;
- minimising the surface area disturbed by excavation at any one time;
- confining vehicle movements to designated access routes;
- limiting the speed of vehicles on unpaved roads; and
- immediate encapsulation of materials considered unsuitable for use as construction fill.

Operations

During the development of the dispersion modelling undertaken by Holmes Air Sciences, a number of steps were taken to develop air quality mitigation measures for the Project. A range of controls would be employed by NCIG to reduce air quality emissions from the Project. These controls are based on procedures developed at contemporary existing coal export facilities. The controls that would be implemented for the Project can be summarised in three broad categories (Appendix B):

- planning controls (which increase the separation between dust emission sources and receivers);
- engineering controls; and
- operational controls which vary operations when adverse meteorological conditions occur.

Planning controls include the maintenance of adequate buffer distances between dust sources and sensitive receivers. In this respect, the major dust generating activities at the Project (i.e. coal storage area) would have a separation distance of approximately 2 km from the nearest residential area of Mayfield (Appendix B).

Engineering controls involve measures such as: covering/enclosing conveyors; enclosing transfer points; using dust collection systems at the rail unloading stations; and installation of spray systems on transfer points and stockpiles (Appendix B). The specific air quality control measures that are proposed for the Project are listed below:

- moisture levels of the coal stockpiles would be monitored and maintained to minimise dust emissions;
- a dust extraction system would be provided at the train unloading stations, with the hopper designed for dust containment;
- coal transfer conveyors would be covered or enclosed on three sides, except for yard and wharf conveyors;
- conveyors over roads would be fully enclosed;
- conveyor transfer points would be fully enclosed;
- buffer bins would be fully enclosed; and
- water sprays would be used on stockpiles and immediately after conveyor transfer points.

The water sprays on the coal stockpiles would include rain gun type sprays mounted on the berms approximately 60 m apart on each side of the coal stockpiles (Appendix B). The system would be controlled by software integrated with the on-site meteorological station (Section 4.2.2). The moisture status of coal stockpiles and relevant meteorological conditions would be monitored and dust suppression sprays on the coal stockpiles would be automatically activated to minimise dust emissions as required.

Air Quality Monitoring

An AQMP would be prepared for the construction and operation the Project. The AQMP would describe the following elements:

- air quality monitoring to be undertaken for the Project;
- Project mitigation measures with respect to air quality;
- a protocol for the ongoing management of air quality;
- procedures to be followed in the event of an exceedance of criteria should they occur; and
- complaint response protocols.

Notwithstanding the predicted compliance with applicable air quality criteria, the AQMP would detail specific actions for responding to exceedances of criteria and complaints should they occur. The results of the air quality monitoring would be used to optimise air quality controls, validate the air quality modelling predictions and would be reported to relevant authorities via the AEMR (Section 5).

A network of up to six dust depositional gauges would be installed for the Project prior to the commencement of construction. These gauges would be installed on Kooragang Island and in surrounding residential areas (such as Mayfield, Fern Bay and Stockton).

The dust deposition gauges would be analysed for ash content and insoluble solids in accordance with AS 3580.10.1-1991 *Methods for Sampling and Analysis of Ambient Air – Determination of Particulates – Deposited Matter – Gravimetric Method*.

A HVAS would be installed at Stockton to facilitate monitoring of PM_{10} concentrations. The HVAS would monitor PM_{10} over a six day continuous cycle in accordance with the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (EPA, 2001).

NCIG intends to pursue opportunities to integrate its monitoring networks with the PWCS monitoring network. Where practicable, this would include the sharing of data.

Greenhouse Gas

Mitigation Measures

Minimising fuel and electricity usage is an inherent objective of Project planning and cost control systems. Additional controls on greenhouse gas emissions associated with the Project would include:

- regular on-site energy audits to optimise energy efficiency;
- consideration of energy efficiency in plant and equipment selection/purchase;
- regular maintenance of plant and equipment to minimise fuel consumption and associated emissions;
- planting of native vegetation, as part of visual screens in select locations around the Project site; and
- installation of solar-powered monitoring equipment and other instrumentation where practicable.

Odour

An Odour Management Plan for the dredging activities would be implemented under the Port Consent.

A Spontaneous Combustion Management Plan (Section 5) would be developed for the Project and would include the following:

- coal stockpile management measures;
- monitoring of potential causes of spontaneous combustion events; and
- corrective action in the event of spontaneous combustion.

4.5 VISUAL CHARACTER

A Visual Impact Assessment for the Project was undertaken by EDAW Australia and is presented as Appendix H.

4.5.1 Existing Environment

Project Setting

The Project setting comprises a number of distinct landscape units of varying levels of landscape quality. These have been defined as follows (Appendix H):

- Kooragang Nature Reserve;
- Hunter River;
- heavy industry; and
- residential areas.

These units are described below in the context of regional, sub-regional and local settings (with views towards the Project site). These settings are defined by distance from the Project as follows (Figure 4-10):

- greater than 5 km from the Project – regional setting;
- 1 to 5 km from the Project – sub-regional setting; and
- up to 1 km from the Project – local setting.

Regional Setting (>5 km)

The visual character of the regional setting has attributes of a high scenic quality due to the presence of water, the coastline and vegetation patterns associated with the estuarine environment (i.e. Kooragang Nature Reserve), as well as attributes of a low scenic quality due to the modification that has resulted from the presence of heavy industry in the Newcastle region.

Sub-Regional Setting (1 to 5 km)

The sub-regional setting comprises large scale heavy industrial and port facilities including the PWCS Kooragang Coal Terminal, OneSteel and Steel River Industrial Estate developments. The sub-regional setting also includes residential and commercial precincts of the city of Newcastle.

Residential areas within the sub-regional setting include Mayfield West, Mayfield, Fern Bay and Stockton. The Hunter River and estuarine environment within the sub-regional setting taken in isolation has attributes of high scenic quality. However, given the proximity to the heavy industrial uses, the sub-regional setting is considered to be of low scenic quality (Appendix H).

Local Setting (<1 km)

The Project local setting has been disturbed by previous landfill activities and also has a number of modifying infrastructure developments including the PWCS Kooragang Coal Terminal and OneSteel on the southern bank of the Hunter River (south arm). Other features of the local setting include the road networks on Kooragang Island and connecting bridges, electricity transmission lines and Energy Australia's wind turbine. The visual character of the local setting is therefore considered to be of low scenic quality. Notwithstanding, the Hunter River and estuarine environment within the local setting taken in isolation has attributes of high scenic quality.

A small residential area in Sandgate (Figure 4-10) within an Urban Services Zone under the Newcastle LEP, lies within the local setting, however no views of the Project site are available from this location.

Sensitive Visual Settings

The most sensitive visual settings in the vicinity of the Project are the elevated residential areas of Mayfield, Mayfield West and Fern Bay. In addition, commuters travelling along Cormorant Road would have close views of the Project.

Residences with views of the Project at distances of less than 2.5 km have a high level of visual sensitivity, however this would vary according to the location and the degree to which the Project is visible. The visual sensitivity of viewpoints along Cormorant Road within 1 km of the Project is also considered to be high (Appendix H).

Night Lighting

The visual setting is generally well lit as a consequence of the existing industrial and port facilities which operate 24 hours per day. Numerous light emitting sources exist in the local, sub-regional and regional settings including fixed lighting associated with industrial developments and vehicular lights associated with traffic on the road network (e.g. Cormorant Road).

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FIGURE 4-10
Visual Settings and Viewpoints

NCIG-05-01 Sect4_017C

4.5.2 Potential Impacts

Visual Impacts that are expected to arise as a result of Project activities were assessed in accordance with the methodology described below.

Assessment Methodology

The assessment methodology employed by EDAW Australia is based on the visual management system developed by the United States Department of Agriculture (USDA) Forestry Service (USDA, 1974). Potential visual impacts were assessed by evaluating the degree of visual modification in the context of the visual sensitivity of surrounding landuse areas from which the Project may be visible.

The level of visual modification is a function of the contrast between the Project and the existing visual landscape. The degree of visual modification generally decreases with distance. The degree of visual modification is considered negligible if the Project is distant and relates to a small proportion of the overall landscape (Appendix H).

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from surrounding areas, and is a function of both landuse and duration of exposure.

For the purposes of the Visual Assessment (Appendix H), landuses in the vicinity of the Project were characterised in terms of low, moderate or high visual sensitivity, as follows:

- Low visual sensitivity – industrial areas and local roads.
- Moderate visual sensitivity – tourist roads and major roads (e.g. Cormorant Road).
- High visual sensitivity – residential areas and natural/recreation areas (e.g. Kooragang Nature Reserve).

However, as distance from the viewer to the Project increases, the level of visual sensitivity is reduced (Appendix H).

Potential visual impacts are determined in accordance with the matrix presented in Table 4-17.

The assessment has been undertaken from within regional (>5 km), sub-regional (1 to 5 km) and local (<1 km) settings and includes qualitative assessment components as detailed in Appendix H.

Visual Landscape Alteration

Elements of the Project considered to have the potential to impact on the visual landscape include:

- rail spurs, rail sidings rail loops, rail overpass, train unloading stations and connecting conveyors;
- coal storage area including coal stockpiles, conveyors, transfer points and combined stacker/reclaimers;
- wharf facilities and shiploaders, conveyors and buffer bins;
- administration and workshop buildings; and
- night lighting.

Visual Impact Assessment

Table 4-18 summarises the results of the Visual Assessment undertaken for the Project (Appendix H). The assessment viewing locations are shown on Figure 4-10. Further description is provided below in relation to the assessed impacts from within the regional, sub-regional and local settings.

Table 4-17
Visual Impact Matrix

Visual Modification	Visual Sensitivity: High	Moderate	Low
High	H	H	M
Moderate	H	M	L
Low	M	L	L
Very Low	L	VL	VL

VL = Very Low
L = Low
M = Moderate
H = High

Source: Appendix H

Table 4-18
Visual Impact Assessment Summary

Viewing Location	Viewpoint (Figure 4-10)	Sensitivity	Visual Modification Level	Impact	Impact After Amelioration
Regional Setting (Greater than 5 km)	-	L	VL	VL-N	VL-N
Sub-Regional Setting (1 – 5 km)					
Mayfield	VP1	H	L-VL	L-M	L-M
Mayfield West (Gregson/Stevenson Avenue)	VP2	H	L-VL	L-M	L-M
Fern Bay (Nelson Bay Road)	VP3	H	VL	L	L
Kooragang Nature Reserve	VP4	M-H	L	L-M	L-M
Stockton Bridge	VP5	M	L	L	L
Local Setting (Up to 1 km)					
Cormorant Road	VP6	M-H	M-H	M-H	L-M
Hunter River (south arm)	VP7	L	L	L	L
Sandgate Residential – Urban Services Zone (River Road)	VP8	H	Nil	Nil	Nil

H – High, M – Moderate, L – Low, VL – Very Low, N – Negligible
Source: Appendix H

Regional Setting (>5 km)

The potential visual impact of the Project on the regional setting is considered to be very low to negligible. There may be distant elevated viewing locations within this setting that have views to the Project site but at this distance the sensitivity level reduces to low. The level of apparent visual modification from this distance would be very low because:

- the proposed development would not be distinguishable from the existing heavy industry landscape setting;
- the reduction in clarity of viewing which occurs over distance; and
- the limited number of viewing locations (Appendix H).

Sub-Regional Setting (1 to 5 km)

The potential visual impacts on viewing locations within the sub-regional setting would vary according to the visual sensitivity and visual screening provided by intervening vegetation and the built form of large scale industrial elements. The potential impacts of the Project from selected viewpoints within the sub-regional setting are described below.

<u>Mayfield and Mayfield West Residential Areas</u>

There are occasional, distant views to the site through gaps in buildings and along streets from the Mayfield and Mayfield West residential areas. An elevated vantage point exists within the Mayfield West residential setting along Gregson Avenue (VP2 - Figure 4-10).

The industrial development along the southern bank of the south arm of the Hunter River is a dominant element in the foreground and middleground (Appendix H). Less elevated viewpoints are screened by vegetation and large buildings along Industrial Drive. The Project components would add to the industrial buildings and features but would be partially screened by the intervening vegetation from VP2. It would therefore result in a very low to low level of visual modification (Table 4-18).

A low to very low visual modification level coupled with a high visual sensitivity would result in a low to moderate visual impact from these residential areas (Table 4-18).

<u>Fern Bay Residential Areas</u>

Views to the site from the Fern Bay residential areas (VP3) (Figure 4-10) are partially screened by existing road and riverside vegetation. Views across the Hunter River channel are dominated by the existing PWCS Kooragang Coal Terminal (Appendix H). The Project would be predominantly screened by the existing industrial buildings and would result in a very low level of visual modification (Table 4-18).

Given that the site would be obscured by the existing PWCS Kooragang Coal Terminal, a very low visual modification level coupled with a high visual sensitivity would result in a low visual impact (Table 4-18).

Kooragang Nature Reserve and Kooragang Wetland Rehabilitation Project

The estuarine environment associated with the Kooragang Nature Reserve and Kooragang Wetland Rehabilitation Project is predominantly flat with low lying vegetation allowing for distant views to the existing PWCS Kooragang Coal Terminal. The Project components would add to the industrial buildings and features in the background but would not create a significant modification to the visual backdrop (Appendix H). Therefore, the Project would result in low visual modification (Table 4-18).

A low visual modification combined with a high visual sensitivity within the 1 to 2.5 km radius of the Project site would result in a moderate visual impact, whilst a low visual modification combined with a moderate visual sensitivity within the 2.5 to 5 km radius of the Project site would result in a low visual impact (Table 4-18). Significant portions of the Kooragang Nature Reserve and Kooragang Wetland Rehabilitation Project are within 1 to 5 km of the Project site.

Stockton Bridge

Westbound lanes of traffic on Stockton Bridge (VP5) have expansive views over the Hunter River (Stockton Channel), as well as the heavy industrial area concentrated along the water's edge. The industrial development along the Hunter River is the dominant element in views from the bridge. As such, development of a Project of a similar form and character to the existing PWCS Kooragang Coal Terminal would result in a low level of visual modification (Appendix H). A low level of visual modification, combined with a moderate level of visual sensitivity, would result in a low visual impact (Table 4-18).

Local Setting (<1 km)

The potential visual impacts of the proposed development on viewing points within the local setting are described below. The visual assessment (Appendix H) focussed on the visual impact that may result on views for the most sensitive visual settings/landuses where routinely accessed or readily accessible viewpoints exist.

Cormorant Road

Cormorant Road (VP6), which runs through the Project site, is a major road catering for industrial transport as well as commuters and tourists to the area. There are currently views into the Project site to the north of Cormorant Road through a chain mesh fence. Views to grassed vacant land and the south arm of the Hunter River to the south of Cormorant Road are also available. The development would be visually similar to the PWCS Kooragang Coal Terminal on either side of Cormorant Road. However, on the north side of Cormorant Road, Project elements (e.g. coal stockpiles) would be significantly closer than existing structures and more visually dominant (Appendix H).

The Project rail loops would be located to the north-west of Cormorant Road and would be generally concealed behind the existing southern embankment of the KIWEF and associated vegetation. The Project conveyors from the coal storage area to the wharf facilities over Cormorant Road and the shiploading facility and wharf would be a dominant element in close proximity to the road, but would be generally consistent with the existing facilities immediately to the east. The level of visual modification would therefore be moderate to high (Table 4-18).

Given the moderate to high level of visual modification coupled with a moderate to high level of sensitivity, a moderate to high visual impact would result on views from Cormorant Road, immediately adjacent to the Project site. The establishment of foreground vegetation screening along Cormorant Road along the southern boundary of the Project coal storage area to obscure potential views of the Project site would reduce the level of visual impact for vehicles travelling along Cormorant Road to low to moderate (Table 4-18).

Hunter River

Heavy industrial elements dominate the viewshed of the Hunter River (VP7). The visual modification level of the Project is therefore considered to be low (Table 4-18).

The Hunter River is used for a variety of purposes, ranging from a transport corridor for freighters and bulk carriers, to a recreational resource for water skiers and fisherman. The sensitivity of these user groups ranges from low to high, although given the long standing industrial uses and their dominance of the rivers edge, some desensitisation of users may have occurred.

The visual sensitivity of users of the river is therefore considered to be low (Appendix H).

A low level of visual modification, combined with a low level of sensitivity, would result in a low visual impact on users of the Hunter River (Table 4-18).

Sandgate Residential Area (Urban Services Zone)

The Sandgate residential area (Urban Services Zone) (VP8) is located immediately adjacent to the south arm of the Hunter River to the south-west of the Project site (Figure 4-10). Given the Project site would not be visible, there would be no resulting visual impact to views from this location.

Night Lighting

Night lighting would emanate from two main sources*:*

- overhead lighting of the coal storage area, train unloading station, wharf facilities and shiploaders; and
- mobile vehicle-mounted lights (e.g. trains and work vehicles on site).

The scale and nature of night lighting for the Project would be similar in intensity to the existing night lighting at the PWCS Kooragang Coal Terminal.

Potential night lighting impacts on the local and sub-regional settings would generally be restricted to the production of a glow above operational areas that contrast with the night sky. This effect would decrease with distance however the glow would be visible at nearby residential areas and along the local road network (i.e. Cormorant Road).

The potential impact of night lighting on sensitive visual settings would be negligible given the presence of numerous light emitting sources in the local, sub-regional and regional settings (Appendix H).

4.5.3 Mitigation Measures and Management

Measures that would be employed to mitigate visual impacts include: the design of infrastructure and landscaping to meet the requirements of the Newcastle DCP; establishment of visual screening; and management of night lighting.

Infrastructure and Landscaping Design

A Landscape Management Plan (Section 5) would be developed for the Project to fulfil the requirements of the Newcastle DCP. Administration and workshop areas would be appropriately landscaped with selective tree planting, formal gardens and grassed areas in keeping with the "shop front" location on Egret Street.

Project infrastructure would be designed and constructed in a manner that minimises visual contrasts (e.g. suitable coloured cladding for buildings and the integration and rationalisation of signage) in accordance with the requirements of the Newcastle DCP.

Visual Screening

An earth bund approximately 1,500 m in length would be constructed on the northern side of Cormorant Road (Section 2.5.3). The bund would be located east of the Pacific National access road between the coal storage area and Cormorant Road. The bund would essentially be an extension of, and of a similar height to, the existing southern embankment of the KIWEF.

Night Lighting

Night Lighting would comply with AS 4282-1995 *Control of Obtrusive Effects of Outdoor Lighting*.

Night lighting would be restricted to the minimum required for operational and safety requirements and would directed away from roads and sensitive viewpoints, where practicable. Light shields would be used to limit the spill of lighting where practicable.

4.6 SURFACE WATER

4.6.1 Existing Environment

The Land Contamination and Groundwater Assessment undertaken by RCA Australia (2006) for the Project is presented in Appendix D and includes the characterisation of existing surface water resources on the Project site. Surface water management studies have also been undertaken by NCIG and its Project designers (NCIG and Connell-Hatch, 2006) as part of the Project feasibility studies and are referenced where relevant.

Regional Hydrology

Kooragang Island is defined by the north and south arms of the Hunter River which drains to the Pacific Ocean (Figure 4-4). Kooragang Island was originally a series of deltaic islands near the mouth of the Hunter River until the land was reclaimed and converted into a single island by in-filling of tidal mudflats and creeks (Section 4.1.1).

Water levels, flows and water velocities vary within the Hunter River estuary due to a number of factors, including (NSW Waterways, 2003):

- astronomical tides, ocean storm surges, coastal trapped waves and potential sea level rise transferring from the ocean to the estuary;
- freshwater flow, generally from rainfall runoff; and
- local wind setup (increases in mean water level due to wind) within the estuary.

The tides at the entrance of the Hunter River estuary are semi-diurnal with a strong spring-neap cycle. Tides in the Hunter River estuary vary from the ocean entrance to the tidal limits, generally with a gradual reduction in the mean tidal range with distance upstream. The tidal limit in the Hunter River is approximately 64 km upstream from the ocean (NSW Waterways, 2003).

Flooding

The Lower Hunter River Flood Study (NCC and Port Stephens Council, 1994) indicates that with the exception of south arm of the Hunter River (Lot 20, DP 262325 – Figure 1-4) all land subject to development for the Project is above the 1% annual exceedance probability (AEP) flood level. This study found that as a result of land reclamation and filling undertaken on the southern side of the Kooragang Island mainline rail embankment a 1% AEP flood level would not inundate the Project site (Figure 4-11). The study did however conclude that localised flooding may occur across the Project site as a result of poor local drainage (NCC and Port Stephens Council, 1994).

Local Hydrology

The Project site has been heavily disturbed by land reclamation activities and the long term disposal of dredge spoil and industrial waste.

Rail Infrastructure Corridor

The Project rail infrastructure corridor traverses the KIWEF (Figure 4-3). Surface water features in this area comprise waterbodies created by the existing Kooragang Island mainline rail embankment, emplacement cells associated with the KIWEF and a number of depressions in the KIWEF landform that intermittently fill with water in response to rainfall runoff. Drainage channels also exist adjacent to the Kooragang Island mainline which report to the south arm of the Hunter River. Deep Pond is a large waterbody in this area and is connected to ponds to its south-east via drainage lines (Figure 4-3) (NCIG and Connell-Hatch, 2006).

Coal Storage Area

The Project coal storage area is relatively flat with a slight fall to the north-west (Figure 4-3). Two stormwater drainage channels exist including a west-east channel on the northern boundary of the coal storage area and a north-south concrete-lined stormwater channel along the eastern boundary of the Project site. The west-east channel drains into the north-south stormwater channel which in-turn drains to the south arm of the Hunter River (NCIG and Connell-Hatch, 2006).

Wharf Facilities and Shiploader Area

The Project wharf facilities and shiploader area is relatively flat and drains to the south arm of the Hunter River (Figure 4-3). The south arm of the Hunter River is the dominant natural surface water feature in this area (NCIG and Connell-Hatch, 2006).

Water Quality

A summary of the Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC Guidelines) water quality trigger values is provided below.

The ANZECC (2000) Guidelines provide a comprehensive framework for water quality assessment and management. The ANZECC Guidelines recognise that adequate site specific data may often not be available and provide default trigger values for a range of physical and chemical stressors (e.g. salinity, pH, nutrients, dissolved oxygen, turbidity, etc.) and toxicants (e.g. heavy metals). The ANZECC Guideline trigger values provide a quantitative frame of reference for interpreting the results of baseline water quality monitoring.

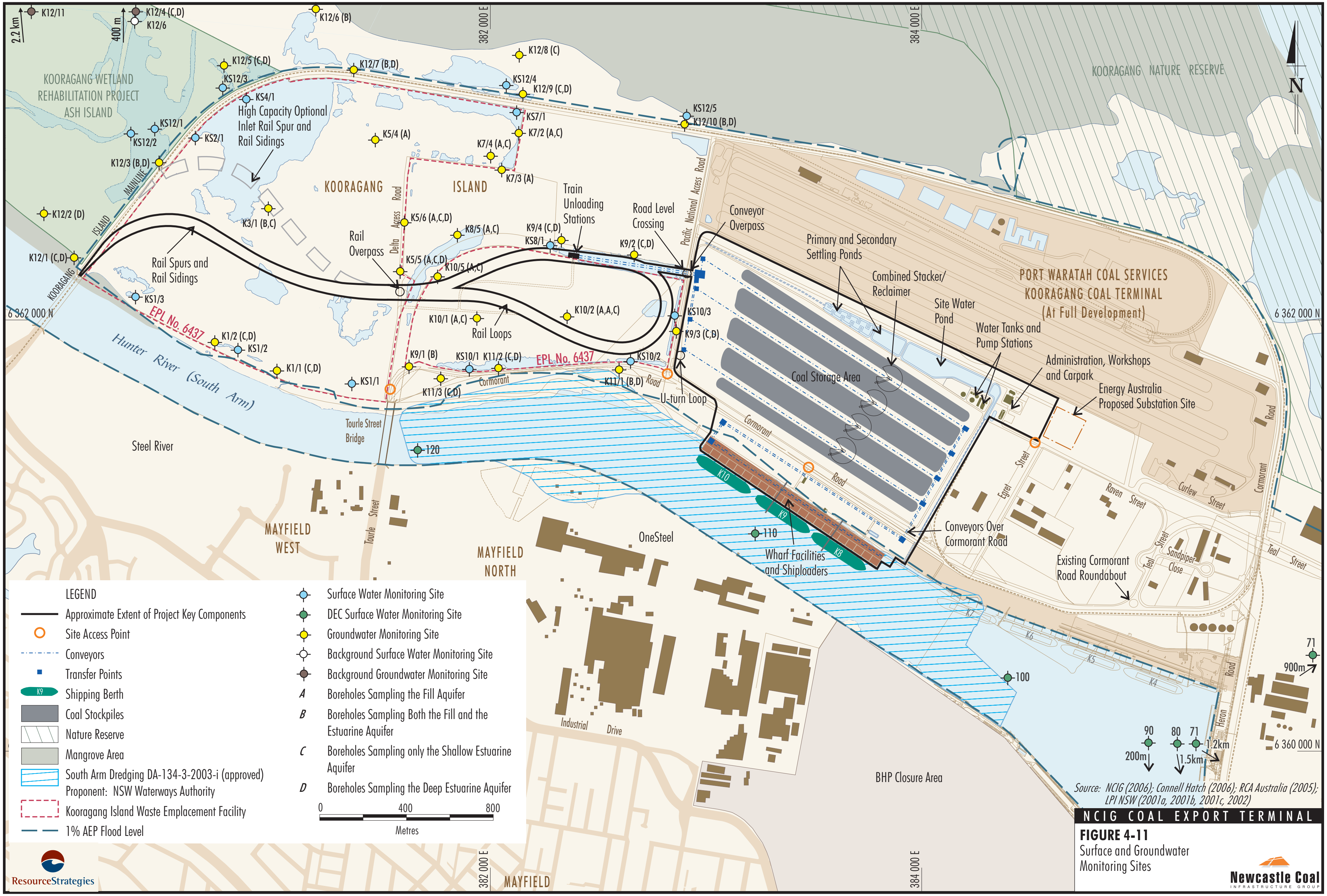

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FIGURE 4-11
Surface and Groundwater Monitoring Sites

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Physical and Chemical Stressors

The ANZECC Guideline surface water quality default trigger values for physical and chemical stressors for the protection of aquatic ecosystems are summarised in Table 4-19.

Toxicants

The ANZECC Guidelines recognise three ecosystem conditions as follows:

- high conservation/ecological value systems;
- slightly to moderately disturbed systems; and
- highly disturbed systems.

Each ecosystem condition in the ANZECC Guidelines is ascribed with a level of protection applicable to toxicants in aquatic ecosystems and is summarised below:

1. High conservation status or highly valued ecosystems are afforded a protection level based on protection of 99% of species.
2. Slightly to moderately disturbed systems are afforded a 95% protection level in most cases although a higher protection level could be applied to slightly disturbed ecosystems.
3. Highly disturbed systems can be afforded a 95% protection level, however depending on the state of the ecosystem, it can be appropriate to apply a less stringent trigger value (i.e. 90% or 80%) as an intermediate target for water quality improvement.

The ANZECC Guidelines surface water quality default trigger values for toxicants (i.e. metals and organic contaminants) for the protection of aquatic ecosystems are summarised in Table 4-20.

Comparisons of water quality data available for the Hunter River estuarine environment and the KIWEF with the water quality trigger values provided in the ANZECC Guidelines are provided below (Appendix D).

Hunter River Estuarine Environment

Water sampling in the Hunter River has been previously undertaken by BHP. Available BHP data reported in the *Proposed Cold Mill Facility Kooragang Island Environmental Impact Statement* (Protech Steel, 2001) indicated pH values of 8.0 and 8.1 which are within the ANZECC Guideline trigger values for the protection of aquatic ecosystems.

Sanderson *et al*. (2002) measured vertical profiles of salinity (and temperature, turbidity and dissolved oxygen) at various locations in the Hunter River estuarine environment in 2001 and derived empirical relationships from the data. Using the empirical relationship, the average salinity concentration within 10 km of the entrance to the Hunter River estuarine environment (i.e. downstream of the Tourle Street bridge [Figure 4-11]) is approximately 37,000 µS/cm and generally ranges between 30,000 µS/cm and 45,000 µS/cm (i.e. ± one standard deviation). The salinity distribution within the Hunter River estuarine environment is affected by tidal and flooding processes (Patterson Britton, 2003).

Sanderson and Redden (2001) compiled 28 years of water quality measurements made by the Hunter Water Corporation, the DEC and Maitland City Council collected at various locations and times in the Hunter River estuarine environment. In summary, the nutrient levels (i.e. TN and TP) and turbidity levels exceeded the ANZECC Guideline trigger values for the protection of aquatic ecosystems (Patterson Britton, 2003). Based on the work of Sanderson and Redden (2001), Manly Hydraulics Laboratory (2002) concluded that mean dissolved oxygen concentrations in the Hunter River were 6.4 mg/L with increasing concentrations moving downstream. Available BHP data reported in the *Proposed Cold Mill Facility Kooragang Island Environmental Impact Statement* (Protech Steel, 2001) indicated dissolved oxygen levels in the Hunter River between 7.2 and 7.4 mg/L. The level of dissolved oxygen saturation varies depending on temperature.

Phenol levels recorded in the Hunter River range from 2 to 15 µg/L, based on available BHP data reported in Protech Steel (2001) and were within the ANZECC Guidelines trigger values for the protection of aquatic ecosystems for all levels of protection.

Table 4-19
ANZECC (2000) Surface Water Quality Default Trigger Values for the Protection of Aquatic Ecosystems (Physical and Chemical Stressors)

Physical/Chemical Stressor	Marine	Estuaries [a]	NSW Lowland Rivers [b]
pH	8.0 - 8.4	7.0 - 8.5	6.5 - 8.5
Total Phosphorus (TP) (µg/L - P)	25	30	25 (For east flowing coastal rivers)
Total Nitrogen (TN) (µg/L - N)	120	300	350 (For east flowing coastal rivers)
Dissolved Oxygen (% saturation)	90 - 110	80 - 110	85 - 110
Specific Electrical Conductivity (EC) (µS/cm)	-	-	200-300 (NSW coastal rivers)
Turbidity (NTU)	0.5 - 10		6 - 50

Source: ANZECC (2000) and Appendix D
[a] Values for south-east Australia.
[b] Values for NSW lowland rivers (<150 m altitude) in south-east Australia.

Table 4-20
ANZECC (2000) Surface Water Quality Default Trigger Values for the Protection of Aquatic Ecosystems (Toxicants)

Toxicant	Default Trigger Values							
	Protection Levels for Aquatic Ecosystems							
	99%		95%		90%		80%	
	Fresh	Marine	Fresh	Marine	Fresh	Marine	Fresh	Marine
Arsenic (As) III (µg/L)	1	ID	24	ID	94	ID	360	ID
Cadmium (Cd) (µg/L)	0.06	0.7	0.2	5.5	0.4	14	0.8	36
Copper (Cu) (µg/L)	1.0	0.3	1.4	1.3	1.8	3	2.5	8
Lead (Pb) (µg/L)	1.0	2.2	3.4	4.4	5.6	6.6	9.4	12
Mercury (Hg) – inorganic (µg/L)	0.06	0.1	0.6	0.4	1.9	0.7	5.4	1.4
Selenium (Se) – total (µg/L)	5	ID	11	ID	18	ID	34	ID
Zinc (Zn) (µg/L)	2.4	7	8	15	15	23	31	43
Cyanide (CN) – Un-ionised (HCN) (µg/L)	4	2	7	4	11	7	18	14
Chromium (Cr) VI (µg/L)	0.01	0.14	1	4.4	6	20	40	85
Manganese (Mn) (µg/L)	1200	80[1]	1900	80[1]	2500	80[1]	3600	80[1]
Phenols (C_6H_5OH) (µg/L)	85	270	320	400	600	520	1200	720
Naphthalene (µg/L)	2.5	50	16	70	37	90	85	120
Phenanthrene (µg/L)[1]	0.6	0.6	2	2	4	4	8	8
Anthracene (µg/L)[1]	0.01	0.01	0.4	0.4	1.5	1.5	7	7
Fluoranthene (µg/L)[1]	1	1	1.4	1.4	1.7	1.7	2	2
Benzo(a)pyrene (µg/L)[1]	0.1	0.1	0.2	0.2	0.4	0.4	0.7	0.7

Source: ANZECC (2000) and Appendix D
[1] Indicative interim working level.
ID: Insufficient Data.

Historical water quality monitoring has also been undertaken in the Hunter River by the DEC. The locations of the water quality monitoring locations are shown on Figures 4-4 and 4-11. A summary of metal concentrations recorded at the sampling locations is provided in Table 4-21.

Measured metal concentration levels were generally above the ANZECC Guidelines trigger values for the protection of aquatic ecosystems (80% level of protection – Table 4-20).

Kooragang Island Waste Emplacement Facility

Surface water monitoring has been conducted routinely since 2000 at the KIWEF in accordance with EPL 6437. A summary of the water quality results between 2000 to 2003 is presented in Table 4-22. The summary below is based on analysis of data obtained for the surface water monitoring sites shown on Figure 4-11.

A comparison of surface water quality at the KIWEF was undertaken against the water quality of a background surface water monitoring location (KS12/6) and the ANZECC guidelines. KS12/6 is located to the north-west of the Project site (Figure 4-11), within RLMC-owned land north of the Kooragang Island mainline, and is considered to be a relevant measure of background surface water quality at Kooragang Island (EPL 6437). A summary of the measured background water quality at location KS12/6 is presented in Table 4-23.

The pH within the KIWEF site varies between 6.9 and 10.3 pH units, with an average of 8.3 pH units. The minimum and maximum pH values exceeded the ANZECC guideline trigger values for the protection of aquatic ecosystems. The average pH (8.3 pH units) is within the ANZECC guideline trigger values for the protection of aquatic ecosystems (Marine, Estuary and NSW Lowland Rivers). The pH observed at the background site (KS12/6) was lower (between 6.7 and 8.0 pH units) than the surface water at the KIWEF (Appendix D).

Electrical conductivity (EC) (between 180 and 4,200 µS/m) exceeded the ANZECC guideline trigger values for the protection of aquatic ecosystems (NSW Lowland Rivers). The average EC at the KIWEF (1,131 µS/m) was lower than the average EC at the background site (3,134 µS/m), however the maximum values recorded at the KIWEF (4,200 µS/m) and the background site (4,350 µS/m) are similar (Appendix D).

The average and maximum chromium values were within the ANZECC guideline trigger values for the protection of aquatic ecosystems (Marine - 80% protection). Phenols, free cyanide, lead and zinc exceeded the ANZECC guideline trigger values for the protection of aquatic ecosystems (Appendix D).

Naphthalene, phenanthrene, fluoranthene and benzo(a)pyrene were within the ANZECC guideline trigger values for the protection of aquatic ecosystems. The recorded values were typically slightly higher than the concentrations observed at the background site (Table 4-23) (Appendix D).

4.6.2 Potential Impacts

Surface Water Quality

Surface water runoff from disturbance areas during construction and operation of the Project could potentially contain sediments, soluble salts, fuels, oils, grease and other contaminants. The potential water quality impacts that relate to these contaminants from each area of the Project site are summarised in Table 4-24.

Proposed mitigation measures to minimise the potential for surface water quality impacts and monitoring programmes are detailed in Section 4.6.3.

Flooding

As discussed in Section 4.6.1, the Lower Hunter River Flood Study (NCC and Port Stephens Council, 1994) indicated that as a result of land reclamation and filling undertaken on the southern side of the Kooragang Island mainline rail embankment a 1% Annual Exceedance Probability (AEP) flood level would not inundate the Project site (Figure 4-11). The Flood Study (1994) also concluded that localised flooding may occur across the site as a result of poor local drainage (NCC and Port Stephens Council, 1994). Development of the Project would not result in any material change to the conclusions made in the Flood Study (1994) (NCIG & Connell-Hatch, 2006).

Table 4-21
Metal Concentrations in the Hunter River – DEC Water Quality Results (Ceased 1992)

Metal	Monitoring Site[1]						
	71	73	80	90	100	110	120
Cadmium (µg/L)	<100	<100	<100	-	-	30	30
Copper (µg/L)	<150	<150	<150	<150	<150	-	-
Lead (µg/L)	<500	<500	<500	<500	<500	440	420
Zinc (µg/L)	<50	<50 - 930	<50	<50	<50	20	30

Source: After ERM Mitchell McCotter (1996) in *Proposed Cold Mill Facility Kooragang Island Environmental Impact Statement* (Protech Steel, 2001)
1 Refer to Figures 4-4 and 4-11.

Table 4-22
Surface Water Quality Summary – Kooragang Island Waste Emplacement Facility

Parameter	Units	No. of Samples	Range	Average (Mean)
pH	pH units	65	6.90 – 10.3	8.3
Conductivity	µS/m	65	180 – 4200	1131
Ammoniacal Nitrogen[1]	mg/L	65	0.1 – 4.6	0.7
Phenols (C_6H_5OH)	µg/L	65	1 – 8	3
Free Cyanide (HCN, CN^-)	mg/L	34	<0.005 – 0.007	0.007
Cyanide Total	mg/L	65	<0.005 – 0.140	0.03
Chromium Total	mg/L	65	0.003 – 0.070	0.03
Iron Total	mg/L	65	<0.1 – 34.0	2.4
Manganese Total	mg/L	65	<0.005 – 4.40	0.54
Molybdenum Total	mg/L	65	<0.005 – 0.28	0.07
Lead Total	mg/L	65	0.001 – 0.51	0.05
Zinc Total	mg/L	65	0.002 – 2.00	0.35
Mercury Total	µg/L	65	<0.05 – 0.25	0.08
Total PAH (Mid)[2]	µg/L	65	0.4 -2.1	1.3
Naphthalene	µg/L	65	<0.05 – 0.30	0.30
Phenanthrene	µg/L	65	<0.05 – 0.30	0.30
Anthracene	µg/L	65	<0.05 – 0.40	0.40
Fluoranthene	µg/L	65	<0.05 – 0.20	0.20
Benzo(a)pyrene	µg/L	65	<0.05 – <0.20	0.10

Source: Appendix D
1 Nitrogen as Ammonia
2 Total PAH (Mid) refers to the calculation of the total PAH concentration using half the detection level for each undetected component.

Table 4-23
Surface Water Quality Summary – Background Surface Water Monitoring Location (KS12/6)

Parameter	Units	No. of Samples	Range	Average (Mean)
pH	pH units	11	6.7 – 8.0	7.5
Conductivity	µS/m	11	2140 – 4350	3134
Ammoniacal Nitrogen[1]	mg/L	11	<0.1 – 2.6	0.3
Phenols (C_6H_5OH)	µg/L	11	<1 – 4	1
Free Cyanide (HCN, CN^-)	mg/L	6	<0.005 – <0.005	0.010
Cyanide Total	mg/L	11	<0.005 – 0.800	0.080
Chromium Total	mg/L	11	<0.01 – 0.03	0.01
Iron Total	mg/L	11	<0.1 – 9.0	1.8
Manganese Total	mg/L	11	0.006 – 1.400	0.360
Molybdenum Total	mg/L	11	<0.01 – 0.009	<0.01
Lead Total	mg/L	11	<0.001 – 0.006	<0.001
Zinc Total	mg/L	11	<0.01 – 0.63	0.18
Mercury Total	µg/L	11	<0.05 – 0.10	0.02
Total PAH (Mid)[2]	µg/L	11	0.4 – 1.6	1.3
Naphthalene	µg/L	11	<0.1 – <0.2	0.1
Phenanthrene	µg/L	11	<0.1 – <0.2	0.1
Anthracene	µg/L	11	<0.1 – <0.2	0.1
Fluoranthene	µg/L	11	<0.1 – <0.2	0.1
Benzo(a)pyrene	µg/L	11	<0.1 – <0.2	0.1

Source: Appendix D
1 Nitrogen as Ammonia
2 Total PAH (Mid) refers to the calculation of the total PAH concentration using half the detection level for each undetected component.

Table 4-24
Potential Surface Water Quality Impacts

Project Site	Potential Impact Scenario	Potential Contaminant
Rail Infrastructure Corridor	Uncontrolled drainage of sediment laden runoff to downstream waterbodies within the KIWEF during construction of rail embankments.	Sediments and soluble salts.
	Uncontrolled drainage of runoff from access roads and construction areas to downstream waterbodies within the KIWEF.	Sediments, soluble salts, fuels, oils and grease.
	Uncontrolled drainage of runoff from exposed soils within the existing KIWEF to downstream waterbodies.	Sediments, soluble salts, heavy metals and organic contaminants.
	Potential erosion and sedimentation resulting from runoff from the rail corridor and associated drainage system.	Sediments.
Coal Storage Area	Uncontrolled drainage to downstream waterbodies during construction of the coal storage area.	Sediments and soluble salts.
	Uncontrolled drainage of runoff from access roads and construction areas to downstream waterbodies.	Sediments, soluble salts, fuels, oils and grease.
	Uncontrolled drainage from the coal storage area to downstream waterbodies during operations.	Sediments, soluble salts, heavy metals, organic contaminants, fuels, oils and grease.
	Potential erosion and sedimentation resulting from runoff from the coal storage area and associated drainage system during operation.	Sediments.
	Spillage/overflow of site water to downstream waterbodies.	Sediments, soluble salts, fuels, oils and grease.
Wharf Facilities and Shiploader Area	Uncontrolled drainage of sediment laden runoff to the south arm of the Hunter River during construction of the berths and wharf structure, excavation within 40 m of the Hunter River and during piling operations.	Sediments and soluble salts.
	Uncontrolled drainage of runoff to the south arm of the Hunter River from access roads and wharf construction areas including excavation within 40 m of the Hunter River.	Sediments, soluble salts, fuels, oils and grease.
	Uncontrolled drainage from the wharf facilities and shiploader area during operations.	Sediments, soluble salts, fuels, oils and grease.

Source: after NCIG & Connell-Hatch (2006)

As discussed in Section 2.5.1, the dredging operations would be undertaken in accordance with the Port Consent. A detailed *Tidal Hydrodynamics, Flooding and Water Quality Assessment* was undertaken by Patterson Britton (2003) and included as part of the Port Consent EIS. The assessment concluded that:

> *…there would not be significant impacts on hydrodynamics.*
>
> *With regard to flooding, it was found that the general flood flow distribution, volumes and duration would not be altered by a significant amount. It was estimated that there would be a localised and substantial reduction in peak flood levels in the South Arm in the vicinity of Tourle Street Bridge (0.6 m in the 1% AEP event), and a slightly reduced flood risk throughout the lower Hunter estuary. These benefits were not expected to cause significant impacts on ecosystems relying on flood inundation.*
> *…*
>
> *Flood levels upstream of the Railway Bridge were predicted to marginally increase as a result of installation of a temporary sheet pile wall (for a period of about one year) to contain contaminated sediments on the vicinity of the former BHP Steelworks site during the dredging activities. This slight increase in flood levels was not expected to lead to significant flood damages.*

Construction of the berths and wharf facilities for the Project would not significantly affect the above findings of the study undertaken by Patterson Britton (2003) as no significant alterations to the profile (i.e. cross section) of the south arm of the Hunter River (in addition to that approved under the Port Consent) is proposed as part of the Project (NCIG & Connell-Hatch, 2006).

4.6.3 Mitigation Measures, Management and Monitoring

The Project water management system described in Section 2.8 was developed by NCIG & Connell-Hatch (2006) to minimise potential surface water quality impacts. Detailed design of the Project water management system would be undertaken as part of the Project SWMP described below. The water management system would be developed in accordance with accepted water management principles including maximising re-use of water on-site.

Key components of the water management system include:

- the separation of surface water runoff generated from within the active Project operational areas from that generated from surrounding areas;
- containment and re-use of water on-site; and
- the implementation of adequate water management controls to minimise the potential for impacts to off-site water resources.

A surface water monitoring programme would be developed for the Project as part of the SWMP.

Water Management – Construction

Temporary erosion and sediment controls (e.g. silt fences and sediment control structures) would be installed prior to the commencement of construction activities. A silt curtain would be used during construction of the shipping berth batters, wharf structure and during piling operations (Section 2.8.1).

The site drainage network (including primary and secondary settling ponds and site water pond) would be established at the commencement of construction activities to capture site runoff and to manage sea water draining from dredged material during preloading of the coal storage area (Section 2.5.1). Runoff (including sea water) captured from the coal storage area during construction would be water quality tested and if the relevant criteria stipulated in the Project EPL is met would be returned to the south arm of Hunter River from the site water pond via the existing concrete-lined stormwater channel (Figure 2-7). Water would be returned to the south arm of Hunter River during dredging activities in accordance with the requirements of an EPL to be obtained from the DEC (Section 3.1.2). Water that does not meet the relevant water quality criteria would be stored on-site and treated prior to release and/or re-used on-site.

Water Management - Operation

A network of stormwater drains and stormwater settlement ponds, primary and secondary settling ponds and a site water pond would be used to manage runoff on and around the site (Section 2.8.1). All site water management structures would be lined with low permeability materials (e.g. compacted clay or geo-membrane) to minimise the potential for leakage.

Stormwater runoff from areas external to the Project site would be directed around the Project infrastructure areas by table drains and culverts to the existing stormwater drainage system on Kooragang Island (Section 2.8.1). Stormwater runoff collected on the Project infrastructure areas would be diverted through sediment control structures and/or to stormwater settlement ponds. Lined sumps would be installed where necessary at the end of the open drains to act as pollutant traps.

The coal storage area would be sloped with dedicated drains located along the pads and berms. A sub-grade drainage system would be incorporated into the coal stockpile pads to capture water infiltrating through the coal stockpiles (Section 2.5.1). The sub-grade drainage system would comprise a series of underground drains, pits and transfer pumps for controlling drainage from the coal storage area.

The primary and secondary settling ponds and site water pond would be constructed to the north of the coal storage area (Figure 2-7). The settling ponds would capture sediments not trapped in the concrete sumps in open drains. Water in the site water pond would be pumped to a raw water tank with a capacity of up to 4 ML. The raw water tank would store water for re-use on-site for purposes such as dust suppression, fire protection, plant washdown and landscape management.

A 500 kL potable water tank would be installed adjacent the raw water tank for potable water supply purposes (e.g. amenities and ship potable water supply). A 2 ML fire services tank would also be installed for emergency fire fighting situations.

Stormwater runoff from the rail infrastructure area would be diverted via table drains along the rail infrastructure corridor to localised sediment control structures/settlement ponds. Once runoff has passed through these structures it would report to the existing drainage system across the KIWEF. Sediment control structures/settlement ponds would also be installed at the administration and workshop area and the wharf facilities and shiploaders. Water collected in these ponds would be transferred via pump and pipeline to the primary and secondary settling ponds (Figure 2-7).

Consistent with the design goal of no discharge to the Hunter River during operations, the stormwater settlement ponds, primary and secondary settlement ponds and the site water pond would be designed and constructed with sufficient capacity to contain a 1 in 100 year ARI rainfall event. All Project water management structures would be operated in accordance with the requirements of the Project EPL.

Site Water Management Plan

A Site Water Management Plan (SWMP) would be developed for the Project construction and operations in consultation with relevant authorities. The SWMP would describe the Project water management system, including:

- updates of the predicted site water balance including details of the Project water supply system (Section 2.8.2);
- details of all water management structures including settling ponds and water tanks;
- locations and design specifications for all water diversions from undisturbed runoff areas including channel design and stabilisation, sediment retention storages and other structures;
- details of internal drainage of water from construction/development runoff or operational areas, including bunding, drainage channels, dewatering sumps and pump and pipelines; and
- procedures that would be implemented to ameliorate potential surface water impacts.

Details of the surface water monitoring programme would be included in the SWMP and would include:

- monthly sampling at a network of surface water quality monitoring sites;
- monitoring of water quality in the raw water tank on a continuous basis;
- analysis of surface water samples for a range of parameters including, but not necessarily limited to pH, electrical conductivity (EC), total dissolved solids (TDS) and total suspended solids (TSS);
- data review procedures for analysing surface water quality results; and
- investigation triggers and contingencies for managing potential adverse impacts of the Project on surface water quality.

The SWMP would be reviewed and revised as required in consultation with relevant authorities and would be periodically updated over the life of the Project.

Erosion and Sediment Control Plan

Erosion and sediment control measures would be designed in accordance with the above water management principles and would involve the preparation and implementation of an Erosion and Sediment Control Plan (ESCP).

The ESCP would describe the sequencing of construction/development works to minimise the area of disturbance at any given time and the progressive stabilisation of disturbed areas. Specific measures to control soil erosion and sediment migration are described in the Section 4.1.3.

4.7 LAND CONTAMINATION AND GROUNDWATER

A Land Contamination and Groundwater Assessment has been undertaken by RCA Australia (2006) for the Project and is presented in Appendix D. The Land Contamination and Groundwater Assessment incorporated a *Stage 1 – Preliminary Investigation* of the Project site in accordance with SEPP 55 (Section 3.3.3) and the Department of Urban Affairs and Planning (DUAP) and EPA (1998) *Managing Land Contamination – Planning Guidelines SEPP 55 – Remediation of Land* (Land Contamination Guidelines).

For the purpose of the Land Contamination and Groundwater Assessment the site has been divided into four land investigation areas (Figure 4-12):

- Site A1 – including the Project coal storage area;
- Site A2 – south of Cormorant Road including the Project wharf facilities and shiploaders;
- Site D1 – the portion of the KIWEF west of the Delta access road that would be traversed by the Project rail infrastructure corridor; and
- Site D2 – the portion of the KIWEF between the Delta access road and the Pacific National access road that would be traversed by the Project rail infrastructure corridor and train unloading stations.

4.7.1 Existing Environment

Land Contamination

As a component of Land Contamination and Groundwater Assessment (Appendix D), previous land contamination studies at the Project site and the results of additional sampling conducted in January 2006 (Connell Wagner, 2006) were reviewed. These previous land contamination studies and the additional sampling (Connell Wagner, 2006) conducted at the Project site, have included:

- soil sampling and analysis;
- site inspections;
- interviews; and
- review of aerial photographs that illustrate past landuse and development of the current Project site landforms.

This section and Table 4-25 provide a summary of this review.

Land Use

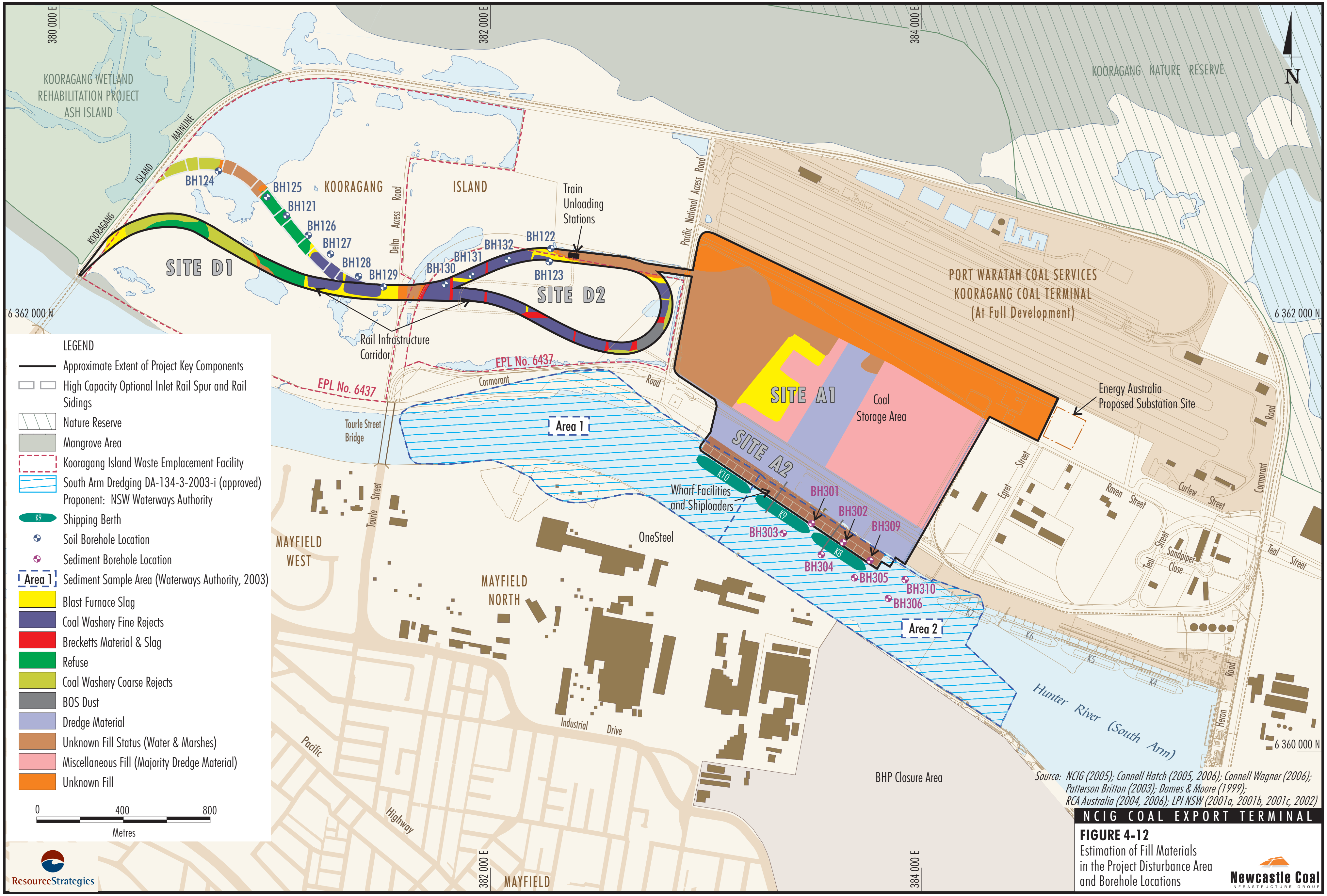
A description of the land use, land forms and soils at the Project is provided in Section 4.1.

As described in Section 3.3.2, the Project Application area is zoned as Zone 4(b) (Port and Industry Zone), Zone 5(a) (Special Uses Zone – Arterial Road) and unzoned land (Figure 1-4). The relevant objectives of these zones are outlined in Section 3.3.2. The land zoning is consistent with the proposed development and no application for site re-zoning is proposed.

Site History

As described in Section 4.1, Kooragang Island was originally a series of deltaic islands (including Ash Island, Dempsey Island and Moscheto Island) at the mouth of the Hunter River (Figures 4-1 and 4-2). The original islands were low-lying mud flats that where susceptible to flooding and subject to tidal influence (Appendix D).

Kooragang Island was used for agriculture (predominately grazing and dairy farming) during the 1800s up to the early to mid 1900s. In the late 1880s dredging of the Newcastle Harbour commenced. Dredged materials (i.e. sand, silt and clay) from these dredging activities were used intermittently to reclaim the tidal estuary up until the 1950s (Appendix D).



NCIG COAL EXPORT TERMINAL

FIGURE 4-12
Estimation of Fill Materials in the Project Disturbance Area and Borehole Locations

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Table 4-25
Summary of Land Contamination Investigation

Site Area	Known Landuses	Known Fill Materials	Recorded Contaminants	Studies Reviewed
A1	• Agriculture (grazing and aerial spraying) • Land reclamation • Landfilling	• Dredge material from the Hunter River and Throsby Creek • Uncontrolled filling with demolition rubble (e.g. concrete and timber) • Blast furnace slag	• Arsenic, cadmium, copper, lead, manganese, mercury, zinc, organochloro pesticides (OCP) polycyclic aromatic hydrocarbons (PAH), and total petroleum hydrocarbons (TPH). • Acid sulphate soils.	• Dames and Moore (1999) • Coffey Partners (1996) • URS (2000a) • Protech Steel (2001) • DLWC (1997) • Umwelt (2003)
A2	• Agriculture (grazing) • Land reclamation	• Dredge material from the Hunter River	• Arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, PAHs and polychlorinated biphenyls (PCB).	• NSW Waterways Authority (2003) • Connell Wagner (2006) • DLWC (1997) • Umwelt (2003)
D1 and D2	• Agriculture (grazing) • Land reclamation • Landfilling	• Basic oxygen steelmaking (BOS) flue dust • Blast furnace slags • Plant refuse • Steel slag (brecketts) • Oil sludges • Tarry waste • Lime sludge • Flyash • Bloomcaster dusts • Refractory waste • Coal washery reject and shales	• Arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, OCP, organophosphate pesticides (OPP), PAHs, PCB and TPH.	• Douglas Partners (2003) • Connell Wagner (2006) • DLWC (1997) • Umwelt (2003)

Source: after Appendix D

The enactment of the *Newcastle Harbour Foreshore Improvement Act 1953* (NHFI Act) in 1953, permitted the NSW Public Works Department to reclaim land and convert the islands into an area suitable for industrial use (Appendix D). Kooragang Island was named in 1968.

In 1972, BHP (and its subsidiaries) commenced utilising the KIWEF (Sites D1 and D2) as a solid waste facility. Solid waste disposal at the site ceased in late 1999 following the closure of the BHP steelworks site. RLMC currently holds EPL 6437 for the disposal of Solid Waste Class 2 at the KIWEF (Section 3.6.3).

Sites A1 and A2 comprise vacant industrial lots and have only been previously used for filling activities and agricultural use (including aerial spraying) (Appendix D).

Known Fill Materials

Figure 4-12 shows the estimated fill materials at the Project site (Appendix D).

Dredged material from the Hunter River carried out under the NHFI Act and additional dredge material from Throsby Creek in the mid 1990s make-up the major fill materials on Site A1. Slag materials and demolition wastes (e.g. concrete and timber) are also known to occur on Site A1 (Appendix D).

Site A2 consists of dredged material from the Hunter River. The dredged material was sourced during the early to mid 1900s as filling at Site A2 was completed prior to 1960s (Appendix D).

Fill materials at Sites D1 and D2 comprise a range of solid wastes (Table 4-25) from the former BHP (and its subsidiaries) steelworks site. Filling occurred at Sites D1 and D2 between 1972 and 1999. The majority of Sites D1 and D2 are covered by inert materials (generally coal washery reject) (Appendix D).

Assessment Criteria

In accordance with the recommendations of the EPA (1998) *Guidelines for the NSW Site Auditor Scheme*, the relevant guidelines for evaluation of soil contamination are the following:

- National Environment Protection Council (NEPC) (1999), *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPM Guideline).
- EPA (1994) *Guidelines for Assessing Service Station Sites*.
- EPA (2004b) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste.*

The NEPM Guideline provides investigation concentrations for contaminants based on human health risk and the proposed exposure scenario. Schedule B(1) of the NEPM Guideline provides investigation concentrations for contaminants based on human health risk and certain exposure scenarios due to site use. The soil Health Investigation Levels exposure setting 'F' (HIL 'F') from Schedule B(1) is the most appropriate NEPM Guideline for the Project (i.e. industrial land use) (Appendix D).

The EPA (1994) *Guidelines for Assessing Service Station Sites* is used for analytes not included in the NEPM Guideline HIL 'F'.

The EPA (2004b) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste* were compiled to enable classification of waste material depending on contamination status. Material can be classified as Inert Waste, Solid Waste, Industrial Waste or Hazardous Waste by these guidelines.

Evaluation of contaminant concentrations was undertaken on the basis of discrete sample results and the 95% Upper Confidence Limit (UCL) of the data set. Greater emphasis is placed on the discrete sample results where the site history shows that activities at the site may have resulted in point source contamination (Appendix D).

Results of Investigations

A number of contamination investigations have been conducted at the Project, including soil sampling and analysis. A description of these investigations is provided below. Table 4-26 provides a summary of the soil sampling analyses and Table 4-27 summarises exceedances recorded at the Project. A description of surface water quality is provided in Section 4.6.1.

Site A1 – Coal Storage Area

Dames and Moore (1999) recorded four exceedances. Benzo(a)pyrene was above the NEPM Guideline HIL 'F' and TPH C10-C36 was above the *Guidelines for Assessing Service Station Sites* in the underlying soils on one occasion. Two samples of manganese were above the NEPM Guideline HIL 'F', however the 95% UCL remained below.

Stage 2 Throsby Creek Dredging Disposal Sites Maryville and Kooragang Geochemical Sampling (Coffey Partners, 1996) included sampling and analysis of material dredged from Throsby Creek and disposed of at Site A1 in 1995. A total of 10 samples of the dredged material were analysed and results indicated three samples with concentrations of benzo(a)pyrene and two samples of Total polycyclic aromatic hydrocarbons (PAH) in excess of the NEPM Guideline HIL 'F' (5 mg/kg and 100 mg/kg respectively) (Appendix D).

Protech Steel Proposed Cold Mill Facility EIS (Protech Steel, 2001) reported manganese to be present at concentrations above the NEPM Guideline HIL 'F' criteria.

From the site history information, it was concluded that there is potential contamination issues associated with filling and with the potential use of pesticides during previous spraying activities on Site A1. The potential for Site A1 to be contaminated by heavy metals (particularly manganese) and PAHs was also noted (Appendix D).

Protech Steel (2001) concluded that Site A1 was suitable for the proposed use as a Cold Mill Facility (i.e. industrial) and did not present any risk to the health or safety of future workers using the site for the proposed use. The Protech Steel Cold Mill Facility was granted development consent by the Minister for Planning on 14 May 2002 after a comprehensive assessment process.

Site A2 – Wharf Facilities and Shiploaders

Site A2 comprises reclaimed Hunter River foreshore formed during the dredging of the harbour in the early 1880's and more recently by land reclamation conducted by the NSW Public Works Department in accordance with the NHFI Act (Appendix D).

Based on a review of aerial photographs of Site A2 in 1961, 1974 and 1985 it is apparent that Site A2 has remained undeveloped since filling which was predominantly finalised prior to 1961 (Appendix D).

Table 4-26
Summary of Soil Sampling

Analyte	Criteria[1]	Site A1						Site A2							Sites D1 and D2		
		Dames and Moore (1999)						Patterson Britton (2003)				Connell Wagner (2006)			Connell Wagner (2006)		
		Fill Layer Soils			Underlying Soils			Area 1[2]		Area 2[2]							
		Range	Mean	95% UCL	Range	Mean	95% UCL	Mean	95% UCL	Mean	95% UCL	Range	Mean	95% UCL	Range	Mean	95% UCL
Metals																	
Arsenic	500	<LD – 21	4	5	1 – 28	10	11	6	7	10	11	-	-	-	<1 – 40	8	10
Cadmium	100	<LD – 11	1	1	<LD – 4	1	1	0.6	0.8	0.9	1.0	-	-	-	<0.1 – 8.8	0.8	1.0
Chromium	500	-	-	-	-	-	-	32	38	39	41	-	-	-	<1 – 930	73	141
Copper	5,000	<LD – 221	20	32	<LD – 98	36	42	24	29	38	40	1 – 52	19	52	<2 – 100	19	24
Lead	1,500	<LD – 249	36	52	<LD – 336	126	148	61	80	113	131	1 – 410	66	252	<2 – 1,510	107	242
Manganese	7,500	2 – 20,500	1,054	2,135	41 – 2,380	421	514	-	-	-	-	-	-	-	-	-	-
Mercury	75	<LD – 1	0.1	0.2	<LD – 1.1	0.2	0.3	0.16	0.23	0.27	0.32	0.01 – 0.47	0.12	0.36	<0.05 – 0.86	0.18	0.22
Nickel	3,000	-	-	-	-	-	-	27	32	34	36	1 – 140	23	76	<1 – 1,070	36	31
Silver	-	-	-	-	-	-	-	<LD	<LD	<LD	<LD	0.10 – 0.40	0.14	0.17	-	-	-
Zinc	35,000	3 – 2,880	243	412	4 – 2,940	867	1,056	432	781	654	757	2 – 2,810	434	819	<5 – 17,000	633	1,011
Organics																	
Acenaphthene	-	-	-	-	-	-	-	0.06	0.09	0.27	0.36	0.01 – 46.69	2.21	19.40	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	0.05	0.07	0.13	0.16	0.01 – 1.43	0.20	0.72	-	-	-
Anthracene	-	-	-	-	-	-	-	0.08	0.12	0.28	0.35	0.01 – 12.70	0.76	5.45	-	-	-
Benzene	1[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.2	-	-
Benzo(a)anthracene	-	-	-	-	-	-	-	0.17	0.27	0.41	0.50	0.01 – 2.97	0.37	1.48	-	-	-
Benzo(a)pyrene	5	<LD – 5.8	-	-	<LD – 5.5	-	-	0.23	0.38	0.58	0.71	0.01 – 2.43	0.38	1.33	<0.5 – 13.0	1.2	1.2
Chrysene	-	-	-	-	-	-	-	0.15	0.23	0.35	0.42	0.01 – 2.70	0.37	1.43	-	-	-
Dibenz(ah)anthracene	-	-	-	-	-	-	-	0.02	0.03	0.10	0.11	0.01 – 0.25	0.11	0.20	-	-	-
Ethyl Benzene	3.1[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5		
Fluoranthene	-	-	-	-	-	-	-	0.40	0.68	0.98	1.22	0.01 – 24.59	1.58	10.79	-	-	-
Fluorene	-	-	-	-	-	-	-	0.06	0.08	0.20	0.25	0.01 – 22.16	1.12	9.29	-	-	-
Naphthalene	-	-	-	-	-	-	-	0.4	0.7	4.0	5.5	0.01 – 115.41	7.15	53.35	-	-	-
Pesticides	-	-	-	-	-	-	-	<LD	<LD	<LD	<LD	<1 – 2.5	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	0.17	0.26	0.60	0.80	0.01 – 47.30	2.49	20.30	-	-	-
Pyrene	-	-	-	-	-	-	-	0.40	0.69	0.95	1.18	0.01 – 16.49	1.20	7.42	-	-	-
SVOC[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Toluene	1.4[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	-	-
TPH C6-C9	65[3]	<LD	-	-	<LD	-	-	-	-	-	-	-	-	-	<10	-	-

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Table 4-26 (Continued)
Summary of Soil Sampling

Analyte	Criteria[1]	Site A1						Site A2							Sites D1 and D2		
		Dames and Moore (1999)						Patterson Britton (2003)				Connell Wagner (2006)			Connell Wagner (2006)		
		Fill Layer Soils			Underlying Soils			Area 1[2]		Area 2[2]							
		Range	Mean	95% UCL	Range	Mean	95% UCL	Mean	95% UCL	Mean	95% UCL	Range	Mean	95% UCL	Range	Mean	95% UCL
Organics (Continued)																	
TPH C10-C36	1,000[3]	<LD – 394	-	-	<LD – 1148	-	-	-	-	-	-	-	-	-	<100 – 2,950	890	-
Xylenes	14[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.5	-	-
Total OCP	-	<LD	-	-	<LD	-	-	-	-	-	-	-	-	-	<0.05	-	-
Total OPP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	-	-
Total PAH	100	<LD – 57.8	-	-	<LD – 49.1	-	-	4.8	12.3	10.4	12.9	0.02 – 301.49	19.29	133.97	0.7 – 371.1	25.0	36.3
Total PCB	-	-	-	-	-	-	-	<LD	<LD	<LD	<LD	<5	-	-	<0.5	-	-

Source: after Appendix D

1 NEPC (1999) *National Environmental Protection (Assessment of Site Contamination) Measure,* HIL 'F' (Commercial/Industrial).

2 Refer to Figure 4-12.

3 EPA (1994) *Guidelines for Assessing Service Station Sites.*

4 SVOC were detected in some analytes however, these analytes are included in the PAH suite and therefore have already been incorporated.

Note: All units in mg/kg.

95% UCL 95% Upper Confidence Level.

<LD less than the limit of detection.

OCP organochloro pesticides.

OPP organophosphate pesticides.

PAH polycyclic aromatic hydrocarbons.

PCB polychlorinated biphenyls.

SVOC semi volatile organic compounds.

TPH total petroleum hydrocarbons.

Table 4-27
Summary of Soil Sampling Recorded Exceedances

Site Area	Number of Samples	Number of Exceedances[1, 2]	Description of Exceedances
A1	828	4	• Manganese on two occasions. • TPH C10-C36 on one occasion. • Benzo(a)pyrene on one occasion.
A2	597[3]	4	• PAH on four occasions.
D1 and D2	903	19	• Lead on one occasion. • TPH C10-C36 on 13 occasions. • Benzo(a)pyrene on three occasions. • PAH on two occasions.

Source: after Appendix D

1 NEPC (1999) *National Environmental Protection (Assessment of Site Contamination) Measure,* HIL 'F' (Commercial/Industrial).

2 EPA (1994) *Guidelines for assessing Service Station Sites.*

3 Excludes sampling conducted by Patterson Britton (2003).

The 95% UCL of all analytes did not exceed the NEPM Guideline HIL 'F' criteria. A comparison of the results with the Waste Classification Guidelines indicates that sediment could be classified as inert or solid waste (Appendix D).

Additional sediment sampling was undertaken by Connell Wagner (2006) and comprised the collection of up to 32 samples from eight bores (BH301-BH306, BH309 and BH310) located within river sediment (Figure 4-12). The data indicates two of the 27 samples exceeded the NEPM Guideline HIL 'F' criteria.

Total PAH exceeded the NEPM Guideline HIL 'F' criteria (100 mg/kg) on four occasions. In addition, the 95% UCL for Total PAH (133.97 mg/kg) was above the NEPM Guideline HIL 'F' criteria (100 mg/kg). There were no other exceedances recorded (Appendix D).

Sites D1 and D2 – Rail Infrastructure Corridor and Train Unloading Stations

Investigations undertaken by Douglas Partners (2003) found that chemical concentrations in some areas of Sites D1 and D2 exceeded the NEPM Guideline HIL 'F' criteria and the Industrial Waste criteria in the *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste* (EPA, 2004b).

Available site information indicates that a range of contaminants are likely to be present in areas of Sites D1 and D2 including ammonia, phenols, cyanide, chromium, iron, manganese, molybdenum, zinc, mercury and PAH, TPH and asbestos.

Contaminant concentrations are related to particular fill materials and as such, elevated concentrations would be identified in areas including the basic oxygen steelmaking (BOS) flue dust disposal area and areas of general refuse (Figure 4-12). Some co-disposal of waste was also likely to have taken place in parts of the site suggesting that contaminants may be present in random locations across Sites D1 and D2.

Additional chemical characterisation of fill materials along the Project rail infrastructure corridor has been undertaken by Connell Wagner (2006). The sampling program comprised the collection and analysis of 49 samples from twelve sampling locations (BH121-BH131) along the proposed rail infrastructure corridor within Sites D1 and D2 (Figure 4-12). Laboratory analysis was undertaken on samples collected from a range of depths within the fill profile and analysis was undertaken for benzene, toluene, ethyl benzene and xylene (BTEX), TPH, PAH, heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury and zinc), semi volatile organic compounds (SVOC), OCP, organophosphate pesticides (OPP) and polychlorinated biphenyls (PCB).

Results are summarised below and sampling locations are shown on Figure 4-12.

- TPH C10-C36 was detected in most samples and was above the NEPM Guideline HIL 'F' (1000 mg/kg) in 13 samples at the following locations:
  - BH123 (6.5-6.95 m) and (8.0-8.45 m);
  - BH125 (2.5-2.95 m);
  - BH126 (5.5-5.95 m);

- BH127 (1.2-145 m) and (2.5-2.9 m) and (4.0-4.45 m);
- BH128 (2.5-2.9 m) and (4.0-4.45 m) and (5 m);
- BH129 (2.5-2.92 m);
- BH131 (2.5-2.95 m); and
- BH132 (1.0-1.45 m).

- benzo(a)pyrene was detected in excess of the NEPM Guideline (5 mg/kg) in three of the 49 samples in the following locations:
  - BH123 (0-0.5 m);
  - BH125 (2.5-2.95 m); and
  - BH132 (1.0-1.45 m).
- PAH was detected in excess of the NEPM Guideline (100 mg/kg) in two of the 49 samples in the following locations:
  - BH125 (2.5-2.95 m);
  - BH132 (1.0-1.45 m).
- PCB was detected in one sample, BH130 (1.0-1.45 m) but was well below the NEPM Guideline (50 mg/kg).
- Volatile Organic Compounds were not detected except for PAH and Carbazole in BH125 (2.5-2.95 m).
- The 95% UCL of all analytes did not exceed their relevant criteria.

Groundwater

A description of the groundwater systems identified at the Project is presented below.

Hydrogeology

The Project site hydrogeology comprises two aquifers (fill and estuarine). The two aquifers are separated in some areas by a clay aquitard (i.e. drill data indicates that the clay aquitard is not present in all areas) (Appendix D).

The fill aquifer is unconfined and is primarily recharged by rainfall. Groundwater flow is primarily horizontal, generally flowing towards the nearest surface waterbody. The water table has been identified at depths between 0.4 and 1.2 m from the surface in the fill aquifer (Appendix D).

The estuarine aquifer consists of sand of a moderate to high permeability. The potentiometric surface of the estuarine aquifer lies between the base of the fill aquifer and the water table, therefore allowing for the vertical flow from the fill aquifer to the estuarine aquifer (Appendix D).

The thickness of the clay aquitard ranges from 0 m to 15 m (i.e. the clay aquitard is not present in all areas of the Project site). Despite the aquitard's low permeability, there is some vertical flow between the fill and estuarine aquifer (Appendix D).

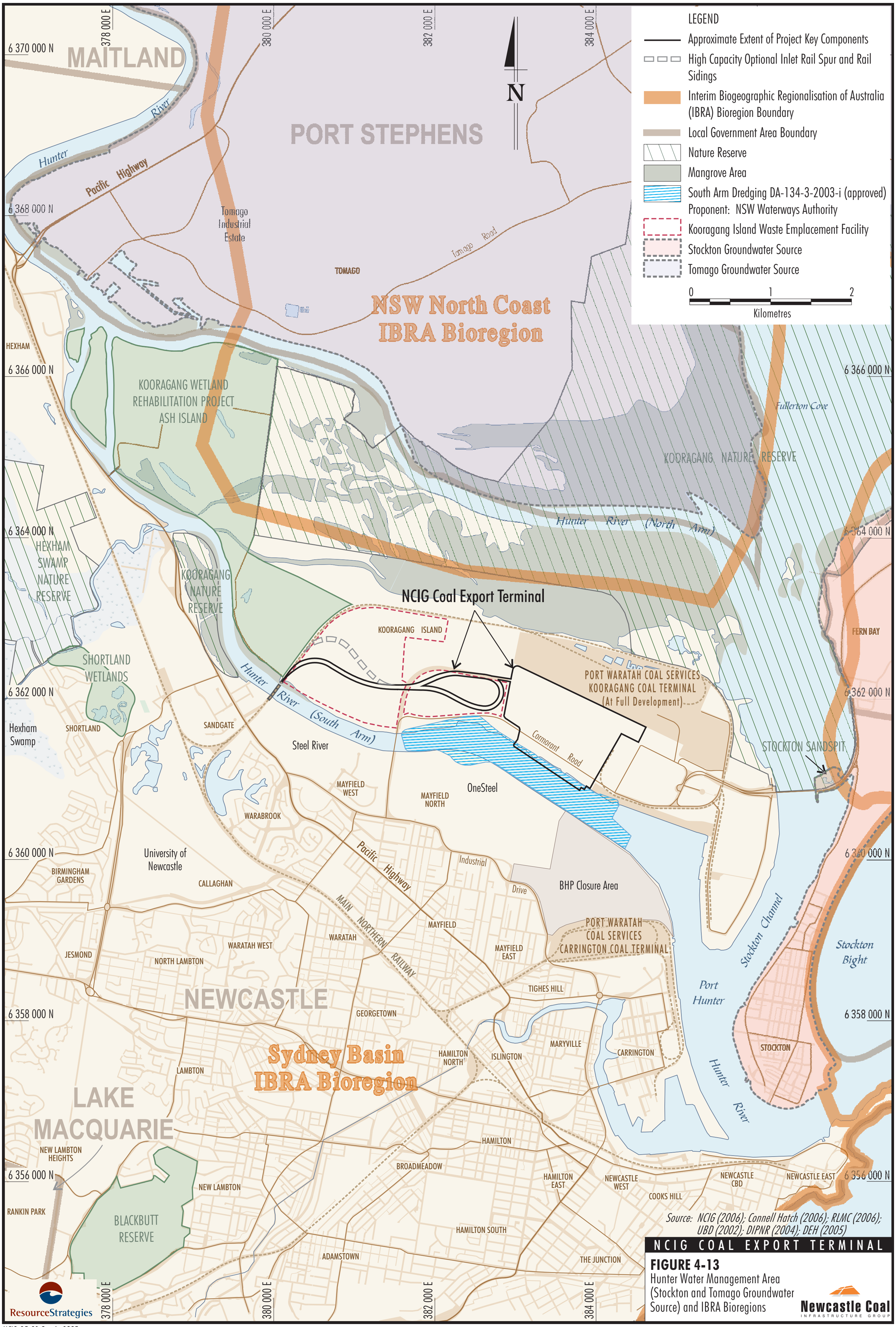
Kooragang Island is located to the south and west of the Tomago and Stockton groundwater sources, respectively (Figure 4-13). Fullerton Cove is located to the north-east of Kooragang Island between the Tomago and Stockton groundwater sources (Figure 4-13). The Kooragang Wetland system surrounds the Project site. Due to the potential for the groundwater system at the Project site to have hydraulic connection with these groundwater systems (and the Hunter River, Hunter River Estuary and associated aquifer systems) comprehensive groundwater management measures and monitoring systems have been developed for the Project and are described in Section 4.7.2.

Dredge sand is the major fill material in the fill aquifer in Sites A1 and A2. The water table has been identified at depths between 0.4 and 1.2 m from the surface. The groundwater flow in the fill and estuarine aquifers is generally towards the south arm of the Hunter River (Appendix D).

The fill aquifer in Sites D1 and D2 comprises various waste materials, which have been placed in slag bunds. The permeability of the waste materials varies from low to moderate (Appendix D). Groundwater flow in the fill aquifer is found generally to be dominated by two areas of recharge, evidenced by groundwater mounding as identified in Site D2 (Figure 4-14). The groundwater flow from this area is radial to the surrounding surface water ponds (Figure 4-14). Groundwater flow would also be expected to be downward to the underlying aquifer (Appendix D).

The groundwater flow regime in the estuarine aquifer comprises a low hydraulic gradient with a groundwater divide present in a north-west/south-east direction midway through the site (Figure 4-15). Groundwater to the north of the divide flows north. Groundwater flow south of the divide flows towards the south, ultimately discharging to the south arm of the Hunter River (Appendix D).

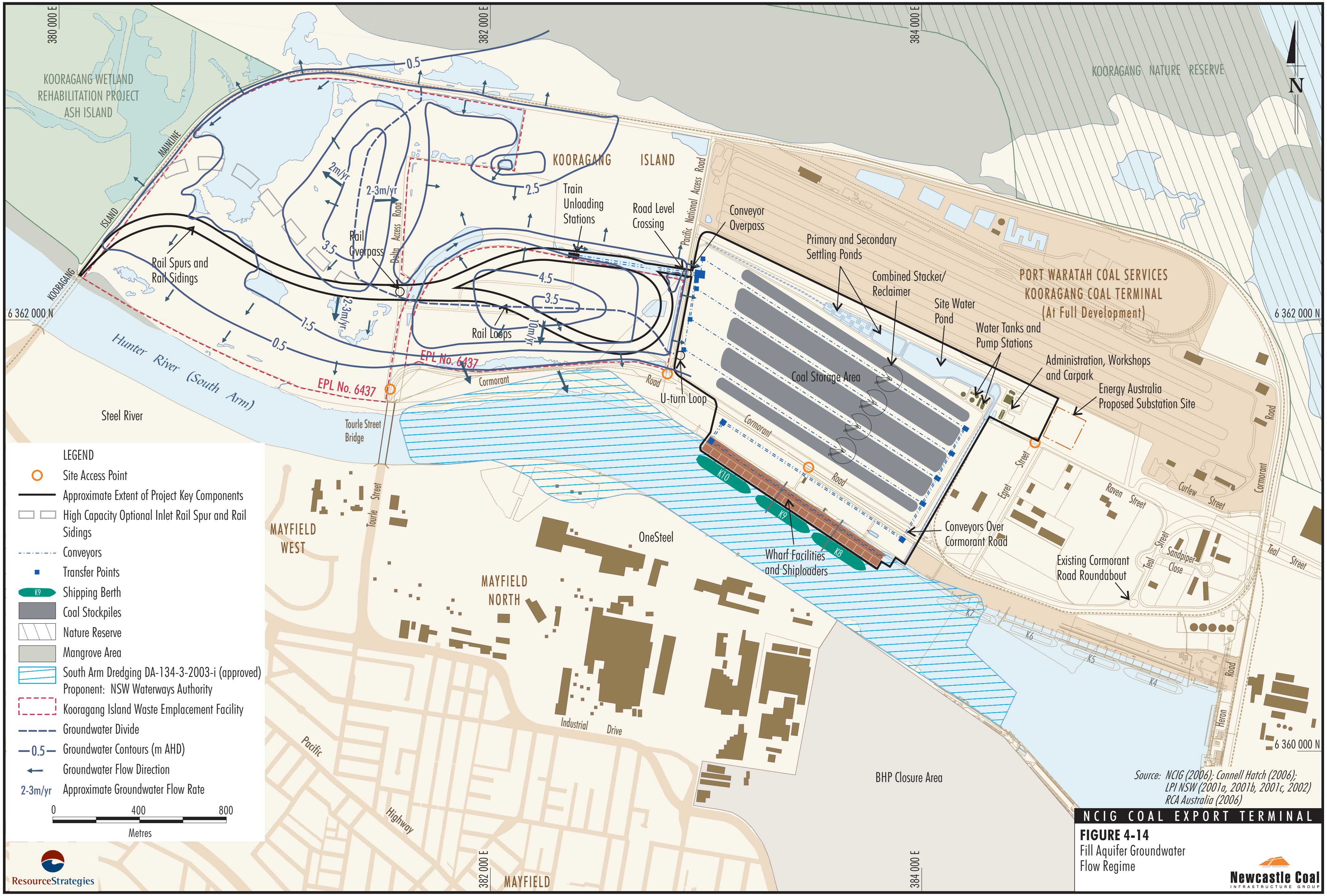
The estimated groundwater table contours shown on Figures 4-14 and 4-15 are based on a compilation of historical groundwater data and interpolation where necessary (Appendix D).



NCIG COAL EXPORT TERMINAL

FIGURE 4-13
Hunter Water Management Area (Stockton and Tomago Groundwater Source) and IBRA Bioregions

NCIG-05-01 Sect4_022E



NCIG-05-01 Sect 4_024B

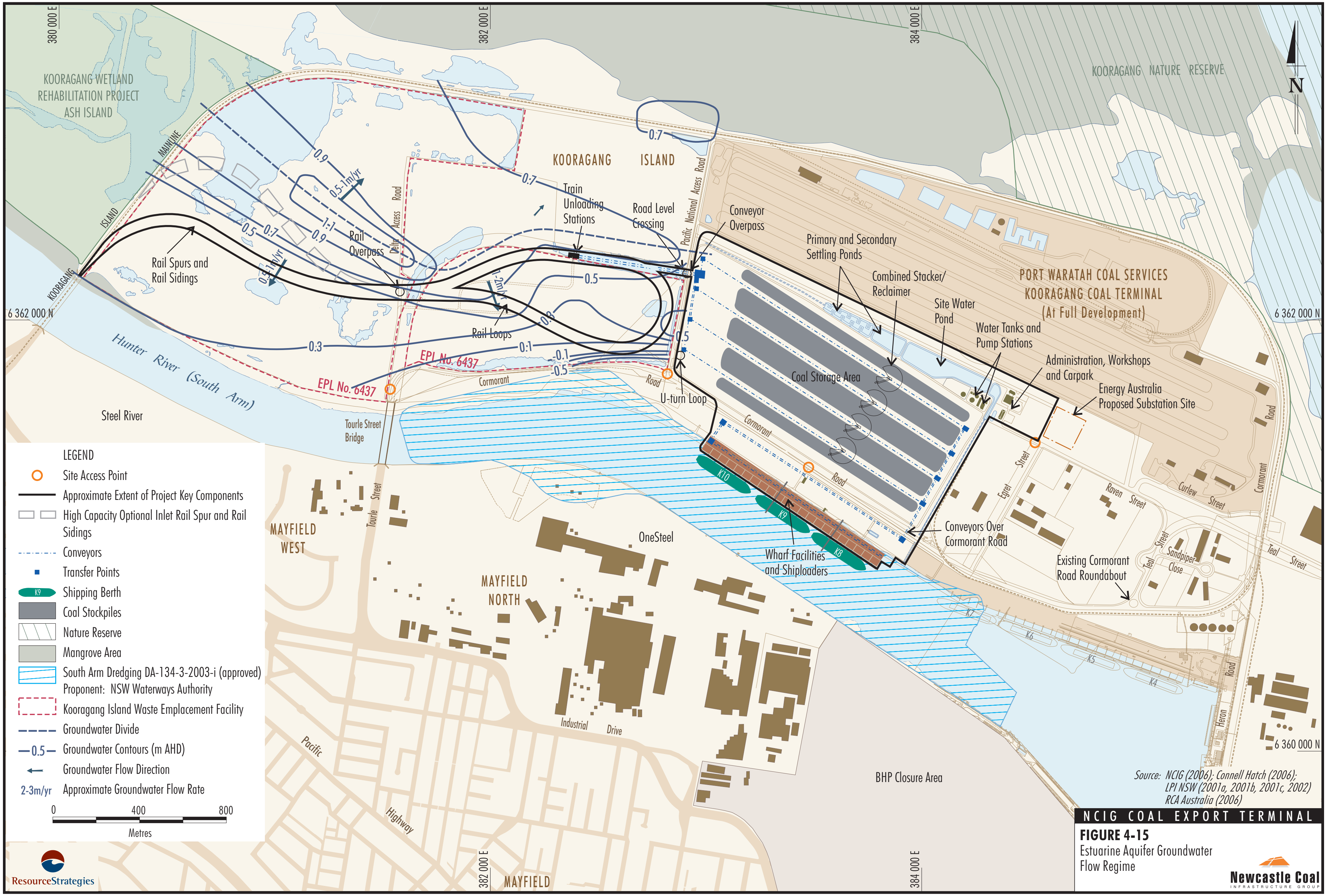


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FIGURE 4-15
Estuarine Aquifer Groundwater Flow Regime

Groundwater Quality

Guidelines applicable for the assessment of groundwater quality at the Project site are the ANZECC (2000) Guidelines. A summary of the ANZECC guidelines water quality trigger values is provided in Section 4.6.1.

Site A1

As part of the Dames and Moore (1999) site investigation, grab samples were taken from eight test pits on Site A1. Table 4-28 summarises the groundwater quality results of these groundwater samples.

The maximum arsenic and lead values for all samples were within the ANZECC water quality trigger values for the protection of aquatic ecosystems (95% protection) (Table 4-20). The maximum Copper and Zinc values for the 10 samples analysed were within the ANZECC water quality trigger values for the protection of aquatic ecosystems (Marine - 80% protection) (Table 4-20).

The maximum manganese value for the samples exceeded the ANZECC water quality trigger values for the protection of aquatic ecosystems (Table 4-20).

Protech Steel (2001) identified low concentrations for most organic and inorganic parameters tested with the exception of TPH, which was identified at concentrations of up to 400 mg/L.

Sites D1 and D2

Groundwater sampling at the KIWEF began in 1979 with sampling undertaken irregularly until 1998. A formal monitoring programme was designed and implemented in March 1999. This programme also included the installation of new bores to augment the monitoring bore network at the site. Figure 4-11 shows the location of the groundwater monitoring sites. Groundwater monitoring at the site continues on a biannual programme. Results of groundwater monitoring over the period from March 1999 to March 2002 are summarised in Table 4-28.

The pH ranged from 6.8 to 12.2 pH units in the fill aquifer, 5.7 to 10.4 pH units in the shallow estuarine aquifer and 5.9 to 7.8 pH units in the deep estuarine aquifer. The pH values for some samples exceed the ANZECC water quality trigger values for the protection of aquatic ecosystems (NSW Lowland Rivers) in the fill aquifer (Table 4-19). The pH for samples taken from the shallow and deep estuarine aquifers are within the ANZECC water quality trigger values for the protection of aquatic ecosystems (NSW Lowland Rivers) (Table 4-19).

The EC measurements for samples taken from the fill and estuarine aquifers exceeded the ANZECC water quality trigger values for the protection of aquatic ecosystems (NSW Lowland Rivers) (Table 4-19).

Average concentrations from samples in the fill aquifer for phenol, naphthalene, anthracene, fluoranthene, benzo(a)pyrene are within the ANZECC water quality trigger values for the protection of aquatic ecosystems (Marine – 80% protection level) (Table 4-20). Maximum naphthalene, phenanthrene, anthracene, fluoranthene, benzo(a)pyrene values recorded for some samples taken from the shallow estuarine aquifer exceeded the ANZECC water quality trigger values for the protection of aquatic ecosystems (Table 4-20).

Elevated concentrations of ammonia, iron, molybdenum, chromium, lead and zinc were not limited to samples from the site. This indicates that elevated concentrations of these parameters may be occurring naturally, and may not be related to activities undertaken at the site (Appendix D).

Suitability of Site for Use

RCA Australia (Appendix D) concluded that with the implementation of the measures presented in Section 4.7.2 (including the SWGMP and the SEMP), that the Project site is suitable for the purpose of the development of the Project.

Table 4-28
Summary of Groundwater Quality

Parameter	Units	Site A1	Sites D1 and D2								
		Fill Aquifer	Fill Aquifer			Estuarine (Shallow) Aquifer			Estuarine (Deep) Aquifer		
		Max	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
pH	pH units	-	6.8	12.2	9.9	5.7	10.4	7.3	5.9	7.8	7.1
Conductivity	µS/cm	-	53	1,650	368	140	7,010	2,845	160	5,280	3,566
Ammoniacal Nitrogen[1]	mg/L	-	0.1	8.9	2.2	0.1	11.0	2.8	1.2	61.0	9.7
Phenols	µg/L	-	<1	220	38	<1	98	3	0.5	16.0	0.7
Free Cyanide (HCN, CN^-)	mg/L	-	<0.05	0.19	0.05	<0.005	0.04	0.01	<0.005	<0.005	<0.005
Cyanide Total	mg/L	-	<0.005	4.50	0.16	<0.005	2.80	0.04	<0.005	0.09	0.02
Arsenic (filtered)	µg/L	20	-	-	-	-	-	-	-	-	-
Cadmium (filtered)	µg/L	<LD	-	-	-	-	-	-	-	-	-
Chromium Dissolved	mg/L	-	<0.1	0.011	0.01	<0.01	0.007	0.0001	0.001	0.05	0.02
Copper (filtered)	µg/L	5	-	-	-	-	-	-	-	-	-
Iron Dissolved	mg/L	-	<0.005	15.0	3.7	0.1	140	7.0	0.07	24.70	3.03
Manganese Dissolved	mg/L	-	<0.01	0.9	0.28	<0.005	4.77	0.91	0.049	3.12	0.70
Manganese (filtered)	µg/L	6,330	-	-	-	-	-	-	-	-	-
Molybdenum Dissolved	mg/L	-	<0.01	0.14	0.03	0.01	0.06	0.003	0.005	0.009	0.010
Lead Dissolved	mg/L	-	<0.002	0.27	0.07	0.002	0.110	0.001	<0.002	0.028	0.010
Lead (filtered)	µg/L	3	-	-	-	-	-	-	-	-	-
Zinc Dissolved	mg/L	-	<0.005	0.26	0.05	<0.005	0.29	0.01	<0.005	3.92	0.06
Zinc (filtered)	µg/L	36	-	-	-	-	-	-	-	-	-
Mercury Dissolved	mg/L	-	<0.05	0.14	0.08	<0.001	0.45	0.03	<0.05	0.22	0.03
Mercury (filtered)	µg/L	<LD	-	-	-	-	-	-	-	-	-
Total PAH (Mid)[2]	µg/L	7	0.8	98.1	10.9	0.4	846.9	31.8	0.375	4.105	1.300
Naphthalene	µg/L	-	<0.1	45.0	4.9	<0.05	190	3.9	<0.05	1	0.03
Phenanthrene	µg/L	-	<0.1	93	7	<0.05	260	7.73	<0.05	0.90	0.01
Anthracene	µg/L	-	<0.1	5.7	2.0	<0.05	30	0.99	<0.05	<0.20	<0.10
Fluoranthene	µg/L	-	<0.1	0.2	0.1	<0.05	35	1.17	<0.05	1.30	0.02
Benzo(a)pyrene	µg/L	<LD	<0.05	0.2	0.1	<0.05	2.0	0.03	<0.05	<0.20	<0.10
TPH C6-C9	µg/L	72	-	-	-	-	-	-	-	-	-
TPH C10-C36	µg/L	340	-	-	-	-	-	-	-	-	-
Total OCP	µg/L	<LD	-	-	-	-	-	-	-	-	-

Source: after Appendix D
1 Nitrogen as Ammonia.
2 Total PAH (Mid) refers to the calculation of the total PAH concentration using half the detection level for each undetected component.
<LD Less than the limit of detection.
OCP organochloro pesticides.
PAH polycyclic aromatic hydrocarbons.
TPH total petroleum hydrocarbons.

4.7.2 Potential Impacts, Mitigation Measures, Management and Monitoring

This section describes the potential land contamination and groundwater impacts associated with the development of the Project and provides mitigation and management measures.

Potential land contamination and groundwater impact mechanisms associated with the Project include the following:

- Contact with potentially contaminated soils and/or acid sulphate soils in Project excavations during construction.
- Contact with, or uncontrolled release of, potentially contaminated water that accumulates in Project excavations during construction.
- Project excavations resulting in the connection of groundwater aquifer systems leading to the mobilisation of contaminated groundwater.
- Preloading of soils during construction of Project elements (i.e. rail embankment and coal storage area) resulting in the mobilisation of contaminated groundwater.
- Infiltration of water through the Project rail infrastructure corridor compromising the long-term performance of the KIWEF capping strategy.

Each of the above potential impact mechanisms has the potential to result in impacts on existing surface and groundwater resources if not appropriately mitigated/managed. Presented in the following sections are the mitigation and management measures that have been developed by NCIG to address these issues.

Soil Management During Excavations

Project elements have been designed to minimise excavations. Limited excavations would be required during the construction of the Project, including (NCIG, 2006a):

- construction of sections of the rail infrastructure corridor;
- foundations for the train unloading stations; and
- development of surface water management infrastructure.

Excavations have the potential to intercept contaminated soils and/or acid sulphate soils (Section 4.1.2).

Prior to any excavation on site, a representative surface and sub-surface soil sampling and analysis programme would be undertaken in order to characterise the material to be excavated. The sampling programme would be undertaken in accordance with the EPA (2004b) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste*. Further validation samples would be taken where necessary during excavation and handling of excavated material.

Materials that are identified as not being suitable for use as fill material on site would be excavated and removed from the site to adjacent RLMC owned land. The material would be placed in encapsulated cells and capped with an appropriate cover layer in accordance with Benchmarks 1 and 2 in *Environmental Guidelines: Solid Waste Landfills* (EPA, 1996), or removed from the site for treatment at a licensed facility.

The characteristics of all soil materials would be recorded during excavation and movement on site. Records would include a description of the excavated soil and the depth and location of its source and final placement.

The detailed design of soil management during excavations would take into consideration the results of the detailed geotechnical and geochemical investigations to be undertaken as part of the detailed design of the Project.

The presence or otherwise of acid sulphate soils would be identified during the surface and sub-surface soil sampling and analysis and managed as described above. Measures such as lime dosing of soils would also be undertaken if necessary.

To manage the risk of human exposure to potentially contaminated materials (including airborne particulates) during excavation activities, a range of controls would be implemented, including:

- using water sprays to control dust;
- minimising the surface area disturbed by excavation at any one time;
- confining vehicle movements to designated access routes;
- limiting the speed of vehicles on unpaved roads; and
- immediate encapsulation of materials considered unsuitable for use as construction fill.

As the administration and workshop buildings area would have a higher occupation of workers than other areas across the Project site, a representative surface and sub-surface soil sampling and analysis programme would be undertaken in order to characterise the material in accordance with the EPA (2004b) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste*. Management of any unsuitable materials would also be conducted as described above. This process would be conducted as part of the detailed geotechnical and geochemical investigations to be undertaken as part of the detailed design of the Project and would be detailed in the SEMP described below.

Water Management During Excavations

Water that accumulates in excavations during Project construction would be tested to determine its quality. Depending on the quality of this water it would be pumped to dedicated detention ponds or (if the water quality is suitable) pumped to the primary and secondary settling ponds for storage on-site and re-use.

Water that is considered to be of unsuitable quality for re-use would be temporarily stored within dedicated detention ponds with low permeability liners (e.g. compacted clay or geo-membrane) before being treated for re-use and/or removed from site and disposed of by a licensed contractor.

Interference with Aquifer Systems During Excavations

There would be minimal excavations into the existing ground surface during the construction of the coal storage area (Appendix D). Excavations would be primarily associated with the construction of water management infrastructure. Any excavation for water management infrastructure would be lined with a low permeability material. To minimise potential for interference with groundwater aquifer systems, major structures on Site A1 would be supported on piles (Appendix D).

There would be minimal excavations required within 40 m of the south arm of the Hunter River as piling would be used. Excavations within 40 m of the south arm of the Hunter River would be associated with the construction of the shipping berths. Excavations for the development of the berths would be undertaken as part of the dredging operations in accordance with the existing Port Consent (Section 3.6.1).

As described in Section 2.4.2, the train unloading stations would be located on the northern side of the rail loop and the existing KIWEF embankment (Figure 2-1). Construction of the train unloading stations would only require minor excavation (3 to 5 m) for the preparation of foundations. To minimise the risk of these excavations resulting in a hydraulic connection between the fill and estuarine aquifers, piled foundations together with a jet-grouted base and secant pile and/or diaphragm sub-surface perimeter walls would be used for the construction of the train unloading stations and associated conveyors (Figure 2-4). This design effectively seals the structure from the aquifers and after a short settlement period there would be no cross flow around the piles (Appendix D).

Preloading of the Coal Storage Area – Groundwater Management

As described in Section 2.5.1, preloading would be undertaken as part of the construction of the coal storage area to provide for consolidation of the existing soils.

Wick drains would be used to accelerate consolidation in the clay aquitard. Wick drains assist in dissipating the increased pore pressure in the clay aquitard (therefore expediting the consolidation process) by providing a conduit for groundwater movement.

Similar methods for accelerating consolidation were, and continue to be used at the adjacent PWCS site. Monitoring of bores over several years at the PWCS site has shown there has been little or no affect on groundwater quality (Appendix D).

The subsurface profile at Site A1 varies significantly. The thickness of the clay aquitard ranges from 0 m to 15 m (i.e. the clay aquitard is not present in all areas of the Project site) (Appendix D). Therefore the fill and estuarine aquifers are hydraulically connected in some locations. Therefore increasing the level of connection between the estuarine and fill aquifers is expected to have minimal impact as they are already connected (Appendix D). In addition, the wick drains are also expected to eventually collapse or block with sediment.

Notwithstanding the above, bores would be located around the perimeter of Site A1 to monitor the fill and estuarine aquifers as part of the SWGMP (Section 5).

If groundwater monitoring indicates the need, an investigation would be undertaken and additional/contingency control measures would be developed in consultation with the relevant authorities, including measures such as:

- pumping from bores to intercept migrating groundwater;
- localised subsurface low permeability barriers around affected areas (i.e. a physical barrier to groundwater migration in potentially affected areas); and
- subsurface low permeability barrier around the perimeter of Site A1 (i.e. a physical barrier to groundwater migration from the coal storage area).

The above measures are consistent with the design goal of no discharge of water to the Hunter River. The detailed design of these controls would take into consideration the results of the detailed geotechnical and geochemical investigations to be undertaken as part of the detailed design of the Project.

Preloading of the Rail Infrastructure Corridor – Groundwater Management

As described in Section 2.4, Sites D1 and D2 would contain Project rail infrastructure. The rail infrastructure predominately requires the placement of fill material over the top of the existing surface to create an embankment. The depth of fill material required varies across Sites D1 and D2, depending on the existing surface level. The placement of the embankment material would cause consolidation of the underlying soils.

As described above, the consolidation of the clay aquitard would lead to an increase in pore pressure, which would induce flows from the clay aquitard into the fill and estuarine aquifer. This increase in flow would be expected to be short term and localised (Appendix D).

The Project rail infrastructure corridor would be located in a narrow corridor across the central portion of Sites D1 and D2. The presence of fill materials would assist in dissipating the groundwater pressure from the placement of fill for the rail embankment. The increase in flow rate is expected to be only minor. Consolidation of the alluvial and estuarine sediments is likely to be minimal due to the previous placement of large quantities of fill in this area during the operations of the KIWEF (Appendix D).

It is expected that some short term localised increases in the groundwater table would occur in areas of consolidation. Within Sites D1 and D2 this increase in the groundwater table is expected to have negligible impact on surrounding groundwater systems due to the elevated water table already present in this area. Groundwater within Sites D1 and D2 is up to 4 m higher than surrounding groundwater systems and a subsequent further increase in this water table is not expected to modify the surrounding groundwater systems significantly (Appendix D).

Wick drains would be used to accelerate consolidation in the clay aquitard as described above in areas of significant fill. A potential impact of the use of wick drains is connecting the fill and estuarine aquifers allowing for increased groundwater flows between the aquifers. The increase in flow would be localised and of generally short duration (Appendix D). The wick drains are also expected to eventually collapse or block with sediment, which would reduce the flow between the aquifers.

Notwithstanding the above, contingency measures have been developed. Bores would be located along the perimeter of the rail infrastructure corridor to monitor the fill and estuarine aquifers as part of the SWGMP. If a significant change/effect is identified during groundwater monitoring, an investigation would be undertaken and additional control measures would be developed, which may include pumping from bores and the installation of localised subsurface low permeability barriers (i.e. subsurface physical barrier to groundwater migration) around affected areas.

Rail Infrastructure Corridor – Capping Strategy

In addition to the mitigation and management measures described in the previous sections, the Project rail infrastructure corridor has been designed with a capping system to minimise long-term infiltration. The relevant aspects of the rail infrastructure corridor design are described below.

Surface Profile of the Kooragang Island Waste Emplacement Facility and Integration with Capping Strategy

The design of the Project rail infrastructure corridor (Section 2.4) is consistent with that required by EPL 6437 for the capping of the whole KIWEF in that it is consistent with the goals of Benchmark techniques 28 and 29 (see below) of the EPA (1996) *Environmental Guidelines: Solid Waste Landfills*.

The geometry of the rail embankment is such that cut and fill has been minimised were practicable. This means that sufficient flexibility remains for the design of the ultimate capping strategy for the remainder of the KIWEF by RLMC (Appendix D).

NCIG has consulted with RLMC, and its consultants, regarding the general layout design of the Project elements and is satisfied that the layout of the Project rail infrastructure is such that it would not prevent compliance with condition O10.2 of EPL 6437 by the RLMC. As shown conceptually on Figure 4-16, the future capping of the KIWEF can be readily integrated with (i.e. connected to) the Project capping layer in the areas of rail infrastructure. This would provide for a contiguous boundary to control vertical infiltration (Appendix D). In an overall landscape and surface drainage context, the Project rail infrastructure corridor would:

- follow the existing surface where practicable;
- incorporate culverts for under-drainage;
- maintain drainage structures from the centre of the rail loop (Figure 2-1); and
- include surface drains that connect with existing surface drainage features, accommodating the effective closure and capping of the KIWEF.

However, it should be noted that the design and timing of the KIWEF capping is not under the control of NCIG (Section 3.6.3).

The relevant goals of Benchmark technique 28 and how they have been incorporated into the Project design are discussed below.

Benchmark Technique 28

As described in Section 4.7.1, Sites D1 and D2 comprise the KIWEF which operates under EPL 6437. Condition O10.2 of EPL 6437 states:

> *Final capping must comprise the following: a seal bearing surface, a sealing layer, an infiltration layer and the revegetation layer as specified in NSW EPA's publication "Environmental Guidelines: Solid Waste Landfills" unless otherwise approved in writing by EPA.*

In addition, the EARs issued by the DoP (Section 1.2) require the capping layer for the rail infrastructure corridor to meet Benchmark technique 28 of the EPA (1996) *Environmental Guidelines: Solid Waste Landfills*.

The environmental goals of Benchmark technique 28 are performance based and aim to:

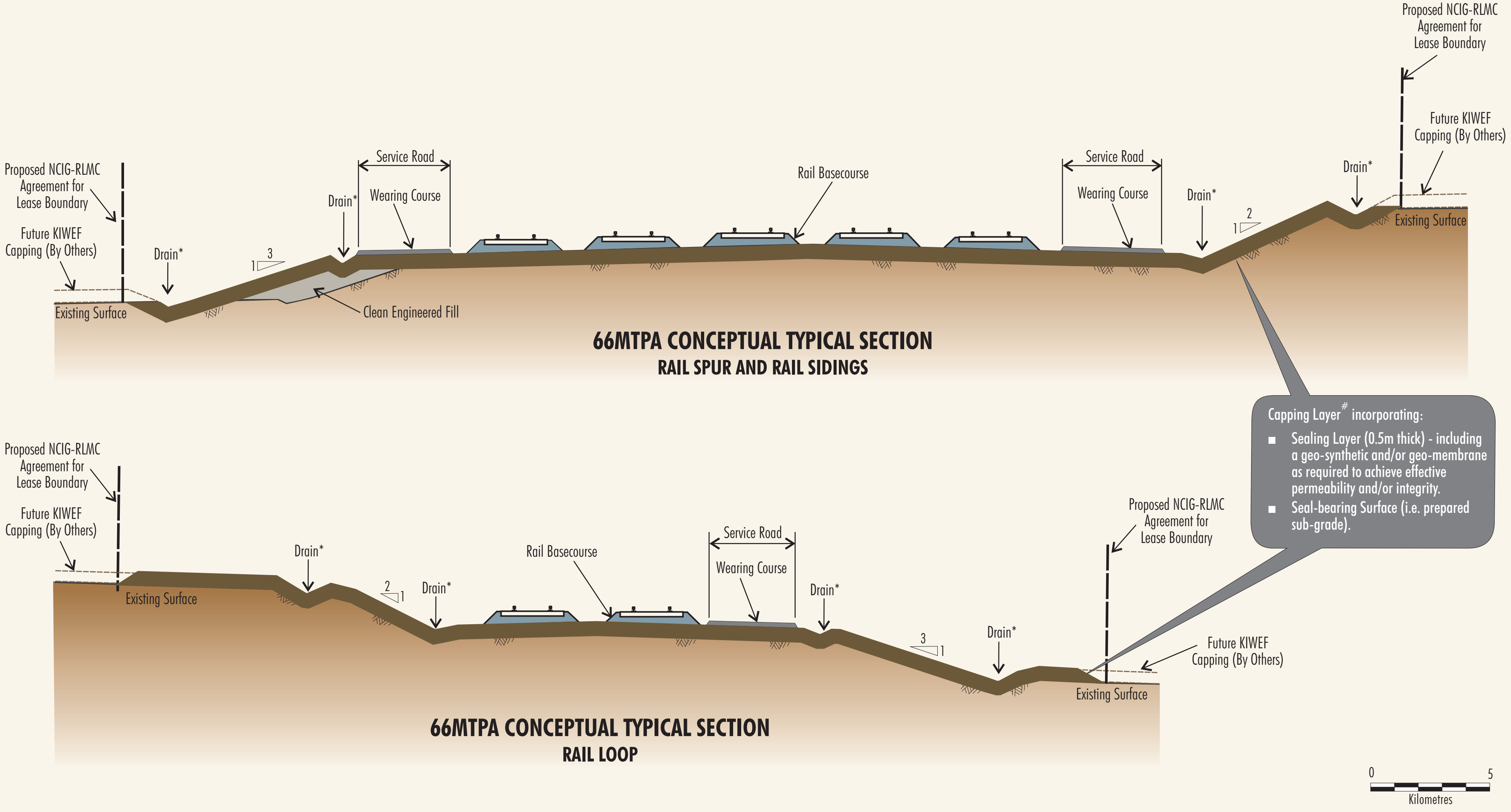
- prevent pollution of water by leachate;
- prevent landfill gas emissions;
- assure quality of design, construction and operation;
- minimise landfill space used;
- prevent degradation of local amenity; and
- ensure adequate staffing and training.

Consistent with the requirements of Benchmark technique 28, the design of the Project rail corridor would incorporate the following elements (Figure 4-16) (Appendix D):

1. A seal-bearing surface (i.e. prepared sub-grade).
2. A 0.5 m thick sealing layer with an effective permeability of not greater than 1×10^{-8} m/s (unless otherwise agreed by the DEC). A geo-synthetic and/or geo-membrane would be incorporated into this layer in high fill areas as necessary to achieve the desired effective permeability and/or to protect the integrity of the sealing layer.
3. Table drains along all batter slopes to promote drainage from the rail infrastructure corridor to existing surface water infrastructure.
4. Table drains along up-gradient batters to divert surface water away from the rail infrastructure to existing surface water infrastructure.
5. Site water management structures would be lined with low permeability materials to minimise infiltration.
6. The design marries to the existing surface profile to allow consistency with future capping of surrounding areas.

An infiltration drainage layer with an effective permeability not less than 1×10^{-5} m/s and a revegetation layer would be placed across the capping layer as part of Project closure and rehabilitation works.

A description of how the Project rail infrastructure corridor would meet the environmental goals of Benchmark technique 28 is provided in the following sub-sections.



Notes:

* *Lining/armouring of drain alignments as required.*

\# *An Infiltration Drainage Layer and Revegetation Layer would be placed across the Capping Layer as part of Project closure and rehabilitation works.*

Source: NCIG (2006); Connell Hatch (2006); RCA Australia (2006)

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FIGURE 4-16

Conceptual Typical Cross Section of the Rail Infrastructure Corridor

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Prevent the Pollution of Water by Leachate

The pollution of water from leachate can potentially occur from contaminant migration in groundwaters resulting from surface water infiltration into the fill materials and/or from the placement of fill associated with the construction of the rail embankment resulting in the consolidation of underlying soft clay materials and the associated expulsion of pore waters. Further, the use of wick drains to accelerate the consolidation process has the potential to connect underlying aquifers and result in localised increases in groundwater movement (Appendix D).

The effect of the wick drains would be expected to be short in duration and the wick drains would eventually collapse or block with sediment (Appendix D).

The proposed capping strategy acts to minimise surface water infiltration by constructing a low permeability capping layer, installing a drainage system to promote surface water runoff and the lining of table drains.

The capping layer would be engineered to have an effective permeability of 1 x 10^{-8} m/s. To minimise the potential for localised failure of the capping layer due to differential settlement, where practicable it would be constructed after preloading is complete. Alternatively a geo-synthetic reinforcement layer would be placed under areas of significant fill to protect its integrity.

Visual inspections of the capping layer would be conducted immediately after construction and during operations. Failed capping would be removed and replaced.

Table drains would be installed along the batter slopes (1V:3H) of the rail infrastructure corridor to promote drainage. Table drains would be located on up-gradient batters to divert surface water runoff away from the rail infrastructure area. The table drains would be protected to minimise erosion and would be lined with low permeability materials to minimise infiltration. The table drains would discharge to small on-site stormwater settlement ponds prior to release into the existing site surface water system.

Prevent Landfill Gas Emissions

As described in Section 4.7.1, fill types placed within the KIWEF comprised byproducts from the former BHP steelworks site and are typically inert, non-biodegradable materials and did not include the placement of putrescible or gas generating waste (Appendix D). As such, it is considered that a gas drainage layer is not necessary at the KIWEF to control landfill gas emissions. In any case, it is considered that a gas drainage layer along the thin section of the rail corridor through the greater KIWEF site would be ineffectual (Appendix D).

Assuring Quality of Design, Construction and Operation

The capping layer for the rail infrastructure corridor would be constructed by suitably qualified contractors. Validation testing would be conducted post construction to validate that design specifications have been achieved.

Minimise Landfill Space Used

The rail infrastructure corridor lies on completed cells for the majority of its length. Therefore the amount of land fill space used (lost) would be minimised (Appendix D).

Prevent Degradation of Local Amenity

Degradation of the local amenity can potentially occur from uncontrolled waste materials, dust, odours, sedimentation and contamination of waters.

The proposed capping layer provides for the effective management of waste materials by covering them.

No odours are likely to be generated from the site due to the fill types present which have low potential for gas generation.

Dust controls are discussed in Section 4.4.3 and would include an AQMP.

Surface and groundwater controls are discussed in Section 4.6.3 and below, respectively.

In addition, a NMP (Section 4.3.3) and a SWGMP (Section 4.6.3) would be developed as part of the Project.

Adequate Staffing and Training

Adequate staffing and relevant training would be implemented for the construction and operation of the Project. The Project would not limit RLMC's ability to provide adequate staff and training for its management of the overall KIWEF.

Benchmark Technique 29

The EARs issued by the DoP (Section 1.2) require the capping layer for the rail infrastructure corridor to meet Benchmark technique 29 of the EPA (1996) *Environmental Guidelines: Solid Waste Landfills*.

The environmental goals of Benchmark technique 29 are performance based and include some of the same goals as in Benchmark technique 28 (addressed above). Additional environmental goals included in Benchmark technique 29 are:

- detect water pollution;
- detect landfill gas emissions;
- prevent unauthorised entry; and
- prevent noise pollution.

The capping strategy described above would not prevent RLMC from meeting these goals.

In addition, the Project would include an AQMP (Section 4.4.3), NMP (Section 4.3.3) and a SWGMP (below) which would assist in meeting the goals of Benchmark technique 29.

Other Management Measures

In addition to the existing sources of potential contamination at the Project (described in Section 4.7.1), other potential sources of contamination would develop as a result of the Project. Section 4.14 summarises the results of the PHA conducted for the Project (Appendix I) and identifies sources of potential risk to the environment, including additional sources of land contamination. Potential land contamination risks have been identified as including criminal activity, spills, fires or explosions associated with the transport, storage and usage of fuels and chemicals.

Measures to reduce the potential for the additional contamination of land from fuel and chemicals include the following:

- Contractors carrying dangerous goods loads would be appropriately licensed in accordance with the provisions of the ADG Code (DTRS, 2000). Contractors would operate under the provisions of NCIG contractor management plans so that their safety standards and work procedures meet statutory requirements.
- Carriers of dangerous goods would maintain a communication system (e.g. two-way radio or mobile telephone) in truck cabs to allow for prompt notification in the event of an accident. Trucks would carry fire fighting equipment.
- On-site consumable storage areas would be designed with appropriate bunding and would be operated, where applicable, in compliance with the requirements of AS 1940-2004 *The Storage and Handling of Flammable and Combustible Liquids*. Storage areas would be regularly inspected and maintained as required.
- Project rail infrastructure and signalling would be designed in accordance with the relevant rail authority standards. Project train loading activities and rail infrastructure would be regularly inspected and maintained as required. Rail transport contractors would also operate under the provisions of NCIG contractor management plans.
- Site security and fencing of the Project site.

Soils and Excavation Management Plan

A SEMP would be developed for the Project detailing methods for the management of potentially contaminated soils and water. The SEMP would be prepared prior to the development of the Project and would incorporate the outcomes of geotechnical and geochemical investigations undertaken as part of the detailed design of the Project.

The performance of the mitigation and management measures would be monitored by the SWGMP. Additional controls would be developed and implemented if the monitoring suggests the need.

Surface Water and Groundwater Monitoring Programme

A SWGMP would be developed for the Project as part of the water management system and would be detailed in the SWMP and would include:

- monthly sampling at a network of surface water and groundwater quality monitoring sites;
- analysis of groundwater samples for a range of parameters including, but not necessarily limited to groundwater level, pH, EC, total dissolved solids, total suspended solids, Total PAH and a suite of metals;
- data review procedures for analysing surface water and groundwater quality results; and
- investigation triggers and contingencies for managing potential adverse impacts of the Project on surface water and groundwater quality.

The detailed design of the SWGMP would consider the proposed groundwater controls described in this section and the results of the detailed geotechnical and geochemical investigation undertaken as part of the detailed design of the Project.

4.8 FLORA

A Flora Assessment was prepared for the Project in association with (i.e. co-authored by) Professor David Goldney and is presented in Appendix E. The Flora Assessment was prepared in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

4.8.1 Existing Environment

Methodology

The existing environment in the Project site and surrounds relevant to flora was determined by a literature review of previous studies in the Project site and surrounds, targeted field surveys and database searches as described below.

Literature Review

There are numerous previous vegetation studies and flora assessments which have been undertaken in the Project site and surrounds. The literature review which was undertaken as part of the Project Flora Assessment included review of relevant reports (e.g. EISs, reports prepared for government departments and scientific literature).

The flora assessments conducted for the *Big Pond Habitat Offset Scheme Flora and Fauna Studies* (BPHOS Report) (Department of Commerce, 2005), the *Protech Steel Proposed Cold Mill Facility EIS* (Protech Steel, 2001) and the *Terrestrial Ecology Impact Assessment Report* (Umwelt, 2003b) included relevant portions of the NCIG Project site. The vegetation communities and flora species identified by these reports are considered in the Flora Assessment (Appendix E).

Other relevant reports were reviewed to determine whether any of the flora species recorded in them were identified as threatened species, populations or Endangered Ecological Communities (EECs) as listed under the NSW *Threatened Species Conservation Act, 1995* (TSC Act) and/or threatened species or EECs as listed under the Commonwealth EPBC Act (Appendix E).

Field Surveys

Field surveys for the Project were conducted by Connell-Hatch during the summer of 2005/2006 to augment earlier studies undertaken by Protech Steel (2001) and Umwelt (2003) and included a vegetation survey and targeted searches for *Zannichellia palustris* (a submerged aquatic plant listed as Endangered under the TSC Act) (Connell-Hatch, 2006a and 2006b). The vegetation survey was used to identify, describe and map vegetation communities present in the Project site, to identify flora species occurring in the Project site and to determine the presence or likelihood of threatened flora species and/or Endangered Ecological Communities (EECs) occurring within the Project site (Connell-Hatch, 2006a).

Field surveys targeting *Zannichellia palustris* were undertaken to identify suitable habitat for this species within the Project site and to identify the presence or absence of this species (Connell-Hatch, 2006b). Further detail of the methodology used for the field surveys is presented in Appendix E.

Database Searches

Database searches for the Project site and surrounds were undertaken using the following databases:

- The Department of Environment and Conservation (DEC, 2006) Atlas of NSW Wildlife (Newcastle [9232], Port Stephens [9332] and Lake Macquarie [9231] 1:100,000 map sheets).
- The Sydney Royal Botanic Gardens (2006) (using a search area of approximately 400 km^2 surrounding the Project site).

The searches were used to determine whether any previously recorded flora in the Project site and surrounds are threatened species or populations as listed under the TSC Act and/or EPBC Act. A list of the threatened flora species identified by the database searches is provided in Appendix E.

Project Setting

The Project site lies in the North Coast Botanical Division (Anderson, 1968; Harden, 1990). The Project site is situated in the far north-eastern corner of the Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion (DEH, 2005) and is also close to the NSW North Coast Bioregion (located immediately to the north) (Figure 4-13). Due to its close proximity, the Project site is also likely to be influenced by the environmental characteristics of the NSW North Coast Bioregion.

The nearby Hunter Estuary Wetlands comprise the Kooragang and Hexham Swamp Nature Reserves, Shortland Wetlands (Figure 4-13) and the SEPP 14 listed wetlands associated with the lower Hunter River Estuary. The statements of significance for the listing of the Hunter Estuary Wetlands on the Register of the National Estate include recognition of their international significance as waterbird habitat (DEH, 2006). The Hunter Estuary Wetlands are also listed as a Wetland of International Importance under the Ramsar Convention (2006).

The Project site is situated approximately 1 km to the south of the Kooragang Nature Reserve (which is approximately 2,900 ha in area [NPWS, 1998]) and approximately 2.5 km to the east of Hexham Swamp Nature Reserve (which is approximately 900 ha in area [NPWS, 1998]) (Figure 4-13).

Kooragang Nature Reserve is largely an estuarine wetland with areas that have been modified for farmland (NPWS, 1998). Kooragang Nature Reserve supports mangrove forests, saltmarsh, saline and freshwater pastures, swamp forests and rainforests (*ibid*.).

Hexham Swamp Nature Reserve is predominantly a freshwater swamp but contains estuarine habitat in its north-eastern corner, adjacent to the Hunter River (NPWS, 1998). The vegetation of Hexham Swamp includes saltmarsh and mangroves, reed community, freshwater meadows and seasonal freshwater swamps and freshwater grassy swamps (*ibid*.).

Vegetation Communities in the Project Site

The wetland habitat types in the Project site vary from semi-natural to highly disturbed (Connell-Hatch, 2006a). The Project site includes ephemeral and semi-permanent wetlands which are subject to seasonal changes in vegetation and water levels. The three main wetland types identified in the Project site are (Connell-Hatch, 2006a):

- ephemeral freshwater wetlands dominated by Common Reed (*Phragmites australis*) and Cumbungi (*Typha orientalis*);
- ephemeral sedge swamps dominated by Marsh Clubrush (*Bulboschoenus fluvitalis*); and
- estuarine wetlands dominated by Samphire (*Sarcocornia quinqueflora*) and Sand Couch (*Sporobolus virginicus*).

Terrestrial habitat is also present in the Project site and is characterised by dense grassland (dominated by landscape and pasture species) and landscape plantings (Connell-Hatch, 2006a). The majority of the KIWEF site (i.e. including the Project rail infrastructure corridor) is dominated by introduced grasses and herbaceous weeds (*ibid.*).

The Project wharf facilities and shiploader area (i.e. the banks of the south arm of the Hunter River) consists of modified grassland and plantings of native species (Umwelt, 2003b). There are several scattered juvenile mangrove trees along the shoreline in this area (Umwelt, 2003b).

Any disturbance of mangroves in this area would be completed as part of the dredging activities. This dredging is authorised for the purposes of the EP&A Act by the Port Consent (Section 3.6.1).

Flora Species Composition

Very few native flora species were recorded in the Project site as part of the flora surveys for the Project apart from native aquatic vegetation and landscape (amenity) plantings (Connell-Hatch, 2006a). A total of 96 plant taxa were recorded by the vegetation survey and of these, 42 were native and 54 were exotic species (Connell-Hatch, 2006a).

An additional 102 flora species have been recorded in the Project site and surrounds by previous studies, of which over half were exotic (Department of Commerce, 2005; Protech Steel, 2001; URS, 2000c in Protech Steel, 2001) (Appendix E).

Landscape plantings are dominated by Swamp Paperbark (*Melaleuca ericifolia*), eucalypts, Sickle Wattle (*Acacia falcata*), Coastal Wattle (*Acacia longifolia* var. *sophorae*), and Green Wattle (*Acacia irrorata*) (Connell-Hatch, 2006a).

A list of the plant species recorded in the Project site is provided in Appendix E.

Threatened Flora Species

The only threatened flora species listed under the TSC Act and/or EPBC Act recorded in the Project site was *Zannichellia palustris* which has been identified in Ponds A and H, I and L (RLMC, 2003; Connell-Hatch, 2006b) (Figure 4-17). Of these ponds, only Pond H is within the Project disturbance area and would be partially disturbed by the Project.

A database search using the Atlas of NSW Wildlife (DEC, 2006) indicated that *Zannichellia palustris* has been recorded at two locations in the region (i.e. the Newcastle 1:100,000 map sheet), the closest of which was located approximately 2 km north-west of the Project site. *Zannichellia palustris* has been found in brackish ponds on Kooragang Island and in Ironbark Creek (Winning, 1996).

No other threatened flora species listed under the TSC Act or EPBC Act was recorded by previous studies in the Project site or surrounds (e.g. Winning, 1991; Protech Steel; 2001; Umwelt, 2003b; RLMC, 2003; Department of Commerce, 2005).

Endangered Ecological Communities

Within the Project site, the following two EECs have been identified:

- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC (Freshwater Wetlands on Coastal Floodplains EEC) (Connell-Hatch, 2006a, Department of Commerce, 2005).
- Coastal Saltmarsh in NSW North Coast, Sydney Basin and South East Corner Bioregions EEC (Coastal Saltmarsh EEC) (Connell-Hatch, 2006a).

Rare Flora

Zannichellia palustris, which has been recorded in the Project site (Connell-Hatch, 2006b; RLMC, 2003), is recognised as rare nationally (Briggs and Leigh, 1996).

Introduced Flora Species and Noxious Weeds

Most of the terrestrial areas within the area of the Project rail infrastructure corridor and surrounds are dominated by herbaceous weeds and introduced grasses including noxious weeds such as Bitou Bush and Pampas Grass. Seven noxious weeds listed by NCC were recorded in the Project site and surrounds by the vegetation survey, namely, Crofton Weed (*Ageratina adenophora*), Burr Ragweed (*Ambrosia confertifolia*), Bitou Bush (*Chrysanthemoides monilifera* ssp. *rotunda*), Boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*), Pampas Grass (*Cortaderia selloana*), Lantana (*Lantana camara*) and Yellow Wood Sorrel (*Oxalis corniculata*) (Connell-Hatch, 2006a).

The following additional noxious weeds listed by NCC were recorded in the Project site and surrounds by previous studies (URS, 2000c; Protech Steel, 2001; Department of Commerce, 2005), *viz.* Ragweed (*Ambrosia artemisiifolia*), Mossman River Grass (*Cenchrus echinatus*), African Boxthorn (*Ligustrum sinense*), Prickly Pear (*Opuntia stricta*), *Oxalis perennans* and Noogorra Burr (*Xanthium* sp.).

4.8.2 Potential Impacts

Detailed evaluations were conducted to determine the likelihood of the Project having a significant effect on *Zannichellia palustris,* Freshwater Wetlands on Coastal Floodplains EEC and Coastal Saltmarsh EEC. These evaluations were based on the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). These evaluations are documented in full in Appendix E.

Based on the evaluations, it is considered that the Project is unlikely to have a significant effect on threatened species or EECs. Therefore, the impact of the Project on threatened flora and EECs is not considered to be significant from a local or regional perspective.

Source: NCIG (2006); Connell Hatch (2006)

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FIGURE 4-17
Project Site and Ponds

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Presented below is an assessment of the potential impacts of the Project on flora. In considering these potential impacts, it is relevant to note the condition and context of the Project site.

- The Project site is situated on land zoned Zone 4(b) (Port and Industry), 5(a) (Special Uses Zone - Arterial Road) and an unzoned area (Hunter River) under the Newcastle LEP. The Kooragang Nature Reserve located approximately 1 km to the north of the Project site provides protected habitat for threatened flora, as it is on land zoned 8(a) (National Parks) by the Newcastle LEP.
- The Project rail infrastructure would be constructed on land which is part of the KIWEF which is owned by the RLMC. The KIWEF is licensed as a Solid Waste Class 2 landfill under EPL 6437, issued under the POEO Act.
- The ecosystem in the Project site can be considered to be dynamic as the landuse history of the site is such that much of the original vegetation has been covered by fill. Embankments, excavations and changed hydrological conditions have created the conditions for wetlands and marshes of varying conservation values.

Overall the ecosystem processes operating in the Project site are considered to be sub-optimal. However, the Project site provides habitat for a threatened flora species and two EECs.

Potential impacts of the Project on flora have been assessed in terms of threatening processes as follows.

Clearing of Native Vegetation - Vegetation Clearance is classified as a Key Threatening Process under the TSC Act. Alteration of habitat can result in direct loss of habitat as well as isolation of habitat through creation of barriers to movement between populations. There is considerable information about the value of vegetation corridors to flora and fauna in Australia (Saunders and Hobbs, 1991).

A corridor has been defined as a "*linear two-dimensional landscape element that connects two or more patches of wildlife habitat that have been connected in historical time*" (Soule and Gilpin, 1991). Vegetation clearance associated with the Project has the potential to fragment vegetation remnants and impact on the continuity of corridors.

The majority of vegetation clearance would occur within the Big Pond area as part of the construction of the Project coal storage area. Approximately 3 ha of Coastal Saltmarsh EEC and approximately 50 ha of Freshwater Wetlands on Coastal Floodplains EEC would be directly disturbed by the Project. Significant areas of these two EECs in the Project site and surrounds would not be directly disturbed by the Project (Appendix E).

Alteration to the Natural Flow Regimes of Rivers, Streams, Floodplains and Wetlands - Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is also listed as a Key Threatening Process under the TSC Act. However, the Project site and immediate surrounds is now a highly modified floodplain (i.e. would not be described as a natural flow regime) with a series of contrived and more or less artificial wetlands with limited connectivity with surrounding wetland areas.

Big Pond would be directly in-filled as a result of the Project. Smaller waterbodies within the Project site would be disturbed during construction of the rail infrastructure corridor. In addition, the southern area of Deep Pond would be traversed by the Project northern rail spur should it be required when the Project is fully developed to 66 Mtpa. The potential for the Project to alter the existing flow regime in the area of the Project rail infrastructure corridor (i.e. across the KIWEF site) would be minimised by the installation of culverts under the rail embankments at low points in the existing topography. Culverts would allow surface waters to continue to flow across the site in a similar manner to the existing condition.

Coal Dust – Emissions associated operation of the Project would be primarily derived from coal dust emissions from transfer points, stacking/reclaiming, loading/unloading and wind blown emissions (particularly from the surfaces of coal stockpiles) (Appendix B).

Studies have shown that excessive dust generation can impact on the health and viability of surrounding vegetation. Dust can affect vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and allow penetration of phytotoxic gaseous pollutants (Farmer, 1993; Eller, 1977).

As described in Section 4.4.3 and Appendix B, to meet stringent air quality assessment criteria, comprehensive air quality emission controls have been incorporated in the Project design and would be implemented as part of the Project development. The air quality assessment criteria are based on relevant human amenity and health criteria (Appendix B). As described in Section 4.4.3, all relevant air quality assessment criteria are predicted to be met by the Project. Based on this, the effect of Project dust on the health and viability of surrounding vegetation is expected to be minimal.

4.8.3 Mitigation Measures and Management

Although the Project will avoid or minimise direct impacts on threatened species, EECs and associated habitats wherever possible, several measures have been developed to mitigate unavoidable impacts of the Project on flora including a Flora and Fauna Management Plan (FFMP) as described below.

Flora and Fauna Management Plan

The FFMP would be prepared prior to Project construction and would include management measures to be undertaken during construction and operation, including a Vegetation Clearance Protocol (VCP), weed control and landscape plantings. The main components to be included in the FFMP with regards to flora are described below.

During construction, vegetation (including the Freshwater Wetlands on Coastal Floodplains EEC and the Coastal Saltmarsh EEC) immediately adjoining Project disturbance areas would be delineated and clearly marked to minimise the potential for accidental damage during construction.

A Weed Management Programme would be implemented to limit the spread and colonisation of weeds in the Project site during construction and operations.

Landscape (amenity) plantings would be established on available areas of land between the coal storage area and Cormorant Road (Figure 4-10). These landscape plantings would comprise locally indigenous species in order to provide some potential habitat for local fauna.

As previously discussed, dust controls would be employed, including watering of potential dust generating surfaces to minimise dust emissions from the Project.

The potential for a change in the frequency of fires due to the Project would be reduced through the use of water sprays and prudent stockpile management. A 2 ML fire services tank would also be installed for emergency fire fighting situations. An Emergency Response Plan (ERP) and Spontaneous Combustion Management Plan would be prepared for the Project and would describe hazard (i.e. fire) preventative and mitigation measures (Section 5).

The Project would include several measures to minimise disturbance to the marine environment in the south arm of the Hunter River including the water management strategies described in Section 2 of the Project EA. The primary design goal of the Project water management system is that of no discharge to the Hunter River during operation of the Project. Temporary erosion and sediment controls (e.g. silt fences and sediment control structures) would be installed prior to the commencement of construction activities. A silt curtain would be used during construction of the shipping berth batters, wharf structure and during piling operations.

4.8.4 Compensatory Measures and Other Ecological Initiatives

Comprehensive compensatory measures and other ecological initiatives for flora and fauna have been developed for the Project and are presented in Sections 4.9.4 and 4.9.5.

4.9 FAUNA

A Fauna Assessment was prepared for the Project in association with (i.e. co-authored by) Professor David Goldney and is presented in Appendix F. The Fauna Assessment was prepared in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

4.9.1 Existing Environment

Methodology

The existing environment in the Project site and surrounds relevant to fauna was determined by a literature review of previous studies in the Project site and surrounds, targeted field surveys and database searches as described below.

Literature Review

Numerous fauna studies have been undertaken within the Project site and surrounds in the past. A literature review was undertaken as part of the Fauna Assessment and included review of relevant reports (e.g. EISs, reports prepared for government departments and scientific literature) (Appendix F).

The fauna assessments conducted for the BPHOS Report (Department of Commerce, 2005), the *Proposed Cold Mill Facility Kooragang Island EIS* (Protech Steel, 2001), the *Kooragang Port and Transport Corridor SIS* (RLMC, 2003), and the *Terrestrial Ecology Impact Assessment Report* (Umwelt, 2003b) for the Port Consent EIS included relevant portions of the Project site. All fauna species identified by these reports were considered for the Fauna Assessment (Appendix F).

Other relevant reports were reviewed to determine whether any of the fauna species recorded by them were identified as threatened under the EPBC Act and/or threatened species or populations as listed under the TSC Act. This included A. Hamer's Masters and PhD theses and P. Straw's wader habitat investigations which included areas located within the Project site (Hamer, 1998, 2002; Straw, 1999, 2000) and the PWCS (1996) and Cargill (2005) fauna assessments which considered areas on Kooragang Island proximal to the Project site (Appendix F).

Field Surveys

Targeted fauna surveys for the Green and Golden Bell Frog (*Litoria aurea*) and the Australasian Bittern (*Botaurus poiciloptilus*) were undertaken for the Project by Connell-Hatch in summer 2005-2006 (Connell-Hatch, 2006c and 2006d) (Appendix F). A Shorebird Study and Habitat Assessment for the Project was conducted in summer 2005-2006 by Avifauna Research and Services (Avifauna Research and Services, 2006).

The targeted surveys for the Green and Golden Bell Frog included assessing the suitability of waterbodies present in the Project site and surrounds (Figure 4-17) as habitat for the Green and Golden Bell Frog and identifying the presence or absence of the Green and Golden Bell Frog at each of these waterbodies (*ibid*.).

The targeted surveys for the Australasian Bittern included assessing the suitability of the Project site as habitat and identifying the presence or absence of the species in the Project site (Connell-Hatch, 2006d).

The Shorebird Study and Habitat Assessment included survey of shorebirds and their habitat in wetland sites within the Project site and surrounds, including Big Pond and Deep Pond (Avifauna Research and Services, 2006).

Further detail of the methodology used for each of the surveys is provided in Appendix F.

Database Searches

Fauna previously recorded in the Project site and surrounds were determined using the following database searches:

- Department of Conservation (DEC) (2006) Atlas of NSW Wildlife (Newcastle [9232], Port Stephens [9332] and Lake Macquarie [9231] 1:100,000 map sheets);
- Birds Australia (2006);
- Hunter Bird Observers Club (HBOC) (2006); and
- Australian Museum (2006).

The Birds Australia and Australian Museum databases were searched using a search area of approximately 400 km^2 surrounding the Project site. The HBOC databases searched were Ash Island, Big Pond, Deep Pond, Fullerton Cove, Kooragang Nature Reserve, Long Pond and Stockton Sand Spit.

These searches were used to determine whether any previously recorded fauna in the Project site and surrounds were listed as species of conservation significance (including migratory and marine protected species) under the EPBC Act and/or threatened species or populations as listed under the TSC Act. The results of these database searches were incorporated into the Fauna Assessment (Appendix F).

Habitat Resources

The landuse history of the site has meant that much of the original vegetation has been covered with fill and, subsequently, the habitat resources of the Project site are limited (Appendix F). However, habitat for the Green and Golden Bell Frog, the Australasian Bittern and shorebirds was identified during the Project surveys (Connell-Hatch, 2006c and 2006d; Avifauna Research and Services, 2006). For example, embankments, excavations and changed hydrological conditions associated with the KIWEF have created conditions suitable for the Green and Golden Bell Frog.

The grassland within the Project site and surrounds offers foraging opportunities for raptor species (Connell-Hatch, 2006a). However, the Project site does not contain suitable habitat for arboreal fauna as there are no hollow-bearing trees and connectivity with forested habitat in the surrounding area is lacking (*ibid*.).

Fauna Species Composition

Several threatened fauna species were identified in the Project site by the surveys conducted by Connell-Hatch (2006c and 2006d) and the Shorebird Study and Habitat Assessment (Avifauna Research and Services, 2006). These are discussed further below.

Previous fauna studies conducted in the industrial area of Kooragang Island have found few native mammals (e.g. Protech Steel, 2001; Cargill, 2005; Department of Commerce, 2005). For example, the fauna observed in the Big Pond during field surveys conducted for the BPHOS Report were restricted to common birds and feral mammals (Department of Commerce, 2005).

A list of fauna species recorded within the Project site and immediate surrounds by previous studies (*viz*. Protech Steel [2001], Department of Commerce [2005], RLMC [2003] and Umwelt [2003b]) is provided in Appendix F.

The most diverse group of species recorded by Protech Steel (2001) were birds (27 species observed). These were mainly birds that forage on herbaceous material, seeds, small invertebrates and vertebrates found within grassland (Protech Steel, 2001). Four species of frog were recorded, all from reed beds (Protech Steel, 2001). Protech Steel (2001) attributed the low diversity of vertebrates recorded in the area to the disturbed nature of the site, lack of refuge sites and poor vegetation structure.

Threatened Fauna Species

Table 4-29 provides a list of threatened fauna species recorded within the Project site, including the Green and Golden Bell Frog, Black-tailed Godwit, Blue-billed Duck, Freckled Duck and Australasian Bittern. The location of records of the Green and Golden Bell Frog in the vicinity of the Project are shown on Figure 4-18.

No threatened fauna listed under the TSC or EPBC Acts were observed during the field surveys conducted for the BPHOS Report (Department of Commerce, 2005) or by Protech Steel (2001). Similarly, no threatened species under the TSC Act, EPBC Act or *Fisheries Management Act, 1994* were recorded by the Aquatic Ecology Impact Assessment Report for the Port Consent EIS. Although, several Grey-headed Flying Fox (*Pteropus poliocephalus*) were observed flying high over the area near the Project wharf facilities (Umwelt, 2003b), this species was not observed using the Project site as habitat.

The Eastern Bent-wing Bat (*Miniopterus schreibersii*), a threatened species listed under the TSC Act, was recorded near ponds in the adjoining PWCS Kooragang Coal Terminal (PWCS, 1996). In addition, the HBOC recorded the Red-backed Button-quail west of the Delta access road near the Project rail infrastructure corridor on 2 February 2006.

Migratory Species

There were 81 migratory species recorded within the Project site and surrounds. Appendix F presents the migratory species listed under the EPBC Act that have been recorded within the Project site and surrounds by the following sources: Project surveys (Avifauna Research, 2006), Atlas of NSW Wildlife (DEC, 2006), the HBOC (2006), Australian Museum (2006) and Birds Australia (2006).

Forty-five migratory species presently listed under the Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA) and/or the Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) have been recorded in the Hunter Estuary Wetlands (DEH, 2006).

Marine Protected Species

There were 165 marine protected species recorded within the Project site and surrounds. Appendix F presents the marine protected species listed under the EPBC Act that have been recorded within the Project site and surrounds by the following sources: Project surveys (Avifauna Research, 2006), Atlas of NSW Wildlife (DEC, 2006), HBOC (2006), Australian Museum (2006) and Birds Australia (2006).

Table 4-29
Threatened Fauna Recorded within the Project Site

Common Name	Scientific Name	Conservation Status		Location[3]	Reference
		TSC Act[1]	EPBC Act[2]		
Green and Golden Bell Frog	*Litoria aurea*	E	V	Various	RLMC (2003)
					PWCS (1996)
					Hamer (1997, 1998 and 2002)
					Premier's Department (2003)
Black-tailed Godwit	*Limosa limosa*	V	-	Deep Pond	Avifauna Research and Services (2006)
Blue-billed Duck	*Oxyura australis*	V	-	Pond H	Avifauna Research and Services (2006)
				Pond H, Deep Pond	HBOC (Section 3.7.2)
Freckled Duck	*Stictonetta naevosa*	V	-	Deep Pond	Avifauna Research and Services (2006)
				Deep Pond and Ash Island	RLMC (2003)
Australasian Bittern	*Botaurus poiciloptilus*	V	-	Proximal to Project rail infrastructure corridor	RLMC (2003)
				Western end of Pond A	Connell-Hatch (2006b)
				North-west of Pond I near the Delta access road	HBOC (Section 3.7.2)

1 NSW *Threatened Species Conservation Act, 1995*
2 Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*
3 Refer to Figure 4-17.
V Listed as Vulnerable
E Listed as Endangered

Fauna of the Nearby Hunter Estuary Wetlands

The Hunter Estuary Wetlands are listed as a Wetland of International Importance under the Ramsar Convention (Section 4.9.1). In addition to the Ramsar Convention, the management of Kooragang and Hexham Swamp Nature Reserves are also subject to the JAMBA and CAMBA international agreements ratified by the Australian Government (NPWS, 1998).

In addition, the statements of significance for the listing of the Hunter Estuary Wetlands on the Register of the National Estate include recognition of their international significance as waterbird habitat (DEH, 2006). Forty-five migratory species presently listed under the JAMBA and/or the CAMBA have been recorded in the Hunter Estuary Wetlands (*ibid*.).

Migratory shorebirds use geographical routes called 'flyways' (i.e. broad corridors) for migrating. Australia is near the southern end of the East Asian–Australasian Flyway which stretches from the breeding grounds of Siberia and Alaska, southwards through Asia, to the non-breeding grounds of Australia and New Zealand (DEH, 2005b). The Kooragang Nature Reserve is within the East Asian–Australasian Flyway.

The DEC Atlas of NSW Wildlife online database (DEC, 2006) indicates that 141 fauna species have been recorded in Kooragang Nature Reserve including seven amphibians, 127 birds and seven mammals.

Some 17 threatened species listed under the TSC Act that have been recorded in Kooragang Nature Reserve including the Green and Golden Bell Frog, Square-tailed Kite, Freckled Duck, Australasian Bittern, Black Bittern, Greater Sand Plover, Lesser Sand Plover, Pied Oystercatcher, Comb-crested Jacana, Little Tern, Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Terek Sandpiper, Powerful Owl, Grey-headed Flying-fox and Eastern Bentwing-bat. Of these threatened species, the Green and Golden Bell Frog and Little Tern are Endangered under the TSC Act while the remainder are listed as threatened.

4.9.2 Potential Impacts

Detailed evaluations were conducted to determine the likelihood of the Project having a significant effect on threatened and migratory fauna species (Appendix F). These evaluations were based on the Draft *Guidelines for Threatened Species Assessment* (DEC and DPI, 2005).

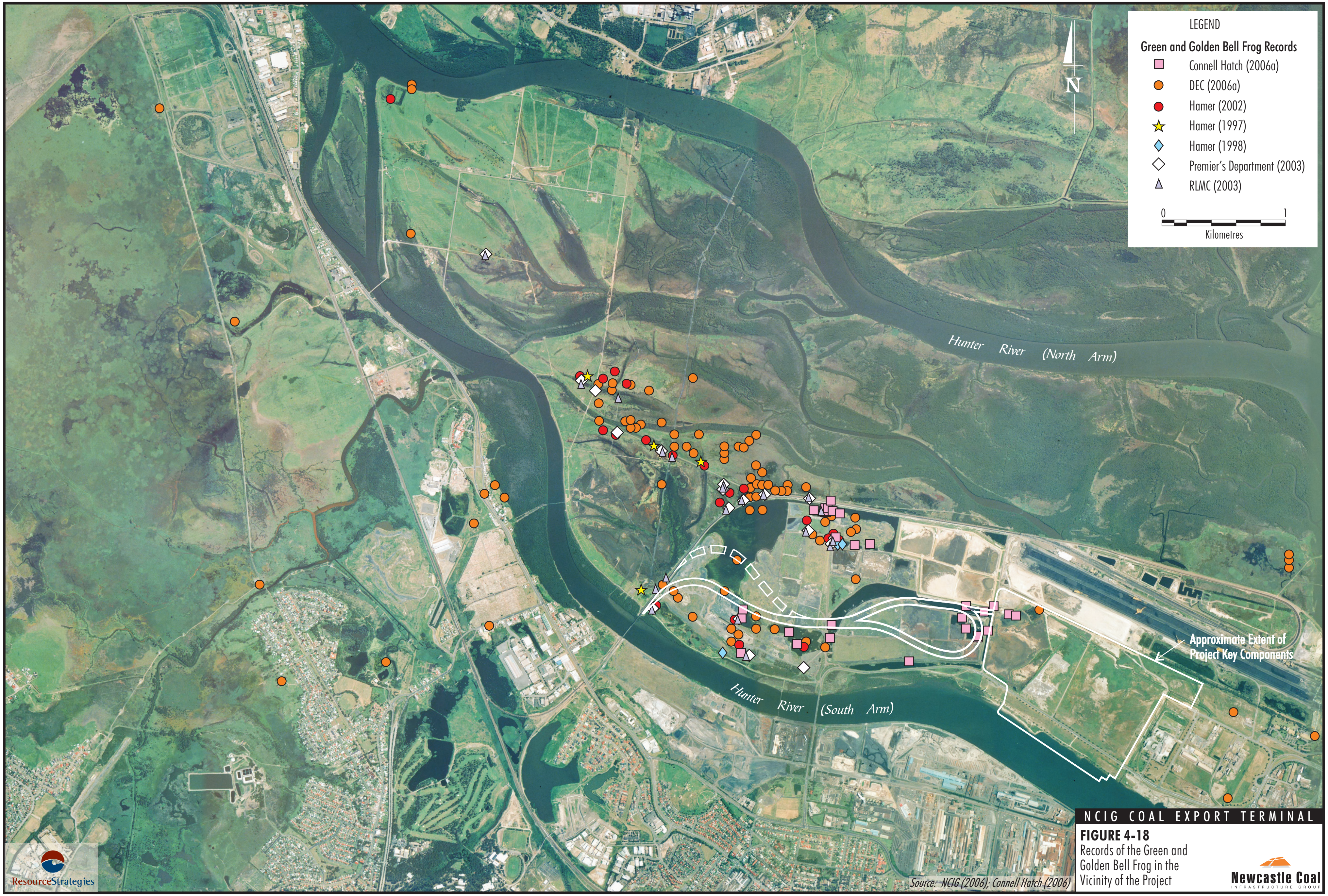


FIGURE 4-18
Records of the Green and Golden Bell Frog in the Vicinity of the Project

NCIG-05-01 Sect4_020D

Individual evaluations were conducted for each of the threatened fauna species previously recorded within the Project site as well as for other threatened species specified by the Project EARs (*viz*., Painted Snipe [*Rostratula benghalensis*], Masked Owl [*Tyto novaehollandiae*] and Beach Stone-curlew [*Esacus neglectus*]).

In addition, an individual evaluation was conducted for the Grass Owl (*Tyto capensis*) as the DEC informed NCIG that this species was recorded in the vicinity of the Project site (i.e. Kooragang Nature Reserve approximately 1 km to the north) earlier this year.

The Project EARs (Section 1.2) required all other threatened fauna species that have been recorded in the Kooragang or surrounding wetlands to be considered. Hence, included in the evaluations were threatened species listed under the TSC Act and/or EPBC Act that were recorded within 20 km of the Project site according to a search of the DEC Atlas of NSW Wildlife (DEC, 2006). These species were grouped according to broad habitat requirement similarities and evaluations were conducted for each group.

In addition, group evaluations were conducted for species listed as migratory under the EPBC Act that were recorded by the DEC Atlas of NSW Wildlife (DEC, 2006). These group evaluations were for migratory turtles and migratory birds. A broader search area was used for migratory species due to their greater mobility. An additional three migratory birds were considered in the evaluations as a result of consultation with the HBOC (*viz*., Grey-tailed Tattler [*Heteroscelus brevipes*], Wandering Tattler [*Heteroscelus incanus*] and Lesser Yellowlegs [*Tringa flavipes*]) (Section 3.7.2).

Based on the evaluations presented in Appendix F, it is considered that the Project is unlikely to have a significant effect on any threatened fauna listed under the TSC Act and EPBC Act or species which are listed as migratory under the EPBC Act. The impact of the Project on threatened fauna is not considered to be significant from a local or regional perspective.

Presented below is an assessment of the potential impacts of the Project on fauna. In considering these potential impacts, it is relevant to note the condition and context of the Project site.

- The Project site is situated on land zoned Zone 4(b) (Port and Industry), 5(a) (Special Uses Zone - Arterial Road) and an unzoned area (Hunter River) under the Newcastle LEP.
- The Kooragang Nature Reserve located approximately 1 km to the north of the Project site provides protected habitat for threatened fauna, as it is on land zoned 8(a) (National Parks) by the Newcastle LEP.
- The Project rail infrastructure would be constructed on land which is part of the KIWEF which is owned by the RLMC. The KIWEF is licensed as a Solid Waste Class 2 landfill under EPL 6437, issued under the POEO Act.
- The ecosystem in the Project site can be considered to be dynamic as the landuse history of the site is such that much of the original vegetation has been covered by fill. Embankments, excavations and changed hydrological conditions have created the conditions for wetlands and marshes of varying conservation values.

Overall the ecosystem processes operating in the Project site are considered to be sub-optimal. However, the Project site provides habitat for threatened fauna.

Potential impacts of the Project on fauna have been assessed in terms of threatening processes as follows:

Clearing of native vegetation – Clearing of native vegetation is classified as a Key Threatening Process under the TSC Act and can lead to destruction of habitat. Alteration of habitat can result in direct loss of habitat as well as isolation of habitat through creation of barriers to movement between populations. The Project is likely to reduce the available habitat for those species that use the Project site (Appendix F).

The landuse history of the Project site has meant that much of the original vegetation has been covered, or disturbed by, landfilling/reclamation activities. Notwithstanding, the Project site and surrounds provide (to varying degrees) opportunities for foraging, breeding, nesting, predator avoidance and movement between wetland areas for fauna, thus promoting genetic diversity and facilitating dispersal/migration. In areas, these opportunities would potentially be reduced as a result of habitat disturbance associated with the Project.

Isolation of habitat through creation of barriers is likely to have implications for the Green and Golden Bell Frog (NPWS, undated in DEC, 2005c). The Project rail infrastructure corridor has the potential to impede the movement/dispersal of the Green and Golden Bell Frog between the areas north and south of the Project rail infrastructure corridor (Figure 4-18). Records of the occurrence of the local population of this species indicate that it is predominantly located to the north of the Project rail infrastructure corridor, however it is also recorded on the southern side (Figure 4-18). However, the Green and Golden Bell Frog exhibits strong migration tendencies (including the ability to move several kilometres) and will traverse roads and other unfavourable surfaces to reach desired habitat (NPWS, undated in DEC, 2005c). It is reasonable to assume that unfavourable surfaces would include railway embankments. Further, as discussed in Section 4.9.3, mitigating features have been incorporated into the design of the relevant Project elements to minimise the potential for barrier effects to occur.

If required, the construction of the Project northern rail spur has the potential to impact on shorebirds which use the southern end of Deep Pond as known habitat would be disturbed during construction. The potential impact on shorebirds has been considered in the threatened species evaluations presented in Appendix F. Relevant mitigation measures to be implemented as part of the Project are described in Section 4.9.3.

Clearing of vegetation would also occur as part of the construction of the Project elements in the coal storage area. This includes the loss of habitat provided by the existing Big Pond. Where relevant, potential impacts associated with the loss of Big Pond are considered in the threatened species evaluations presented in Appendix F.

The loss of Big Pond was assessed in the BPHOS Report (Department of Commerce, 2005) and this is discussed further in Section 4.9.4.

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands – Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is also listed as a Key Threatening Process under the TSC Act. The destruction and alteration of wetlands is described as a threat by the *Draft Recovery Plan for the Green and Golden Bell Frog* (DEC, 2005c). Alteration to wetlands can also impact on shorebirds.

As discussed above, Big Pond would be infilled as part of the construction of the Project coal storage area. If required, the construction of the northern rail spur would involve the disturbance of shorebird habitat in the southern end of Deep Pond.

It should be noted that the existing flow regimes across the Project site are highly modified (i.e. not natural), however the potential for the Project to alter the existing flow regime in the area of the Project rail infrastructure corridor (i.e. across the KIWEF site) would be minimised by the installation of culverts under the rail embankments at low points in the existing topography (Section 4.9.3). Culverts would allow surface waters to continue to flow across the site in a similar manner to the existing condition.

Introduced Species – Potential exists for introduced fauna species to be attracted to the Project site through increased refuge and scavenging areas. These factors could increase the concentration of introduced fauna in and around the Project site. Predation by feral animals such as foxes is thought to be a threat to the Green and Golden Bell Frog (NPWS, undated in DEC, 2005c). Relevant mitigation measures are presented in Section 4.9.3 below.

Traffic Mortality – Traffic movements associated with the construction and operation of the Project have the potential to increase the incidence of mortality of fauna caused by traffic. Road mortality is listed as a Key Threatening Process listed under Schedule 3 of the TSC Act that may impact on the Green and Golden Bell Frog (NPWS, undated in DEC, 2005c).

Noise Emissions – The Project construction and operation would result in noise emissions. Project noise emissions are assessed in Appendix A. Noise emissions have the potential to disrupt the routine activities of fauna (e.g. shorebirds/Australasian Bittern). One of the noise sources would be trains using the Project rail infrastructure corridor which has the potential to impact on shorebirds which use the southern end of Deep Pond.

Numerous studies have been undertaken on the effects of noise on wildlife (e.g. Algers *et al.*, 1978 in Richard Heggie Associates, 1997; Allaire, 1978; Ames, 1978; Busnel, 1978; Lynch and Speake, 1978; Shaw, 1978; Streeter *et al.*, 1979; Poole, 1982 in Richard Heggie Associates, 1997). The studies generally indicate that many species are well adapted to human activities and habituate to noise.

It is relevant to note that the existing records of fauna across the Project site and surrounds coincide with the operation of the existing Kooragang Island mainline and the KIWEF. Notwithstanding this, to meet the stringent noise impact assessment criteria under the NSW INP (EPA, 2000), comprehensive noise mitigation and management measures would be implemented as part of the Project design. These controls on Project noise emissions have been designed to meet relevant human intrusive and amenity criteria and are described in Appendix A. It is considered that the impact of noise generated by the Project on the fauna of the Hunter Estuary Wetlands would be minimal.

Project Lights – The beams of light produced by the headlights of the trains using the Project rail infrastructure corridor have the potential to affect the behaviour of some fauna species, particularly birds, which may disturbed. This potential impact includes areas where the beams of light from the trains sweep across the surface of ponds and wetland areas. Other lights associated with the Project include overhead lighting of the coal storage area combined stacker/reclaimers, train unloading station and wharf facilities and shiploaders, and other mobile vehicle-mounted lights (e.g. work vehicles on-site). It is relevant to note that the existing records of fauna across the Project site and surrounds coincide with the operation of the existing Kooragang Island mainline and the KIWEF.

The Visual Assessment presented in Appendix H concluded that the potential impact of night lighting would be negligible given the presence of numerous light emitting sources in the local, sub-regional and regional settings. With the implementation of the Project lighting design considerations described in Section 4.9.3, it is considered that the potential impacts of Project lighting on fauna would be minimal.

Powerlines – No overhead powerlines would be installed at the Project site as part of the Project.

Fencing – The perimeter of the Project coal storage area and wharf facilities would each be fenced for security purposes. The Project rail corridor would also be fenced either side, including the inside of the rail loops. Fencing currently surrounds the area which would become the Project coal storage area. The fencing would be expected to have minimal impact on wildlife movement, however fauna management would be considered during the design and maintenance of security fencing. This may include flagging tape (or similar deterrent) being placed at regular locations along the top of fencing when in close proximity to ponds utilised by birds.

Fire – Coal stockpiles have the potential to self-heat, giving rise to smoldering fires (i.e. spontaneous combustion). In addition, accidental fires may occur (e.g. fires associated with the transport, storage and usage of fuels and chemicals). However, the frequency of fires would be reduced through the use of the Project controls described in Section 4.9.3. Therefore, it is considered unlikely that the Project would result in a significant change in the frequency of fires.

Dredging – The dredging of the south arm of the Hunter River is authorised for the purposes of the EP&A Act by the Port Consent (Section 3.6.1)

Potential Impacts on the Hunter Estuary Wetlands – It is considered that the Project would not significantly impact on the fauna of the Hunter Estuary Wetlands. As discussed above, although the Project would marginally increase the existing level of noise, which has the potential to disrupt the routine activities of shorebirds, it is considered that the impact of noise generated by the Project on the fauna of the Hunter Estuary Wetlands would be minimal. The Fauna Assessment (Appendix F) does not consider the potential impacts of dredging on the Hunter Estuary Wetlands as this activity is already approved.

4.9.3 Mitigation Measures, Management and Monitoring

Although the Project would avoid or minimise direct impacts on threatened species and associated habitats wherever possible, several measures have been developed to mitigate unavoidable impacts of the Project on fauna. These mitigation measures would be detailed in a FFMP as described below.

The FFMP would be prepared prior to Project construction and would include management measures to be undertaken during construction and operation, including a VCP, Threatened Species Management Protocol (TSMP), landscape plantings, pest management measures, on-site amphibian chytrid fungus management measures, rail culvert modification and fauna monitoring programmes. Further details regarding these management measures are provided below.

Vegetation Clearance Protocol

The FFMP would include a VCP to minimise the potential impacts of vegetation clearance on fauna. During construction, vegetation immediately adjoining the Project disturbance areas would be delineated and clearly marked to minimise the potential for accidental damage during construction.

The VCP would also include a pre-clearance survey, identification of fauna management strategies and specific procedures for vegetation clearance.

Threatened Species Management Protocol

A TSMP would be developed as a component of the FFMP to facilitate the implementation of threatened species management strategies to minimise potential impacts on threatened fauna species.

Green and Golden Bell Frogs found in the Project site during construction or operation would be removed from the direct disturbance area and placed in adjacent suitable habitat in accordance with the *Hygiene Protocol for the Control of Disease in Frogs* (NPWS, 2001) which recommends best-practice procedures for handling frogs and suggests strategies for minimising the potential of spreading amphibian chytrid fungus.

Landscape Plantings

Landscape (amenity) plantings would be established on available areas of land such as between the coal storage area and Cormorant Road (Figure 4-10). These landscape plantings would comprise locally indigenous species in order to provide some potential habitat for local native fauna.

Pest Management Measures

A clean, rubbish-free environment would be mandated to discourage scavenging and reduce the potential for further colonisation of the Project site by non-endemic fauna (e.g. introduced rodents and foxes).

Fox control strategies would be implemented because predation by foxes is a threat to the Green and Golden Bell Frog (NPWS, undated in DEC, 2005c), Freckled Duck (Smith *et al*., 1995) and the Australasian Bittern.

Amphibian Chytrid Fungus Management

Amphibian chytrid fungus is known to be already present on Kooragang Island (Section 3.7.2). However, management measures would be implemented to minimise the further spread of amphibian chytrid fungus, including potentially new strains of the fungus, into the Project site.

Project personnel would be trained in site hygiene management in accordance with the *Hygiene Protocol for the Control of Disease in Frogs* (NPWS, 2001) which recommends best-practice procedures for handling frogs and suggests strategies for minimising the potential of spreading amphibian chytrid fungus. This would include disinfecting tyres and wheels of vehicles brought into the Project site that have been exposed to mud and are to be used in areas in close proximity to potential frog habitat.

Mobile plant that is brought to the Project site during construction activities would be inspected prior to entering the site and would not be permitted to enter the site if it is not adequately clean (i.e. free of soil and/or organic matter).

Project personnel access to Green and Golden Bell Frog habitat located outside the Project disturbance area would be restricted to minimise any further spread of amphibian chytrid fungus.

Rail Culverts Suitable for Green and Golden Bell Frog Movements

The design of rail culverts would include relevant specifications to facilitate the migration/dispersal of the Green and Golden Bell Frog to minimise the potential that frogs located to the south of the Project rail infrastructure are isolated from the rest of the population to the north. An example of rail culverts which are suitable for use by the Green and Golden Bell Frog are culverts which are around 1 m wide and 1 m high. Similar culverts (frog underpasses) have previously been used successfully for a large-scale development in Woonona, NSW (White, pers. comm.).

Suitable habitat for Green and Golden Bell Frogs would be established at the ‘frog underpasses’ in order to encourage the frogs to use them. Habitat creation would include selective planting of plants preferred by the species (e.g. Cumbungi); placing piles of rocks to provide protection from predators in strategic places such as either end of (or within) frog underpasses; and establishment of pond areas at either end of the frog underpasses.

Habitat Replacement at Deep Pond

Habitat in the form of shallow areas for foraging shorebirds would be created during the construction of the northern rail spur embankment, if required to be installed when the Project is fully developed to 66 Mtpa, by modifying the design of the embankment batter slopes to have a gentle toe gradient (i.e. in the submerged zone of the batter slope). This would result in the creation of shallow areas suitable for shorebirds in Deep Pond. The specifications of this initiative would be detailed in the FFMP.

In addition, where practicable, construction of the northern rail spur embankment (if necessary) in the immediate vicinity of Deep Pond would be timed to avoid migratory shorebird usage (i.e. May to August).

Project Lights

The potential impact on fauna caused by the headlights of the trains using the Project rail infrastructure would be minimised by the selective placement of lighting screens in areas where there is an increased potential for interaction with fauna (e.g. where beams of light from the trains would sweep across the surface of Deep Pond). This would also screen the light emitted from the ground-level lighting which would be installed along the rail infrastructure corridor.

Fire

The potential for a change in the frequency of fires due to the Project would be reduced through the use of water sprays and prudent stockpile management. A 2 ML fire services tank would also be installed for emergency fire fighting situations. An ERP and Spontaneous Combustion Management Plan would be prepared for the Project and would describe hazard (i.e. fire) preventative and mitigation measures (Section 5).

Fauna Monitoring

Annual monitoring of the Green and Golden Bell Frog, Australasian Bittern and shorebirds would be undertaken in the area surrounding the Project for the Project duration. The objective of monitoring would be to collect up-to-date information on the use of the Project site and surrounds by fauna. Monitoring data for the Green and Golden Bell Frog would be provided to university institutions undertaking relevant research on the Green and Golden Bell Frog (Section 4.9.5).

4.9.4 Compensatory Measures

Existing Compensatory Habitat

Offsets have already been proposed by the NSW government for the development of Big Pond by the Department of Commerce as part of the BPHOS Report (Department of Commerce, 2005). The BPHOS Report proposes to enhance and create compensatory habitats in the Kooragang Nature Reserve to offset the proposed development of Big Pond (Department of Commerce, 2005).

The proposed compensatory areas are at Ash Island (located on Kooragang Island) and at the Tomago Wetlands (located north of the Hunter River north arm) (Figure 4-4). The aim of BPHOS Report is to modify land of low habitat value to create land with high values particularly for resident and migratory shorebirds.

Other offsets funded by the NSW government for potential impacts on Big Pond included the modifications of the Stockton Sand Spit, diurnal roost improvement at Smith Island and Sandy Island, the artificial roost at Fullerton Cove East, pond construction at Ash Island and reintroduction of tidal flows at Tomago (Straw, 1999; 2000).

In essence, Big Pond is a wetland area that was artificially created and has been manipulated as a foraging habitat for shorebirds (Straw, 1999). Originally, Big Pond was part of an intertidal mangrove area which was cut off from tidal influence when Moscheto Creek was blocked by a railway and then bunded to create land suitable for industrial use (Straw, 1999). Shorebirds ceased to use Big Pond when water flows to the wetland were blocked by an extension of PWCS in 1994 (*ibid*.). In order to make Big Pond attractive again to shorebirds, PWCS constructed a weir so that water levels could be manipulated but this was subsequently removed (*ibid*.).

No waterbirds or threatened avian species were observed during the survey at Big Pond during the Project surveys conducted during summer 2005-2006 (Avifauna Research and Services, 2006). This is most likely because Big Pond has since evolved from a brackish/saline open wetland with extensive mudflats and shallows to a largely freshwater wetland dominated by sedge and reeds as well as some open areas of mudflats or grass (Avifauna Research and Services, 2006).

The offsets funded by the NSW government address the potential impacts of the development of Big Pond.

Kooragang Wetland Rehabilitation Project Environmental Management Plan

A financial contribution would be made to Kooragang Wetland Rehabilitation Project (KWRP) towards updating its Environmental Management Plan to incorporate the details of the proposed habitat creation initiatives outlined below, where relevant to lands managed by the KWRP. This would include a consultation programme and input from relevant independent experts.

Habitat Creation

Habitat creation for the Green and Golden Bell Frog and shorebirds/saltmarsh would be funded as part of the Project.

A financial contribution would be made towards current or future projects which involve habitat creation for the Green and Golden Bell Frog on RLMC-owned lands within the KWRP or alternate suitable lands in the Kooragang Nature Reserve. Habitat creation would be located on the perimeter of existing habitat areas to provide suitable habitat into which the existing Green and Golden Bell Frog population can expand. This habitat creation would also create an opportunity to research the performance of alternative types of habitat enhancement.

Habitat creation initiatives for the Green and Golden Bell Frog would include construction of two habitat ponds of similar scale and detail to existing ponds where the Green and Golden Bell Frogs have been recorded on the KIWEF site (i.e. Pond C). This is consistent with the recovery strategies (i.e. *habitat rehabilitation/restoration and/or regeneration* and *monitoring*) identified by the DEC to help recover the Green and Golden Bell Frog (DEC, 2005d).

Mangroves in the Hunter Estuary have been expanding at the expense of the Coastal Saltmarsh EEC and, in some areas (e.g. Ash Island), mangroves have been removed to enhance habitat for Coastal Saltmarsh EEC and shorebirds. A financial contribution would be made to an organisation such as the KWRP for the removal of up to 6 ha of mangroves from coastal saltmarsh habitat. A financial contribution would also be made towards the construction of a flow control structure to minimise the potential for mangrove propagules to enter areas reserved for saltmarsh. Alternatively, these initiatives may also be applied to lands within the Kooragang Nature Reserve. These works are expected to enhance habitat for shorebirds as well as provide habitat for the Coastal Saltmarsh EEC.

In addition, habitat in the form of shallow areas for foraging shorebirds would be created during the construction of the northern rail spur embankment, if required to be installed when the Project is fully developed to 66 Mtpa, by modifying the design of the embankment batter slopes to have a gentle toe gradient (i.e. in the submerged zone of the batter slope). This would result in the creation of shallow areas suitable for shorebirds in Deep Pond. The specifications of this initiative would be detailed in the FFMP.

No habitat enhancement or creation works would be conducted on land subject to State Environmental Planning Policy 74 (Newcastle Port and Employment Lands) (Section 3.3.3).

4.9.5 Other Ecological Initiatives

Two additional ecological initiatives would be implemented for the Project including financial contributions towards research and exhibitions promoting conservation awareness.

Contribution to Research

A financial contribution would be given to the University of Newcastle, or other appropriately recognised research body, to fund research into the Green and Golden Bell Frog. The focus of research would be to expand existing knowledge of factors affecting the species which may be used to actively improve the strength of the population of Green and Golden Bell Frogs on Kooragang Island.

This is consistent with one of the recovery strategies (i.e. *research: general biological and ecological studies*) identified by the DEC to help recover the Green and Golden Bell Frog (DEC, 2005d).

Contribution to Hunter Wetlands Centre

A financial contribution would be given to the Hunter Wetlands Centre towards an annual exhibition regarding the Green and Golden Bell Frog and migratory shorebirds. The exhibition would include an update on the progress and the effectiveness of the habitat enhancement initiatives conducted as part of the compensatory measures of the Project. This would also provide an opportunity for a representative undertaking the university-based research described above to explain the progress/findings of the research to the interested public.

This is consistent with one of the recovery strategies (i.e. *community and land-holder liaison/awareness and/or education*) identified by the DEC to help recover the Green and Golden Bell Frog (DEC, 2005d).

4.10 HERITAGE

A Preliminary Aboriginal Heritage Assessment (PAHA) has been undertaken in accordance with the DEC *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (the Guidelines) (DEC, 2005). The Guidelines identify the factors that need to be considered when assessing potential impacts on Aboriginal cultural heritage when assessing a Project Application under Part 3A of the EP&A Act. The PAHA was conducted to determine if there were any Aboriginal cultural heritage values associated within the Project site that would require further assessment in accordance with the Guidelines.

A desktop non-Aboriginal heritage assessment has been prepared for the Project on the basis of review of previous assessments conducted on Kooragang Island, consultation with the Aboriginal community and with reference to NCC advice on known non-Aboriginal heritage items in the vicinity of Kooragang Island and a search of the NSW Heritage Office's State Heritage Inventory.

A description of the findings of both of these assessments is provided below.

4.10.1 Existing Environment

Aboriginal Heritage

The Project falls within an area which was, at the time of European settlement, inhabited by members of the Worimi tribal group (Umwelt, 2003a). The Worimi area included the region north of the south arm of the Hunter River including Stockton Bight and the Williams and Paterson River valleys (*ibid.*). The neighbouring Awabakal tribal group occupied areas south of the Hunter River that extended across Maitland, Lake Macquarie, Dora Creek and Newcastle (*ibid.*).

The Project site has been heavily disturbed by historical landuses that included grazing, land reclamation and the long term disposal of dredge spoil and industrial waste (Appendix D and Umwelt, 2003a). A description of the landuse history of the Project site is provided in Section 4.1. As a result of past landuse, the Project site has been heavily disturbed.

A series of aerial photographs is provided on Figure 4-2, which indicates the landuse changes from agricultural development to progressive reclamation of land and deposition of dredge spoil and landfill material to develop the current land surface within the Project site.

Previous Aboriginal Heritage Surveys

A number of Aboriginal heritage assessments have been conducted on Kooragang Island, including portions of the Project site. The major findings of these Aboriginal heritage assessments are summarised in Table 4-30.

Registered Sites

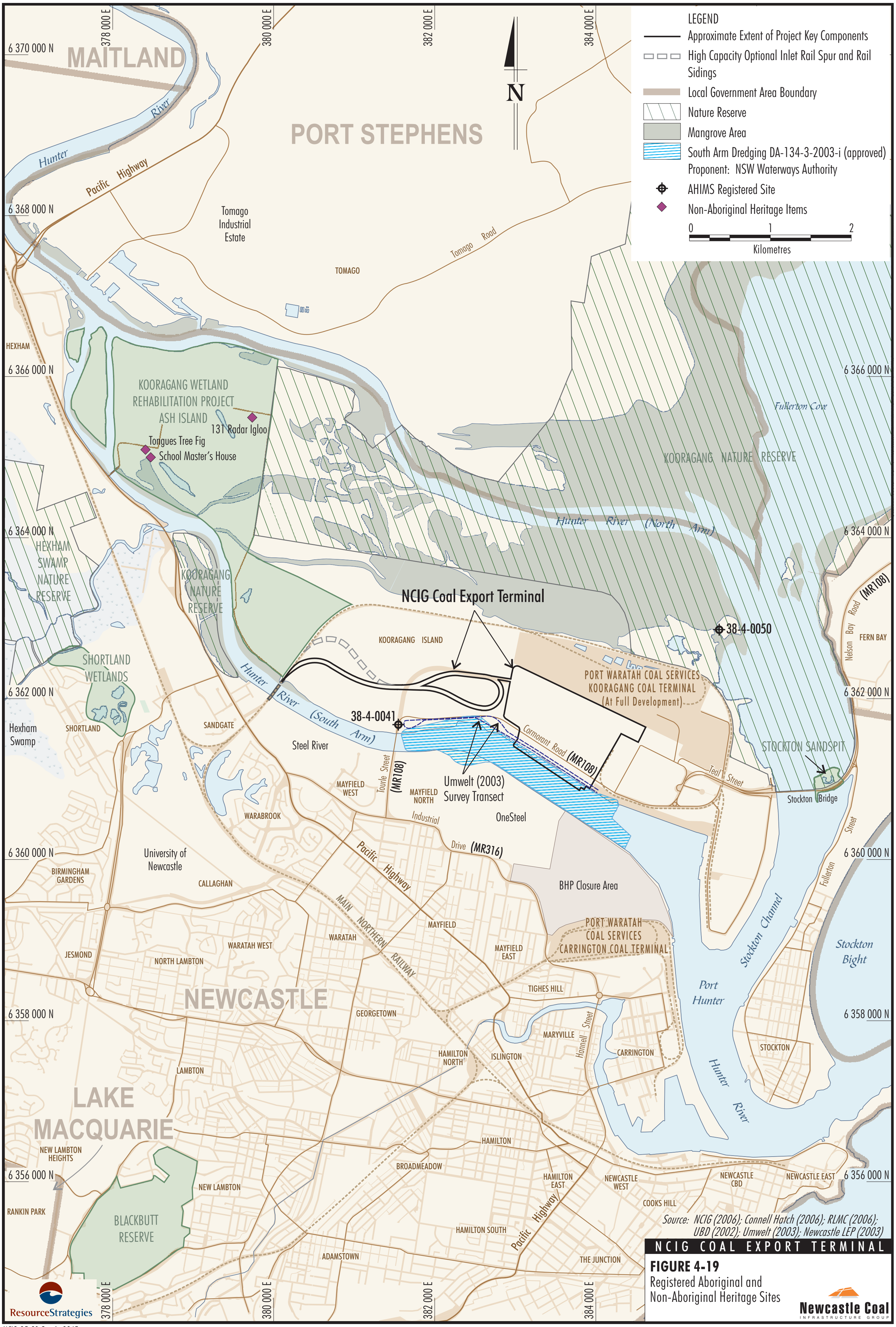
A search of the NSW National Parks and Wildlife Service's (NPWS) AHIMS for recorded Aboriginal sites in the vicinity of the Project was conducted in January 2006. The AHIMS search identified two sites (shell middens) registered for locations on Kooragang Island (Figure 4-19).

The closest shell midden site (NPWS No. 38-4-0041) was recorded outside the Project site, south-east of the intersection of Tourle Street and Cormorant Road (near the Tourle Street Bridge) (Figure 4-19). The site was first recorded in March 1970 and was subsequently destroyed approximately 30 years ago. An attempt to locate the midden site by Umwelt and the Worimi LALC in 2003 was unsuccessful (Umwelt, 2003a).

The second midden site (NPWS No. 38-4-0050) is recorded in the north-east of Kooragang Island, near the mouth of the north arm of the Hunter River (Figure 4-19). The site location is well away from the Project site (approximately 1.5 km distant).

Consultation with Local Aboriginal Groups

Previous consultation with the Worimi Local Aboriginal Land Council (LALC) and the Awabakal LALC has not identified any significant cultural heritage values within the Project site (Table 4-30). Consultation was undertaken with three local Aboriginal groups during the preparation of the EA (Section 3.7.2). This consultation did not identify any particular cultural values on the Project site. Worimi LALC provided written advice that they recognised the disturbed nature of the Project site and did not require any additional heritage survey within the Project site for the EA (Attachment 2).



NCIG COAL EXPORT TERMINAL

FIGURE 4-19
Registered Aboriginal and Non-Aboriginal Heritage Sites

NCIG-05-01 Sect4_006E

Table 4-30
Major Findings of Previous Aboriginal Heritage Assessments

Study/Project	Major Findings
Umwelt, 2003a *Proposed Extension of Shipping Channels, Port of Newcastle*	• Conducted a site survey (23/01/2003) with members of the Worimi Local Aboriginal Land Council (Worimi LALC) along the northern bank of the south arm of the Hunter River (forms part of the Project site) and found no evidence of Aboriginal occupation. • An unsuccessful attempt was made to locate an Aboriginal Heritage Information Management System (AHIMS) site (NPWS No. 38-4-0041) to the west of the Project site near the Tourle Street Bridge. • Aboriginal people would have occupied the area but it is likely that any evidence of their occupation has been destroyed by the reclamation and redevelopment of the area. • No impacts on Aboriginal archaeology and cultural heritage are expected as a result of the extension of the shipping channels. • The Worimi LALC provided a letter agreeing with the findings described above.
Protech Steel, 2001 *Protech Proposed Cold Mill Facility*	• The Protech site (forms part of the Project site) was highly modified and that any evidence of Aboriginal occupation would have been destroyed by the reclamation and redevelopment of the area. • The Awabakal LALC confirmed there were no significant Aboriginal sites on the Protech site. • It was concluded that the Protech facility would not impact on items of Aboriginal cultural significance. • The Awabakal LALC requested that one of their site officers could be present at any excavations.
PWCS, 1996 *Kooragang Coal Terminal Stage 3 Expansion*	• Aboriginal people would have occupied the area but it is likely that any evidence of their occupation has been destroyed by the reclamation and redevelopment of the area. • The Kooragang Coal Terminal project would not impact on items of Aboriginal cultural significance.
Cargill, 2005 *Expansion of the Cargill Oil Seed Processing Facility*	• The Cargill Oilseed Processing Facility site has been highly modified and any archaeological sites have been destroyed by past activities. • No known items of Aboriginal heritage significance exist on the site. • There is a possibility that subsurface archaeological deposits exist below the fill.

Non-Aboriginal Heritage

Section 4.1 provides a description of the landuse history of the Project site.

The lower Hunter River (including the Project site) was first surveyed by Europeans in 1801 (Umwelt, 2003a). In 1830 the first farmers moved to Dempsey Island (now part of Kooragang Island) (*ibid.*). Grazing/agricultural activities continued on Kooragang Island until the 1960s (Appendix D and Umwelt, 2003a). The first industrial works including a saltworks and sulphuric acid plant were established on Moscheto Island (Figure 4-1) (now part of the larger Kooragang Island) in 1836 (Umwelt, 2003a).

Reclamation, landfilling and industrial activities were the major landuses on Kooragang Island (including the Project site) during the mid to late 1900s onwards.

The Newcastle LEP does not list the Kooragang Island area as a heritage conservation area. Schedule 6 of the Newcastle LEP lists heritage items and heritage conservation areas in the Newcastle LGA.

Four heritage items were located on Kooragang Island including a Tongues Tree Fig, Palm, 131 Radar Igloo and School Master's House (Figure 4-19). The Palm was located along Greenleaf Road (eastern Kooragang Island – Figure 4-19), however the NCC Heritage Officer was unable to locate the Palm on a recent visit and it has been assumed destroyed (Sarah Cameron, pers. comm., 13 April 2006). All four of the registered heritage items are located well away from the Project site and would not be impacted by the development.

A search of the NSW Heritage Office's State Heritage Inventory for heritage items in the vicinity of the Project was conducted on 23 March 2006. No additional statutory listed items were identified on Kooragang Island apart from the four sites already identified in the Newcastle LEP.

4.10.2 Potential Impacts

Aboriginal Heritage

As described in Section 4.10.1, two Aboriginal sites (shell middens) on Kooragang Island are registered on the AHIMS database. Neither of these registered site locations is located within the Project disturbance area.

The PAHA conducted for the Project concluded:

- The Project site is located in the Kooragang Port and Industrial Area. The Port and Industrial Area has been subject to agricultural development since European settlement, and over a period of more than 50 years, dredge spoil disposal, land reclamation and waste disposal activities.
- Previous surveys within the Project site and Kooragang Port and Industrial Area for recent development proposals have not identified any remaining archaeological evidence of Aboriginal occupation.
- Consultation with the Aboriginal community for this proposal and previous development proposals has not identified any significant cultural heritage values in the Kooragang Port and Industrial Area.
- In accordance with the Guidelines, it can be concluded that an Aboriginal Cultural Heritage Assessment of the Project site is not required as:
  - NCIG propose redevelopment of a site where Aboriginal objects have not previously been found; and
  - long term disturbance, extensive land reclamation and waste disposal to landfill has taken place at the site, which indicates there is little likelihood of Aboriginal objects remaining.

There would be some excavation on the site associated with the construction of Project infrastructure. Some of this excavation would extend below the existing fill into the underlying natural ground surface and therefore has some limited potential to disturbed unknown Aboriginal objects.

Non-Aboriginal Heritage

No known non-Aboriginal heritage items of significance have been identified within the Project site. The non-Aboriginal heritage sites that are registered in the vicinity of the Project would not be impacted by the development.

In addition, the Port and Industrial area of Kooragang Island is not listed as a heritage conservation area and the extensive land reclamation and waste disposal to landfill that has taken place at the site indicates there is little likelihood of significant non-Aboriginal heritage objects remaining. Notwithstanding, there is the possibility that non-Aboriginal heritage items could be identified during excavation or construction works.

4.10.3 Mitigation Measures and Management

In accordance with EA requirements, the following management measures are proposed to deal with any heritage items that may be uncovered during construction of the Project.

Aboriginal Heritage Management Framework

Notwithstanding the fact that no Aboriginal sites have been identified within the Project site, as a precaution, the Worimi LALC has requested a site monitor be present to facilitate the identification and salvage of any buried artefacts in the unlikely event that any are uncovered during excavation (Attachment 2). The following management framework incorporates the Worimi LALC request:

- During induction training, NCIG personnel would be advised of their responsibility to advise management if they uncover any item that could be of Aboriginal heritage significance.
- Project excavation works that are expected to extend into the natural ground surface (i.e. below known fill material) would be monitored by an Aboriginal heritage representative to identify any archaeological material if it is present in the excavated material.
- If potential archaeological material is identified, based on the significance of the items (as determined by a consulting archaeologist), salvage of a selection of any artefacts may be undertaken in consultation with the DEC.
- If any archaeological material is salvaged on-site, it would be either stored in a keeping place on-site or provided to the Aboriginal community for safekeeping or educational display.
- At the cessation of the Project, if any salvaged Aboriginal objects are stored on-site their management would be determined in consultation with the Aboriginal community and the DEC.

Non-Aboriginal Heritage Management Framework

- During induction training, NCIG personnel would be advised of their responsibility to advise management if they uncover any item that could be of non-Aboriginal heritage significance.
- If an item of possible heritage significance is identified on-site during excavation or general construction activities, analysis would be undertaken by a suitably qualified heritage consultant to determine the significance of the identified objects.
- If the item identified is of local or higher significance, subsequent consultation with the NCC and/or the NSW Heritage Office would be undertaken in regard to the fate of the item.

4.11 TRANSPORT

A Road Transport Assessment was prepared by Masson Wilson Twiney and is presented in Appendix C. Section 2.9.2 describes the Project site access requirements.

4.11.1 Existing Environment

The existing road system and traffic flows in the vicinity of the Project are described in detail in Appendix C and are summarised below.

Road Hierarchy

Arterial Roads

Cormorant Road bisects the Project site and extends from Industrial Drive at its southern extent to Teal Street at its northern extent (Figure 2-1). Cormorant Road forms part of Main Road (MR) 108 which connects Industrial Drive at Mayfield in the south to Williamtown, the Newcastle Airport and Nelsons Bay in the north. Cormorant Road is the major road on Kooragang Island and is under the control of the RTA.

The Pacific Highway is part of the national highway network and connects NSW and Queensland. Access to the Project site and Cormorant Road can be obtained via the Pacific Highway/Industrial Drive (MR 316) intersection when travelling from the north or the Pacific Highway/Hanell Street intersection when travelling from the south (Figure 4-19).

Local Roads

To the immediate east of the Project site, Egret Street runs generally north-south and extends between Cormorant Road at its southern extent and Raven Street at its northern extent (Figure 2-1). Raven Street connects to Teal Street or back to Cormorant Road via Curlew Road. Egret Street, Raven Street and Curlew Street are under the care and control of the NCC. These roads (and the portion of Cormorant Road east of the Teal Street roundabout) provide direct access to the various industrial facilities located on Kooragang Island.

The Pacific National access road runs in a general northerly direction off Cormorant Road and is located approximately midway between Egret Street and the Delta access road (Figure 2-1). The Pacific National access road is signed as a private road (Appendix C).

The Delta access road runs parallel to the Pacific National access road and runs north from Cormorant Road off the Tourle Street Bridge.

Exiting Road and Traffic Conditions

The following sections summarise existing road and traffic flow conditions within the Project site and surrounds.

Existing Road Conditions

Cormorant Road is a two lane undivided road from the Tourle Street Bridge until just before its intersection with Egret Street, where it widens to a four lane undivided carriageway. The four lane carriageway continues to the roundabout at the connection to Teal Street (MR 108).

Cormorant Road is connected to the southern end of Egret Street by a priority controlled intersection. A left turn deceleration lane and a right turn pocket are provided to assist with turning movements from Cormorant Road.

The intersection of Cormorant Road and the Pacific National access road is also priority controlled with a left turn deceleration lane and a right turn pocket provided to assist with turning movements from Cormorant Road.

The Delta access road has separate entry and exit points onto Cormorant Road and is the access route into the KIWEF which comprises the western part of the Project site.

Existing Traffic Volumes

Table 4-31 summarises existing traffic flows on roads in the vicinity of the Project site.

Table 4-31
Annual Average Daily Traffic (AADT) Flows[1]

Road Name/Location	2004
Pacific Highway (west of Maud Street)	22,902
Industrial Drive (east of Tourle Street)	30,717
Nelsons Bay Road	18,966
Tourle Street	24,052

Source: after Appendix C
[1] Average Annual Daily Traffic is two way traffic (flow in both directions) – seven day count.

In addition, RTA traffic counts at the Tourle Street traffic count site recorded the following AADT counts over the years 1995-2001:

- 1995: 23,393 vehicles.
- 1998: 24,637 vehicles.
- 2001: 23,650 vehicles.

The traffic growth rate in the area surrounding the Project has been negligible over the last nine years. An average annual growth rate of 0.6% was recorded between 2001 and 2004 at the Tourle Street traffic count site (Appendix C).

Additional intersection traffic volume data was collected by Stapes Pty Ltd (2005) at the Cormorant Road/Egret Street intersection. Stapes (2005) identified peak traffic activity periods at the Cormorant Road/Egret Street intersection occur between 7.15 – 8.15 am (1,996 movements) and 4.00 – 5.00 pm (2,126 movements).

Intersection Performance

The performance of the Cormorant Road/Egret Street and Cormorant Road/Teal Street intersections was assessed using the intersection analysis computer program SIDRA (Signalised and unsignalised Intersection Design and Research Aid) (Appendix C) (Table 4-32).

Traffic Safety

A review of accident data on Cormorant Road has been undertaken. Analysis of the accident data identified no particular accident patterns or causation factors (Appendix C).

Future Traffic Improvements

The RTA propose to upgrade the existing two lane section of Cormorant Road to a four lane divided road. The RTA has not provided a timeframe for the implementation of this upgrade or the proposed duplication of the Tourle St Bridge (Appendix C) and the Road Transport Assessment has been completed with the assumption that the upgrades would not be in place prior to the initial construction of the Project.

4.11.2 Potential Impacts

Potential traffic impacts on the local road network are assessed in Appendix C and summarised below.

Construction Access Requirements

During construction of the Project, access to the main construction facilities would be via an entry and exit point at the intersection of Egret Street and Raven Street (Figure 2-1).

Table 4-32
Relevant Intersection Performance

Control	Movement	Level of Service* (Morning Peak)	Level of Service* (Afternoon Peak)	Description of Level of Service*
Cormorant Road/Teal Street Intersection				
Roundabout	Cormorant Road (east)	A	A	A – Good operation
Cormorant Road/Egret Street Intersection				
Priority	Egret Street (left turn)	B	B	B – Good with acceptable delays
Priority	Egret Street (right turn)	F	F	F – Extreme delay, traffic signals or other major treatment required

Source: after Appendix C
* Level of Service as determined by SIDRA.

Construction traffic would be required to turn left from the intersection of Egret Street and Cormorant Road (i.e. no right turn would be permitted) and proceed to the roundabout to Stockton to return to Newcastle, or alternatively exit the site via Raven Street (Section 2.9.2).

Construction access to the rail infrastructure corridor would be via the Delta access road from Cormorant Road (heavy vehicles) and the Pacific National access road (light/medium vehicles) (Figure 2-1). The Pacific National access road would also provide supplementary access to the Project coal storage area. No right turn movements from the Pacific National access road or Delta access road would be permitted onto Cormorant Road (Section 2.9.2).

Construction access to the wharf facilities and shiploader area would be via an access road off Cormorant Road (Figure 2-1). No right turn movements from the wharf facilities and shiploader area onto Cormorant Road would be permitted. A U-turn loop would be constructed on the Pacific National access road to allow vehicles exiting the wharf facilities and shiploader area to travel toward Stockton (Figure 2-1).

Temporary Haulage of Fill across Pacific National Access Road and Delta Access Road

Fill material would be hauled between the Project coal storage area and the rail infrastructure corridor during construction. It is estimated that in the order of 25 movements per hour over a three month period would be required. These movements would be managed by temporarily reprioritising traffic on the Pacific National access road and Delta access road or by installing temporary traffic management measures.

Temporary Haulage of Fill across Cormorant Road

Fill material would be hauled across Cormorant Road from the coal storage area to the wharf facilities and shiploader area during construction during daylight hours. It is estimated that in the order of 25 movements per hour over a three month period would be required. Temporary traffic lights would be installed to manage the crossing of Cormorant Road and use of crossings would be restricted to non-peak periods to minimise the potential for delays on Cormorant Road.

Temporary Haulage of Machine Parts across Cormorant Road

It is proposed to haul machine parts that are shipped to the Port of Newcastle across Cormorant Road from the wharf facilities and shiploader area to the coal storage area. These low loader vehicle movements would use the temporary traffic lights and would take some 10 to 15 minutes to complete. It is proposed to undertake these movements late at night under police supervision to reduce potential impacts on traffic flows along Cormorant Road.

There would be a sporadic requirement for up to 2 trips per night which would occur over a period of 9 months.

Conveyors Over Cormorant Road

Conveyors over Cormorant Road would be constructed to move coal from the coal storage area to the wharf facilities for shiploading (Section 2.6.1). The conveyors over Cormorant Road would be designed and constructed to meet RTA requirements.

Operations Access

As described in Section 2.9.2, during the operation of the Project, the main access point for the Project would be via the entrance to the administration and workshop buildings located north of the Egret Street and Raven Street intersection (Figure 2-1). Operational access to the wharf facilities, shiploader area and rail infrastructure corridor would utilise the same access points as during construction (see above). Heavy vehicle access during operations would be significantly lower than during construction.

Car Parking

During the Project construction, an estimated 400 temporary car spaces would be required for Project employees (Appendix C). Based on the expected construction traffic split between the three construction sites, the coal storage area would require 200 car spaces, the wharf facilities area would require 120 car spaces and the rail infrastructure area would require 80 car spaces.

As described in Section 2.9.2, an 80 space car park would be constructed adjacent the administration and workshop buildings and smaller car parking areas would be constructed at the wharf facilities and rail infrastructure corridor for the Project operations.

The layout of the temporary construction car parks would be generally consistent with AS 2890.1:2004 *Parking Facilities – Off-Street Car Parking*. In addition, the permanent car parks would be designed in accordance with Element 4.1 – Car Parking of the Newcastle DCP (Section 3.3.4).

Project Traffic Generation

Table 4-33 summarises predicted peak hour and daily vehicle movements generated by the peak Project construction and peak Project operations.

Construction of the Project would generally be undertaken during daytime hours up to seven days per week (Section 2.3). Predicted traffic generation during construction would include both light vehicles and higher level of heavy vehicle movements associated with deliveries and services.

The percentage of the workforce that would access the site to and from Newcastle during the Project construction is estimated to be 85%. During the Project operations, lower traffic generation would occur. During the Project operations, some 95% of the workforce would be expected to access the site to and from Newcastle.

Four traffic scenarios were investigated to determine the predicted impact of Project traffic flows on the local road network during peak Project construction and operations. A conservative average annual traffic volume growth rate of 1% was applied to the Stapes Pty Ltd (2005) peak hour traffic volume data to estimate the background traffic conditions for 2007 and 2017 (Appendix C). The four scenarios were:

- Scenario 1 – 2007 predicted background traffic conditions (including three years growth at 1% per year).
- Scenario 2 – Scenario 1 and Project traffic related to the initial construction of the Project.
- Scenario 3 – 2017 predicted background traffic conditions (including 12 years growth at 1% per year).
- Scenario 4 – Scenario 3 and Project traffic related to the operation of the Project up to a capacity of 66 Mtpa.

Table 4-34 presents the predicted impact of the Project traffic flows on the local road network during the initial peak Project construction (Scenario 2) and Project operations (Scenario 4). During non-peak times it is anticipated that Project traffic flows would be lower.

Table 4-33
Predicted Project Traffic Flows – Project Construction and Operations

	Period	
	Peak Hours	**Daily Total**
Peak Project Construction		
Light Vehicles	419	1,000
Trucks (deliveries and services)	23	158
Peak Project Operations (66 Mtpa)		
Light Vehicles	27	80
Trucks (deliveries and services)	1	10

Source: after Appendix C

Table 4-34
Predicted Peak Period Daily Traffic Flows on the Local Road Network

Location	Scenario 1 (2007 background)	Scenario 2 (2007 background and initial Project construction)	Scenario 3 (2017 background)	Scenario 4 (2017 background and peak Project operations)
Industrial Drive	32,208	32,700	35,280	35,321
Cormorant Road	25,343	26,327	27,748	27,831
Nelson Bay Road	19,535	19,709	21,432	21,439

Source: after Appendix C

Intersection Performance

The peak hour performance of the intersections and Project access points along Cormorant Road were assessed for the four traffic scenarios outlined above using the intersection analysis computer program SIDRA (Appendix C). Table 4-35 summarises the results of the assessment.

It is expected that the Cormorant Road/Egret Street intersection would operate at a Level of Service D during the afternoon assessment period during peak construction (Scenario 2) (Table 4-35). This Level of Service is considered acceptable as an alternative route exists via Raven Street to which traffic could redistribute if necessary (Appendix C).

The Cormorant Road/Pacific National access road intersection would operate at a Level of Service D during the morning assessment period during peak construction (Scenario 2) (Table 4-35). This Level of Service relates to left turns only and as this access point would be used primarily during construction, it is considered satisfactory (Appendix C). The Delta access road would carry less traffic than the Pacific National access road and is expected to have a similar level of service based on the traffic flows on Cormorant Road.

Potential delay associated with the use of temporary traffic lights on Cormorant Road was also considered. The assessment found that traffic on Cormorant Road would not suffer significant delay as a result of use of the temporary lights at off peak times (Appendix C).

Cumulative Traffic Increases

Other developments in the vicinity of the Project site have the potential to add additional traffic flows that may result in cumulative impacts on the local road network. General traffic expected to be generated by the dredging activities under the Port Consent, the Cargill Oilseed Processing Plant and the Multi-purpose Terminal on the former BHP steelworks site were included in the road transport assessment with a conservative 1% annual traffic growth assumption (Appendix C).

The Road Transport Assessment did not include potential cumulative heavy vehicle traffic associated with haulage of dredged material (under the Port Consent) from the former BHP steelworks site to the KIWEF via the Tourle Street Bridge in the baseline traffic growth assumptions for the following reasons:

- the final fate of any inert or remediated dredge material that is produced on the former BHP steelworks site has not yet been determined (i.e. it may not be transferred to the KIWEF); and
- the proponent for transport of any dredged material from the former BHP steelworks site is required to prepare a Dredged Material Transport Study in consultation with the RTA and NCC which includes establishment of traffic movement scheduling to avoid conflicts with peak traffic flows, sensitive road users and to distribute traffic flows to distribute impacts to the greatest extent reasonably possible.

Table 4-35
Cormorant Road Intersection Performance

Scenario	Level of Service*							
	Cormorant Road/Teal Street Intersection (Roundabout)		Cormorant Road/Egret Street Intersection (Priority)		Cormorant Road/Wharf Facilities Access (Priority)		Cormorant Road/Pacific National Access Road (Priority)	
	Morning Peak	Afternoon Peak	Morning Peak	Afternoon Peak	Morning Peak	Afternoon Peak	Morning Peak	Afternoon Peak
1	A	A	B	B	N/A	N/A	N/A	N/A
2	A	A	B	D	B	B	D	B
3	A	B	C	B	N/A	N/A	N/A	N/A
4	A	B	C	C	B	C	N/A	N/A

Source: after Appendix C
* Level of Service as determined by Signalised and Unsignalised Intersection Design and Research Aid.

4.11.3 Mitigation Measures, Management and Monitoring

Road Upgrades/Improvements

To facilitate the safe use of the Project access points the following road upgrades/traffic management measures would be implemented:

- Improvements to the existing Delta access road intersection north of the Tourle Street bridge – including advance warning signage and a realignment of the existing footpath/cycleway.
- Right turn prohibition onto Cormorant Road from the Pacific National access road and Delta access road.
- New intersection to the wharf facilities area – installation of a central carriageway median island to prevent right turns and suitable lengths of deceleration and acceleration lanes.
- New turning loop on the Pacific National access road (to facilitate U-turns).
- Prohibition of right turn movements at the Cormorant Road/Egret Street intersection – installation of a central carriageway median island to prevent right turns.
- Temporary traffic lights would be installed on Cormorant Road to manage construction traffic crossing directly across the road (haulage of fill and machine parts) at off-peak times.

All of these roadworks would be designed in accordance with the RTA *Road Design Guide* (RTA, 2003a) and in consultation with the NCC and RTA.

Traffic management plans would be completed to address any roadworks on public roads (e.g. improvements to the Delta access road and Cormorant Road intersection) in consultation with the NCC and the RTA and in accordance with the RTA *Traffic Control at Worksites Manual* (RTA, 2003b). Traffic management plans would also be developed to address the construction of the conveyors over Cormorant Road and the haulage of fill across Cormorant Road and Pacific National access road/Delta access road in consultation with NCC and RTA.

A component of the traffic management plans would be identification of relevant aspects of the local road environment including:

- an inventory of road widths, road condition, traffic management and parking controls present;
- a description of the nature and extent of any existing on-street parking;
- existing public transport and pedestrian infrastructure and any requirements for any additional infrastructure of this nature;
- consideration of the requirements of NCC with respect to sight distances, parking, suitable splays and driveway widths at intersections and gates; and
- provision of suitable internal roads on-site.

With the implementation of these traffic management measures, the Road Transport Assessment (Appendix C) concluded that the Project would not create significant adverse traffic impacts on the surrounding road network during either construction or operation and is considered to be acceptable from a road transportation perspective.

Traffic Minimisation

As approximately 95% of the Project operations workforce would be expected to commute from a single source (Newcastle), car pooling to the Project is a feasible traffic minimisation option. NCIG would encourage car pooling to minimise Project traffic generation during the life of the Project.

Cumulative Traffic Impacts

NCIG would consult with the NCC, RTA and other traffic generating projects in the vicinity of the Project site during the Project life to manage cumulative traffic issues, should they arise.

Management of Further Development of the Project

The timing of the progressive development of the Project from 33 Mtpa to 66 Mtpa and the rate of increase in capacity is unknown at this stage. As described in Section 2.3, it is likely that the increase in capacity would be undertaken in a progressive manner. However, if undertaken rapidly it could involve traffic flows of a similar magnitude to the initial establishment of the 33 Mtpa Project.

As described in Appendix C, this expansion could occur at a time when Cormorant Road has been upgraded to two lanes in either direction.

For the progressive expansion from 33 Mtpa to 66 Mtpa, a construction traffic management plan (CTMP) would be prepared in consultation with the RTA and NCC. A CTMP should review the outcomes of the Road Transport Study (Appendix C); compare predicted versus actual road usage levels; consider the road network configuration existing at that time; and, if necessary, make recommendations for further traffic controls in consultation with the RTA and NCC.

4.12 THE REGIONAL ECONOMY

A regional economic assessment was prepared for the Project by Gillespie Economics as part of the Socio-economic Assessment and is presented in Appendix G. The assessment was conducted at two different scales to assess the local impact of the Project and the impacts at NSW state level. The regional economy chosen for the study was the Newcastle Statistical Subdivision (SSD). The Newcastle SSD (Lower Hunter) comprises the Statistical Local Areas (SLAs) of Port Stephens, Maitland, Cessnock, Lake Macquarie, Newcastle inner and Newcastle remainder. A summary of the results of the assessment with regard to the regional and NSW state economy is provided below.

4.12.1 Existing Environment

The regional economic assessment is based on a 2000-2001 input-output analysis for the regional and NSW economies. As described above, the local region comprises the Newcastle SSD.

Gross regional product (GRP) for the NSW economy (household income and other value added contributions) is estimated at $225,151M comprising $93,965M in wages and salaries, and $131,185M in other value added contributions (includes gross operating surplus, depreciation and net indirect taxes and subsidies).

The GRP for the local regional economy is estimated at $13,596M, comprising $5,477M in wages and salaries and $8,118M in other value added contributions.

The comparative distribution of various industry sectors to the GRP, employment and output earnings for the local region and for the state of NSW are presented in Table 4-36.

Comparison with the NSW economy reveals that the mining sector, manufacturing sector and the utilities sector are of greater relative importance to the regional economy. The manufacturing sector, services sector and household expenditure have the greatest reliance on imports in the region (Appendix G).

The services sector is the most significant sector in terms of employment numbers and contribution to both GRP and output for the local region (Table 4-36).

Table 4-36
Contributions to Gross Regional Product, Employment and Output by Industry Sector – Newcastle SSD and NSW (2001)

Sector	Total Employment (%)		Contribution to GRP (%)		Contribution to Output (%)	
	Newcastle	NSW	Newcastle	NSW	Newcastle	NSW
Agriculture/Forestry and Fishing	1	4	1	2	1	2
Mining	1	1	4	2	4	2
Manufacturing	13	12	15	13	34	29
Utilities	1	1	4	2	3	2
Building	6	7	3	4	4	4
Services	78	76	61	67	54	61

Source: after Appendix G

4.12.2 Potential Impacts

Regional economic impact assessment is primarily concerned with the effect of an impacting agent on an economy in terms of specific indicators, such as employment, income, gross regional product and gross regional output. The assessment in Appendix G included consideration of the regional economic impacts of the initial Project construction and operations of the Project on both the Newcastle SSD, and the State of NSW.

Initial Project Construction

Using input-output analysis, it was estimated that the initial construction of the Project (i.e. to reach a 33 Mtpa capacity) would contribute the following to the regional economy and NSW economy, respectively:

Newcastle SSD – Initial Project Construction

- $43M in annual direct and indirect regional value added;
- $25M in annual direct and indirect household income; and
- 587 direct and indirect jobs.

NSW Economy – Initial Project Construction

- $45M in annual direct and indirect regional value added;
- $26M in annual direct and indirect household income; and
- 588 direct and indirect jobs.

The main sectors of the Newcastle economy that would be stimulated by the initial Project construction are business services sectors; wholesale and retail trade sectors; manufacturing sectors (predominantly cement lime and concrete slurry manufacturing, structural metal products manufacturing and fabricated metal products manufacturing); and the transport sector (predominantly road transport).

Further progressive development of the Project to 66 Mtpa capacity would result in additional temporary construction impacts. These impacts would be of a similar magnitude, depending on the rate of construction activity.

Project Operations

Operation of the Project was estimated to have the following impacts on the Newcastle SSD and NSW economy for both the 33 Mtpa and 66 Mtpa capacity facility, respectively:

Newcastle SSD – Project Operations

- $78M (33 Mtpa) and $162M (66 Mtpa) in annual direct and indirect regional value added;
- $18M (33 Mtpa) and $26M (66 Mtpa) in annual household income; and
- 243 (33 Mtpa) and 351 (66 Mtpa) direct and indirect jobs.

NSW Economy – Project Operations

- $83M (33 Mtpa) and $169M (66 Mtpa) in annual direct and indirect regional value added;
- $21M (33 Mtpa) and $30M (66 Mtpa) in annual household income; and
- 305 (33 Mtpa) and 440 (66 Mtpa) direct and indirect jobs.

The main sectors impacted by the operation of the Project are likely to be the agricultural, mining and lifting and material handling machinery manufacturing sector; electricity supply sector; wholesale trade sector; retail trade sector; other property services sector; mechanical repairs sector and other construction sector.

End of Project Life

The construction and operation of the Project would stimulate demand in the Newcastle and NSW economies leading to increased business turnover in a range of sectors and increased employment opportunities. Cessation of the Project would, however, lead to a reduction in economic activity.

The regional economic impetus of the Project may also stimulate a “virtuous cycle” of growth. This theory of regional economic growth suggests that places that are able to attract population migration create increased demands for goods and services and thus more jobs (Appendix G). The socio-economic significance of cessation of the Project would depend on the relative significance of the Project to the regional economy and other regional economic factors at the time. Impacts associated with Project cessation are likely to be greater in a declining economy than in a growing diversified economy.

The magnitude of the regional economic impacts of cessation of the Project would largely depend on whether affected workers and families leave the region. Minimisation of the impacts for the regional economy associated with mine cessation can occur through retention of displaced workers within the region, even if they remain unemployed. This is because continued expenditure by the unemployed who stay in the region would contribute to the final demand. Additional economic activities or developments would also assist in enticing displaced workers to remain in the region.

As described in Section 4.1.3, NCIG would develop a site exit strategy before Project closure in consultation with regulatory agencies and would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure.

Consideration of the potential economic benefits that would be forgone if the Project and associated infrastructure improvements were not undertaken to allow coal producers to meet projected export coal demand is presented in Section 3.9.4.

4.13 SOCIO-ECONOMIC CONSIDERATIONS

For the purposes of the Socio-economic Assessment, the Newcastle SSD was used as the local region.

4.13.1 Existing Environment

A summary of the Socio-economic Assessment in relation to background demographics, employment and community infrastructure is provided below.

Population Profile

Table 4-37 compares population growth experienced in the Newcastle SSD and NSW as a whole and provides estimates of the population growth for the period to 2031.

As shown in Table 4-37 the total population of the Newcastle SSD increased from 427,824 in 1991 to 501,335 in 2003. This population growth rate (0.9%) is similar to that for NSW as a whole (Table 4-37 and Appendix G). The Newcastle SSD population is expected to continue to grow but at a declining rate of 0.6% pa then 0.5% pa after 2016 to reach an estimated population of 585,900 by 2031 (Appendix G).

Demographics

Table 4-38 provides a summary of the age distribution of the Newcastle SSD population for the years 1999 to 2003 and the age distribution for NSW in 2003.

Table 4-37
Newcastle SSD and NSW Population and Population Growth Rate

	Based on Actual Census Figures from 1991 to 2003					Projections		
Year	**1991**	**1996**	**2001**	**2002**	**2003**	**2011**	**2021**	**2031**
Newcastle SSD								
Population	427,824	449,772	470,610	496,990	501,335	528,400	558,300	585,900
Population Growth Rate (% pa)	-	1.0	0.9	0.9	0.9	0.6	0.5	0.5
New South Wales								
Population	5,732,032	6,038,696	6,371,745	6,634,110	6,682,053	7,164,700	7,734,900	8,271,900
Population Growth Rate (% pa)	-	1.1	1.1	0.9	0.7	0.9	0.8	0.6

Source: Appendix G

Table 4-38
Distribution of the Newcastle SSD Population by Age Group

	Newcastle					NSW
Age Category	**1999**	**2000**	**2001**	**2002**	**2003**	**2003**
<14 years	20.8	20.6	20.5	20.2	19.9	19.9
15-44 years	41.9	41.6	41.3	41.2	40.8	43.1
45-64 years	22.6	23.1	23.4	23.8	24.2	23.7
65 years and over	14.6	14.7	14.8	14.9	15.0	13.3

Source: Appendix G

Table 4-38 indicates that the proportion of people under the age of 14 and between the ages of 15 to 44 has declined slightly over time in the Newcastle SSD and the proportion of the population in the older age brackets has slightly increased, reflecting the general aging of the Australian population (Appendix G). Compared to NSW, however, the Newcastle SSD has a slightly lower proportion of 15 to 44 year olds and slightly greater proportion of older people.

The proportion of males (49%) and females (51%) in the Newcastle SSD was relatively even, however the proportion of people born overseas in the Newcastle SSD (3%) is significantly lower then NSW as a whole (20%) (Appendix G).

Employment Profile

Unemployment in the Newcastle SSD has been above the NSW level, however, it has been similar to that for non-Sydney NSW as illustrated in Table 4-39.

The Newcastle SSD unemployment rate fell by 1.3% between 1996 and 2001, less than the fall for NSW (1.6%) and less than the fall for non-Sydney NSW (2.1%). This fall in unemployment rate was helped by a fall in participation rate in the region whereas in NSW there was an increase in the participation rate (Appendix G).

Average individual taxable income in the Newcastle region was is the order of $38,000 in 2003.

Housing

An investigation of local housing in the Newcastle SSD indicated there were approximately 197,500 private dwellings and that there is a higher proportion of separate houses than the State (77% compared with 64% respectively) and a lower proportion of units/flats/apartments (13% compared with 26%) (Appendix G). Table 4-40 provides a summary of the housing in the Newcastle SSD and comparative totals for the Hunter Region and NSW.

While the rental market is tight in Newcastle, with vacancy rates in the order of 2.4% (Appendix G), short term accommodation facilities in the Newcastle SSD are abundant with over 11,500 bed spaces available in motels, hotels or guesthouses (Table 4-41).

Education

The Newcastle SSD is well equipped with education facilities. The NSW Department of Education and Training (DET) is the main provider of primary and secondary education in the Newcastle SSD. The Newcastle SSD has 145 DET infant and primary schools and 28 DET secondary schools (Table 4-42) (Hunter Valley Research Foundation). It is reasonable to assume that schools in the region have excess capacity, as Table 4-42 demonstrates that enrolments in these schools have been decreasing (Appendix G).

Health

The Hunter Area Health Service (HAHS) is the major provider of health services in the region. In 2004, HAHS administered 14 hospitals and was responsible for two psychiatric hospitals, two aged care facilities, 30 community health centres, 37 child and family health centres and 19 dental clinics (Hunter Valley Research Foundation).

There are a variety of allied health service providers including optometrists, pathologists and physiotherapists available in the local region.

Health and community services are a relatively large sector in the Region's economy. This service accounts for 12% of all regional employment in 2001, compared to a figure of 9% for NSW (Hunter Valley Research Foundation).

4.13.2 Potential Impacts

As described in Section 2.11, the development of the Project would employ up to 500 people during the initial construction period and would employ some 100 people when operating at 66 Mtpa capacity. In addition, the development would facilitate flow-on employment in the region. The primary potential impact of the Project on community infrastructure therefore relates to population growth and related effects on housing and community facilities.

The Project also has significant potential to generate employment outside of the Newcastle SSD. Gillespie Economics (Appendix G) has estimated up to 89 jobs would be expected to be created outside of the Newcastle SSD (but within NSW) as a consequence of the Project operations.

Table 4-39
Unemployment in the Newcastle SSD

	Unemployment Rate (%)		Unemployment to Population Ratio (%)		Participation Rate (%)	
	1996	2001	1996	2001	1996	2001
Newcastle SDD	11.6	10.3	7.9	6.9	68.0	67.3
Non-Sydney NSW	11.5	9.4	7.7	6.3	67.3	67.2
NSW	8.9	7.3	6.2	5.1	69.3	69.6

Source: Appendix G

Table 4-40
Housing in the Newcastle SSD

	Population	Total Private Dwellings	Dwelling per Capita	Separate Houses (%)	Other Dwellings (%)	Not Stated (%)	Unoccupied Private Dwellings
Port Stephens	56,677	26,115	0.46	65.6	15.8	1.0	17.6
Cessnock	45,203	18,118	0.40	85.2	5.0	0.9	8.8
Lake Macquarie	177,619	71,986	0.41	80.1	12.4	0.6	6.9
Maitland	53,803	20,639	0.38	84.1	9.9	0.3	5.6
Newcastle	137,307	60,781	0.44	69.5	23.1	0.6	6.8
Newcastle SSD	**470,609**	**197,639**	**0.42**	**76.9**	**13.2**	**0.7**	**8.32**
Hunter Region	**563,587**	**241,620**	**0.43**	**74.4**	**14.8**	**0.7**	**10.1**
NSW	**6,371,745**	**2,571,540**	**0.40**	**64.1**	**26.3**	**0.8**	**8.9**

Source: Appendix G

Table 4-41
Hotels, Motels and Serviced Apartments in the Newcastle SSD, 2003-04
(establishments with 15 or more rooms)

	Number of Establishments	Bed Spaces	Guest Rooms
Port Stephens	21	3,246	1,020
Cessnock	19	2,834	872
Lake Macquarie	15	1,787	518
Maitland	5	475	174
Newcastle	19	3,196	1,110
Newcastle SSD	**79**	**11,538**	**3,694**

Source: Appendix G

Table 4-42
DET Infants, Primary and Secondary Schools and Enrolments

	Number of Schools	Enrolments		
		2002	2003	2004
Infants and Primary				
Pt Stephens	19	5,070	5,012	4,926
Cessnock	22	4,248	4,296	4,292
Lake Macquarie	55	13,928	13,669	13,437
Maitland	15	4,612	4,664	4,747
Newcastle	34	9,182	9,020	8,999
Total	**145**	**37,040**	**36,661**	**36,401**
Secondary				
Pt Stephens	3	2,853	2,867	2,823
Cessnock	3	2,363	2,367	2,411
Lake Macquarie	11	9,576	9,522	9,475
Maitland	4	3,407	3,381	3,394
Newcastle	7	6,618	6,623	6,601
Total	**28**	**24,817**	**24,760**	**24,704**
All DET Schools				
Pt Stephens	22	7,923	7,879	7,749
Cessnock	25	6,611	6,663	6,703
Lake Macquarie	70	23,611	23,304	23,032
Maitland	20	8,065	8,095	8,190
Newcastle	46	17,058	16,897	16,847
Total	**183**	**63,268**	**62,838**	**62,521**

Source: Appendix G

Potential employment effects, population effects and community infrastructure demands that take place outside of the Newcastle SSD are expected to be largely concentrated in major centres such as Sydney, and hence in relative terms any potential adverse impacts are likely to be minor in nature. The following assessment therefore concentrates on potential impacts in the Newcastle SSD.

Initial Project Construction

Workforce

As described in Section 2.11, it is anticipated that 400 people would be employed on average over a 33 month period to undertake Project initial construction activities. During short-term peaks in construction activity, up to a maximum of 500 people would be employed.

A significant proportion of the construction workforce is expected to be sourced from the Newcastle SSD, with an expected 65% of the construction workforce expected to be sourced from the local region.

The regional economic assessment conducted by Gillespie Economics (Appendix G) indicates flow-on employment effects associated with Project construction would create on average an estimated 187 indirect employment opportunities in the Newcastle SSD.

Population Effects

During the initial Project construction there would be a temporary increase in population in the Newcastle SSD as an estimated 140 (average) to 175 (peak) people are expected to come from outside the region to fill 35% of the direct construction employment. Assuming a similar percentage of workers move to the region for the flow-on employment as for during peak periods, the number moving into the region would be in the order of 257 workers (Appendix G).

Assuming that 10% of the direct construction workforce migrating into the region has a normal family size for the region (i.e. 2.5) and the remainder are single[1] and conservatively assuming all flow-on employment workers moving into the region have a family size of 2.5, the peak population increase would be some 406 people, or less than 0.1% of the 2003 population of the region (Appendix G).

Community Infrastructure Effects

The predicted population increases associated with the initial Project construction would be short term and represent less than 0.1% of the 2003 population. Given the existing community infrastructure facilities that are available in the region, this short term population increase is unlikely to place any significant demands on existing community services and facilities (Appendix G). Given the tight rental market in Newcastle, the Project could lead to some increase in rents and this could potentially result in some displacement of lower income Newcastle tenants who may then move to lower priced rental accommodation. However there is large temporary accommodation capacity in the region (Table 4-40) and this may act to alleviate pressure on rentals in Newcastle (Appendix G).

Further Development of the Project to 66 Mtpa

As described in Section 2.3, development of the Project from 33 Mtpa to 66 Mtpa would be undertaken progressively, on the basis of market demand. The employment generation associated with development works to expand the facility above 33 Mtpa capacity would depend on the scale and rate of the expansion. Potential impacts could therefore be of a similar nature to the initial Project construction, but may be significantly less if the expansion is undertaken over a longer period of time.

Project Operations

Workforce

As described in Section 2.11, it is anticipated that 100 people would be employed for the 66 Mtpa Project. A significant proportion of the construction workforce is expected to be sourced from the Newcastle SSD, with only 5% of the operational workforce expected to be sourced from outside the local region.

The regional economic assessment conducted by Gillespie Economics (Appendix G) indicates flow-on employment effects associated with Project operation at 66 Mtpa would create an estimated 251 indirect employment opportunities in the Newcastle SSD.

Population Effects

During operation of the Project the population impacts would be significantly less than during construction. Of the estimated 100 direct workforce at 66 Mtpa capacity, only 5% are expected to originate from outside the Newcastle SSD. If a similar percentage is applied to the estimated flow-on employment and a normal family size for the region of 2.5 is assumed for incoming workers, the increase in population would be in the order of 44 people or less than 0.01% of the regional population (Appendix G).

Housing and Community Infrastructure Effects

Given the low additional population associated with the Project operations direct and indirect employment, no significant community infrastructure effects would be anticipated.

Social Considerations

Employment

The Project would create direct jobs during construction and operation and indirect employment across a range of sectors. These job opportunities would contribute to reduction in regional unemployment, since it is estimated that in the order of 65% of the construction workforce and 95% of the operational workforce would be sourced from within the Newcastle SSD. Even the generation of temporary employment for the unskilled during construction, may provide enough experience to help them secure future permanent employment (Appendix G).

Community Structure

In terms of community structure, Newcastle is a relatively close-knit area with a traditional industrial base in coal shipment and steel production. The Project reinforces and expands this historical focus of the region. Since most of the ongoing workforce would be drawn from the existing population, it is not expected that the proposed development would negatively impact on the existing community structure (Appendix G).

[1] This is because the construction workforce in mining and for other major developments generally tend to be very mobile and are not accompanied by spouse and children.

Amenity

The development of the Project has some potential to adversely affect amenity (e.g. via noise or visual impacts). However Project is located in a recognised industrial area and would include the implementation of mitigation and management measures where practicable to minimise potential impacts on amenity.

Public Health

There is potential for the proposed development to negatively impact on public health through impacts on air and water quality. However, the assessments of these potential affects as described in Sections 4.4.2 and 4.6.2 indicate that the relevant criteria required by the NSW government would be met.

The proposal has the potential to indirectly positively impact on public health through the provision of employment opportunities and the reduction in unemployment. Prolonged unemployment can generate a range of personal and social problems including increased drug and alcohol dependency and increased demand for health services (Appendix G). Providing opportunities to reduce unemployment can be therefore be beneficial (Appendix G).

Crime and Public Safety

The Project is unlikely to have a negative impact on public safety (Appendix G). Access to the site would be restricted to the workforce during both the Project construction and operations. The site would be suitably lit and configured and security patrols would be undertaken to minimise potential for vandalism to occur.

There is some potential for the proposed development to indirectly result in a decrease in crime rates in the region, through providing increased employment opportunities to those who are currently unemployed (Appendix G).

4.13.3 Mitigation Measures and Management

Although the potential population effects of the proposal are largely limited to the initial Project construction, the temporary increase in population could have some minor adverse effects on rental availability in the tight Newcastle rental market. NCIG would consult with the NCC during the development of the Project to monitor this potential issue and discuss management measures, if required.

As noted in Section 4.13.1, there is a wide range of temporary accommodation available in the region.

In addition, the Project would continue to consult with the local community and would establish a Community Consultative Committee for the Project as an on-going channel for communication between the local community and NCIG. The CCC would comprise a similar membership to the current SFG and would meet to discuss development progress, to review the general environmental performance of the Project and to discuss any issues raised by the community.

If during the development social or community infrastructure issues arise, these would be managed in consultation with the NCC and/or the relevant State Government Department.

4.14 HAZARD AND RISK

A Preliminary Hazard Analysis (PHA) was conducted to evaluate the hazards associated with the Project (Appendix I). The PHA is a requirement of SEPP 33 (Section 3.3.3) and was conducted in accordance with the general principles of risk evaluation and assessment provided in the NSW DUAP *Multi-Level Risk Assessment Guidelines* (1999).

In accordance with the Newcastle Development Control Plan, the PHA has been prepared with regard to the *Newcastle and Kooragang Island Area Risk Assessment Study* (DoP, 1992b). The Newcastle Development Control Plan requires that development applications within the Kooragang Port and Industrial Area include an assessment under SEPP 33.

In regards to new development on Kooragang Island, the *Newcastle and Kooragang Island Area Risk Assessment Study* states that:

> *The existing risk levels from the Incitec facility and the proximity to sensitive environmental areas would tend to constrain activities with far field effects or significant potential to harm the biophysical environment.*

The above potential constraint was also considered in the PHA (Section 4.14.1).

4.14.1 Hazard Identification and Risk Assessment

Potentially hazardous materials required for the Project are generally limited to diesel, petrol, hydrocarbons (oil) and gas cylinders (Appendix I). For the purposes of risk identification the Project was divided into a number of operational areas including:

- construction;
- rail spurs, loops and train unloading station;
- coal stockpiles and administration area; and
- shiploading and wharf facilities.

Potential incidents were then identified within each operational area and divided into generic classes including (Appendix I):

- fire;
- explosion;
- toxic release; and
- theft.

Potential hazards identified in the PHA related to the following Project elements/activities:

- diesel, petrol, hydrocarbon and gas use and storage facilities (e.g. fires and leaks/spills);
- general operations, including construction activities (e.g. conveyor or stockpile fires, vehicle fires and leaks/spills);
- failure of water management systems and spills; and
- rail operations (e.g. leaks/spills).

Following the identification of potential hazards associated with the Project, a qualitative assessment of risks to the public, property and the environment associated with the development and operation of the Project was undertaken (Appendix I). Risk treatment measures have been proposed, where required, to produce a low level risk in accordance with the risk acceptance criteria (Appendix I).

Given that the Project complies with the risk acceptance criteria and that no significant far field effects or effects on the bio-physical environment were noted, it is considered that the constraints noted in the *Newcastle and Kooragang Island Area Risk Assessment Study* (DoP, 1992b) are not relevant to the Project (Appendix I).

4.14.2 Mitigation Measures and Management

A number of hazard preventative and mitigative measures would be described in management plans for the Project, including the following:

- Emergency Response Plan (ERP);
- Construction Environmental Management Plan (CEMP);
- Spontaneous Combustion Management Plan (SCMP);
- Site Water Management Plan (SWMP);
- Contractor Management Plan; and
- Traffic management plans.

In addition, the following hazard treatment measures would be adopted for the Project:

- **Maintenance –** Ongoing and timely maintenance of all mobile and fixed plant and equipment in accordance with the manufacturer's recommended maintenance schedule, and consistent with the maintenance schemes required by relevant standards. Only vehicles permitted to carry dangerous goods would be used for the transport of potentially hazardous materials.
- **Staff Training –** Operators and drivers would be trained and (where appropriate) licensed for their job descriptions. Only those personnel licensed to undertake skilled and potentially hazardous work would be permitted to do so.
- **Engineering Structures –** Civil engineering structures would be constructed in accordance with applicable codes, guidelines and Australian Standards.
- **Contractor Management** – All contractors employed by NCIG would be required to operate in accordance with the relevant Australian Standards, NSW Legislation and NCIG's Contractor Management Plan.
- **Storage Facilities –** Storage and usage procedures for potentially hazardous materials (i.e. fuels and lubricants) would be developed in accordance with Australian Standards and relevant legislation.