Site Boundary

Legend

Ecological Boundaries

- Site Boundary
- Study Area

ThreatenedSpecies

- Eucalyptus parramattensis subsp. decadens
- Euphrasia arguta
- Grevillea shiressii
- Maundia triglochinoides
- Zannichellia palustris
- Arrow-head Vine, Tinospora tinosporoides
- Biconvex Paperbark, Melaleuca biconvexa
- Black-eyed Susan, Tetratheca juncea
- Camfield's Stringybark, Eucalyptus camfieldii
- Charmhaven Apple, Angophora inopina
- Coast Headland Pea, Pultenaea maritima
- Dwarf Kerrawang, Rulingia prostrata
- Heath Wrinklewort, Rutidosis heterogama
- Magenta Lilly Pilly, Syzygium paniculatum
- Netted Bottle Brush, Callistemon linearifolius
- Rough Doubletail, Diuris praecox
- Small-flower Grevillea, Grevillea parviflora subsp. parviflora
- Tall Knotweed, Persicaria elatior

0 1 2 3Km

N

Client:	Crawfords Freightlines Pty Ltd		
Drawing No:	0143175s_EIS_G002_R0.mxd		
Date:	15/10/2012	Drawing Size: A3	
Drawn By:	CEW	Reviewed By: RD	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.11- Threatened Flora Records within a 10km radius of the Study Area

Crawfords Freightlines Pty Ltd – EIS

Environmental Resources Management ANP

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Site Boundary

Legend

Ecological Boundaries

- Site Boundary
- Study Area

ThreatenedSpecies

- Australasian Bittern, Botaurus poiciloptilus
- Australian Painted Snipe, Rostratula australis
- Barking Owl, Ninox connivens
- Black Bittern, Ixobrychus flavicollis
- Black-breasted Buzzard, Hamirostra melanosternon
- Black-chinned Honeyeater (eastern subspecies), Melithreptus gularis gularis
- Black-necked Stork, Ephippiorhynchus asiaticus
- Black-tailed Godwit, Limosa limosa
- Blue-billed Duck, Oxyura australis
- Broad-billed Sandpiper, Limicola falcinellus
- Brush-tailed Phascogale, Phascogale tapoatafa
- Bush Stone-curlew, Burhinus grallarius
- Comb-crested Jacana, Irediparra gallinacea
- Curlew Sandpiper, Calidris ferruginea
- Diamond Firetail, Stagonopleura guttata
- Dugong, Dugong dugon
- Eastern Bentwing-bat, Miniopterus schreibersii oceanensis
- Eastern Cave Bat, Vespadelus troughtoni
- Eastern False Pipistrelle, Falsistrellus tasmaniensis
- Eastern Freetail-bat, Mormopterus norfolkensis
- Eastern Grass Owl, Tyto longimembris
- Eastern Osprey, Pandion cristatus
- Flesh-footed Shearwater, Ardenna carneipes
- Freckled Duck, Stictonetta naevosa
- Gang-gang Cockatoo, Callocephalon fimbriatum
- Glossy Black-Cockatoo, Calyptorhynchus lathami
- Gould's Petrel, Pterodroma leucoptera leucoptera
- Great Knot, Calidris tenuirostris
- Greater Broad-nosed Bat, Scoteanax rueppellii
- Greater Sand-plover, Charadrius leschenaultii
- Green Turtle, Chelonia mydas
- Green and Golden Bell Frog, Litoria aurea
- Grey-crowned Babbler (eastern subspecies), Pomatostomus temporalis temporalis
- Grey-headed Flying-fox, Pteropus poliocephalus
- Hooded Robin (south-eastern form), Melanodryas cucullata cucullata
- Humpback Whale, Megaptera novaeangliae
- Koala, Phascolarctos cinereus
- Large-eared Pied Bat, Chalinolobus dwyeri
- Lesser Sand-plover, Charadrius mongolus
- Little Bentwing-bat, Miniopterus australis
- Little Eagle, Hieraaetus morphnoides
- Little Lorikeet, Glossopsitta pusilla
- Little Tern, Sternula albifrons
- Magpie Goose, Anseranas semipalmata
- Masked Booby, Sula dactylatra
- Masked Owl, Tyto novaehollandiae
- New Holland Mouse, Pseudomys novaehollandiae
- New Zealand Fur-seal, Arctocephalus forsteri
- Pied Oystercatcher, Haematopus longirostris
- Powerful Owl, Ninox strenua
- Providence Petrel, Pterodroma solandri
- Regent Honeyeater, Anthochaera phrygia
- Rose-crowned Fruit-Dove, Ptilinopus regina
- Scarlet Robin, Petroica boodang
- Sooty Owl, Tyto tenebricosa
- Sooty Oystercatcher, Haematopus fuliginosus
- Southern Giant Petrel, Macronectes giganteus
- Southern Myotis, Myotis macropus
- Spotted Harrier, Circus assimilis
- Spotted-tailed Quoll, Dasyurus maculatus
- Square-tailed Kite, Lophoictinia isura
- Squirrel Glider, Petaurus norfolcensis
- Superb Fruit-Dove, Ptilinopus superbus
- Swift Parrot, Lathamus discolor
- Terek Sandpiper, Xenus cinereus
- Turquoise Parrot, Neophema pulchella
- Varied Sittella, Daphoenositta chrysoptera
- Wallum Froglet, Crinia tinnula
- Wandering Albatross, Diomedea exulans
- White-fronted Chat, Epthianura albifrons
- Wompoo Fruit-Dove, Ptilinopus magnificus
- Yellow-bellied Sheathtail-bat, Saccolaimus flaviventris

0 1 2 3Km

N

Client:	Crawfords Freightlines Pty Ltd		
Drawing No:	0143175s_EIS_G003_R0.mxd		
Date:	15/10/2012	Drawing Size: A3	
Drawn By:	CEW	Reviewed By: RD	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.12- Threatened Fauna Records within a 10km radius of the Study Area

Crawfords Freightlines Pty Ltd – EIS

Environmental Resources Management ANP

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Table 5.6 Threatened species known or with the potential to occur within 10km of the Study Area

Scientific Name	Common Name	TSC Act	EPBC Act	Atlas Search	EPBC Search
Fauna					
Amphibians					
Crinia tinnula	Wallum Froglet	V	-	Y	N
Litoria aurea	Green and Golden Bell Frog	E	V	Y	Y
Litoria littlejohni	Littlejohn's Tree Frog	V	V	N	Y
Birds					
Anseranas semipalmata	Magpie Goose	V		Y	N
Anthochaera phrygia	Regent Honeyeater	E	E	Y	Y
Ardenna carneipes	Flesh-footed Shearwater	V	MM	Y	N
Botaurus poiciloptilus	Australasian Bittern	E	E	Y	Y
Burhinus grallarius	Bush Stone-curlew	E	-	Y	N
Calidris ferruginea	Curlew Sandpiper	E	MW	Y	Y
Calidris tenuirostris	Great Knot	V	MW	Y	Y
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Y	N
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	E	Y	N
Charadrius leschenaultii	Greater Sand Plover	V	MW	Y	Y
Charadrius mongolus	Lesser Sand Plover	V	MW	Y	Y
Circus assimilis	Spotted Harrier	V	-	Y	N
Daphoenositta chrysoptera	Varied Sittella	V	-	Y	N
Dasyornis brachypterus	Eastern Bristlebird	E	E	N	Y
Diomedea exulans	Wandering Albatross	E	V, MM	Y	N
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Y	N
Epthianura albifrons	White-fronted Chat	V	-	Y	N
Glossopsitta pusilla	Little Lorikeet	V	-	Y	N
Haematopus fuliginosus	Sooty Oystercatcher	V	-	Y	N
Haematopus longirostris	Pied Oystercatcher	E	-	Y	N
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Y	N
Hieraaetus morphnoides	Little Eagle	V	-	Y	N
Irediparra gallinacea	Comb-crested Jacana	V	-	Y	N
Ixobrychus flavicollis	Black Bittern	V	-	Y	N
Lathamus discolour	Swift Parrot	E	E	Y	Y
Limicola falcinellus	Broad-billed Sandpiper	V	MW	Y	Y
Limosa lapponica	Bar-tailed Godwit		MW	N	Y
Limosa limosa	Black-tailed Godwit	V	MW	Y	Y
Lophoictinia isura	Square-tailed Kite	V	-	Y	N
Macronectes giganteus	Southern Giant Petrel	E	E, MM	Y	N
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Y	N
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Y	N
Neophema pulchella	Turquoise Parrot	V	-	Y	N
Ninox connivens	Barking Owl	V	-	Y	N
Ninox strenua	Powerful Owl	V	-	Y	N
Oxyura australis	Blue-billed Duck	V	-	Y	N
Pandion cristatus	Eastern Osprey	V	-	Y	N
Petroica boodang	Scarlet Robin	V	-	Y	N

Scientific Name	Common Name	TSC Act	EPBC Act	Atlas Search	EPBC Search
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Y	N
Pterodroma leucoptera leucoptera	Gould's Petrel	V	-	Y	N
Pterodroma solandri	Providence Petrel	V	-	Y	N
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	Y	N
Ptilinopus regina	Rose-crowned Fruit-Dove	V	-	Y	N
Ptilinopus superbus	Superb Fruit-Dove	V	-	Y	N
Rostratula australis	Australian Painted Snipe	E	V	Y	Y
Rostratula benghalensis	Painted Snipe	-	V, MW	N	Y
Stagonopleura guttata	Diamond Firetail	V	-	Y	N
Sternula albifrons	Little Tern	E		Y	N
Sternula nereis nereis	Fairy Tern		V	N	Y
Stictonetta naevosa	Freckled Duck	V	-	Y	N
Sula dactylatra	Masked Booby	V	-	Y	N
Tyto longimembris	Eastern Grass Owl	V	-	Y	N
Tyto novaehollandiae	Masked Owl	V	-	Y	N
Tyto tenebricosa	Sooty Owl	V	-	Y	N
Xanthomyza phrygia	Regent Honeyeater	E	E, MT	N	Y
Xenus cinereus	Terek Sandpiper	V	MW	Y	Y
Mammals					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Y	Y
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Y	Y
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Y	N
Miniopterus australis	Little Bentwing-bat	V	-	Y	N
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Y	N
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Y	N
Myotis macropus	Southern Myotis	V	-	Y	N
Petaurus norfolcensis	Squirrel Glider	V	-	Y	N
Petrogale penicillata	Brush-tailed Rock-Wallaby	E	E	N	Y
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Y	N
Phascolarctos cinereus	Koala	V	V	Y	Y
Potorous tridactylus tridactylus	Long-nosed Potoroo	E	V	N	Y
Pseudomys novaehollandiae	New Holland Mouse	-	V	Y	Y
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Y	Y
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Y	N
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Y	N
Vespadelus troughtoni	Eastern Cave Bat	V	-	Y	N
Flora					
Allocasuarina defungens	Dwarf Heath Casuarina	-	E	N	Y
Angophora inopina	Charmhaven Apple	V	-	Y	N
Callistemon linearifolius	Netted Bottle Brush	V	-	Y	N

Scientific Name	Common Name	TSC Act	EPBC Act	Atlas Search	EPBC Search
Diuris praecox	Rough Doubletail	V	-	Y	N
Eucalyptus camfieldii	Camfield's Stringybark	V	-	Y	N
Eucalyptus parramattensis subsp. *decadens*		V	-	Y	N
Euphrasia arguta		E	-	Y	N
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Y	N
Grevillea shiressii		V	-	Y	N
Melaleuca biconvexa	Biconvex Paperbark	V	V	Y	Y
Maundia triglochinoides		V	-	Y	N
Persicaria elatior	Tall Knotweed	V	-	Y	N
Pterostylis gibbosa	Illawarra Greenhood	E	E	N	Y
Pultenaea maritima	Coast Headland Pea	V	-	Y	N
Rulingia prostrata	Dwarf Kerrawang	E	-	Y	N
Rutidosis heterogama	Heath Wrinklewort	V	-	Y	N
Syzygium paniculatum	Magenta Lilly Pilly	E	-	Y	N
Tetratheca juncea	Black-eyed Susan	V	V	Y	Y
Tinospora tinosporoides	Arrow-head Vine	V	-	Y	N
Zannichellia palustris		E	-	Y	N

Key: V = Vulnerable; E = Endangered; MM = Migratory Marine; MT = Migratory Terrestrial; MW = Migratory Wetland.

Table 5.7 Migratory species known or with the potential to occur within 10km of the study area

Scientific Name	Common Name	TSC Act	EPBC Act	Atlas Search	EPBC Search
Actitis hypoleucos	Common Sandpiper	-	MW	N	Y
Apus pacificus	Fork-tailed Swift	-	MM	N	Y
Ardea modesta	Great Egret	-	MM, MW	N	Y
Ardea ibis	Cattle Egret	-	MM, MW	N	Y
Ardenna carneipes	Flesh-footed Shearwater	V	MM	Y	N
Arenaria interpres	Ruddy Turnstone	-	MW	N	Y
Calidris acuminata	Sharp-tailed Sandpiper	-	MW	N	Y
Calidris canutus	Red Knot	-	MW	N	Y
Calidris ferruginea	Curlew Sandpiper	E1	MW	Y	Y
Calidris ruficollis	Red-necked Stint	-	MW	N	Y
Calidris tenuirostris	Great Knot	V	MW	Y	Y
Charadrius bicinctus	Double-banded Plover	-	MW	N	Y
Charadrius leschenaultii	Greater Sand Plover	V	MW	Y	Y
Charadrius mongolus	Lesser Sand Plover	V	MW	Y	Y
Diomedea exulans	Wandering Albatross	E1	V, MM	Y	N
Gallinago hardwickii	Latham's Snipe	-	MW	N	Y

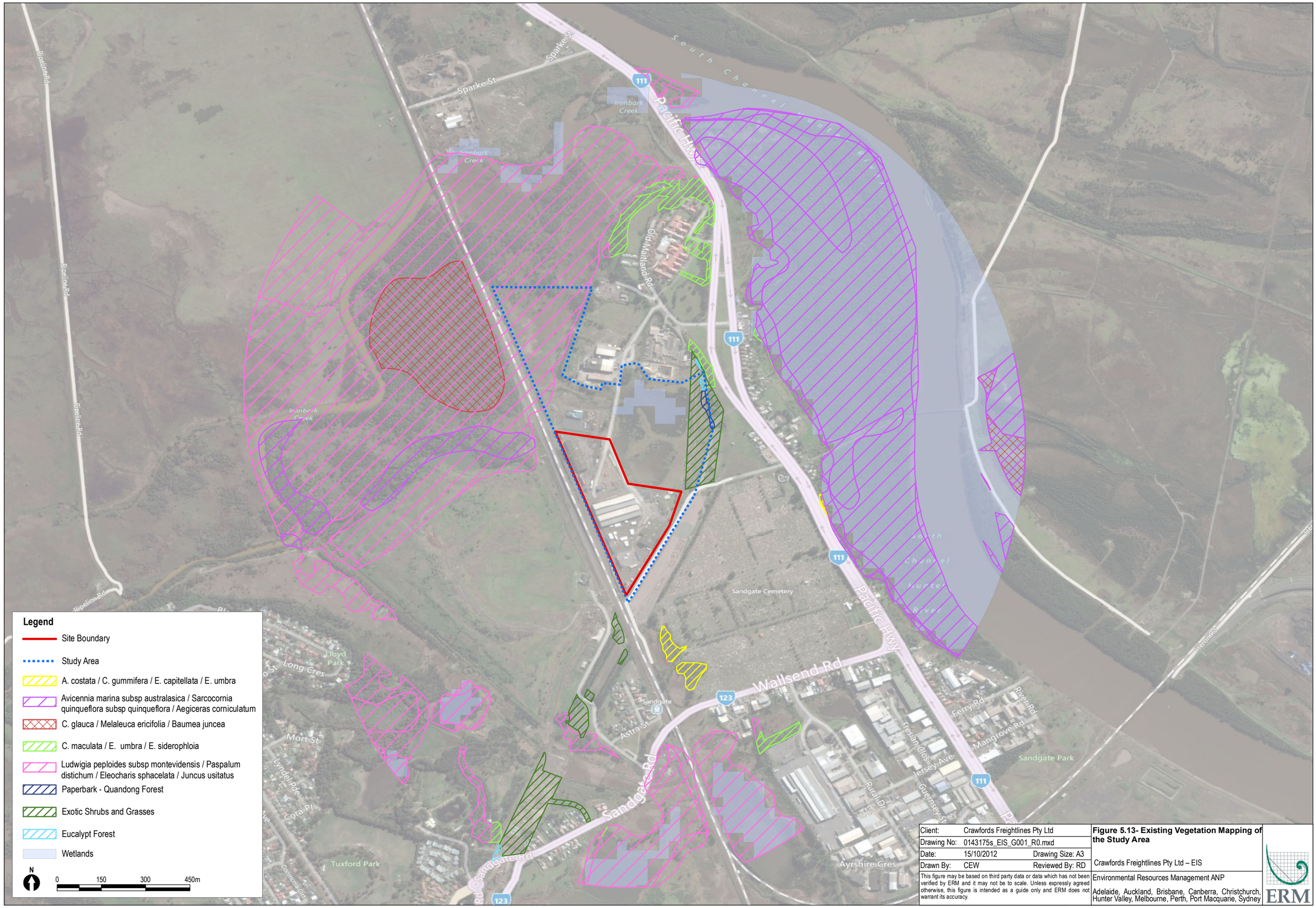
Scientific Name	Common Name	TSC Act	EPBC Act	Atlas Search	EPBC Search
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	MT	N	Y
Heteroscelus brevipes	Grey-tailed Tattler	-	MW	N	Y
Limicola falcinellus	Broad-billed Sandpiper	V	MW	Y	Y
Limosa lapponica	Bar-tailed Godwit		MW	N	Y
Limosa limosa	Black-tailed Godwit	V	MW	Y	Y
Macronectes giganteus	Southern Giant Petrel	E1	E, MM	Y	N
Merops ornatus	Rainbow Bee-eater	-	MT	N	Y
Monarcha melanopsis	Black-faced Monarch	-	MT	N	Y
Myiagra cyanoleuca	Satin Flycatcher	-	MT	N	Y
Numenius madagascariensis	Eastern Curlew	-	MW	N	Y
Numenius minutus	Little Curlew	-	MW	N	Y
Numenius phaeopus	Whimbrel	-	MW	N	Y
Pluvialus fulva	Pacific Golden Plover	-	MW	N	Y
Pluvialus squatarola	Grey Plover	-	MW	N	Y
Rhipidura rufifrons	Rufous Fantail	-	MT	N	Y
Rostratula benghalensis	Painted Snipe	-	V, MW	N	Y
Tringa stagnatilis	Marsh sandpiper		MW	N	Y
Xanthomyza phrygia	Regent Honeyeater	E1	E, MT	N	Y
Xenus cinereus	Terek Sandpiper	V	MW	Y	Y

Key: V = Vulnerable; E = Endangered; MM = Migratory Marine; MT = Migratory Terrestrial; MW = Migratory Wetland.

Literature Review

Vegetation mapping

Existing vegetation mapping of the study area (Hunter & Central Coast Regional Environmental Management Strategy (HCCREMS) 2003) identifies four distinct vegetation types including Paperbark Quandong Forest, Eucalypt Forest, exotic shrubs and grasses and wetland. Existing vegetation mapping is shown in *Figure 5.13* and discussed in the following pages.



Client:	Crawfords Freightlines Pty Ltd		
Drawing No:	0143175s_EIS_G001_R0.mxd		
Date:	15/10/2012	Drawing Size: A3	
Drawn By:	CEW	Reviewed By: RD	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.13- Existing Vegetation Mapping of the Study Area

Crawfords Freightlines Pty Ltd – EIS

Environmental Resources Management ANP

Adelaide, Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Paperbark/ Hard Quandong Forest

Paperbark/ Hard Quandong Forest occurs along the eastern boundary of the study area on slopes surrounding the low lying wet areas. The vegetation community comprises a patchy closed canopy layer of Prickly-leaved Paperbark (*Melaleuca stypheloides*) and Hard Quandong (*Eleocarpus obovatus*), along with Whale Bone Tree (*Streblus brunonianus*), Flintwood (*Scolopia braunii),* Sweet Pittosporum (Pittosporum undulates), Cheese Tree (G*lochidion ferdinandii*) and Mock Olive (*Notelaea longifolia*) (HWR Ecological 2005).

This vegetation community has affinities to the final determination of three endangered ecological communities (EEC's) listed under the TSC Act, including:

- Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion,
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions; and
- River-flat Eucalypt Forest of the North Coast, Sydney Basin and South East Corner Bioregions.

Eucalypt Forest

Eucalypt Forest occurs within the north-east corner of the study area on slopes surrounding low lying wetland areas. The vegetation community comprises of a patchy canopy layer of Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*), Spotted Gum (*Corymbia maculata*) and Grey Ironbark (*Eucalyptus paniculata*). The understorey consists of native species including Gorse Bitter-Pea (*Davesia ulicifolia*) and Blackthorn (*Bursaria spinosa*). However, majority of the understorey is disturbed with weed species including Lantana (*Lantana camara*), Kikuyu (*Pennisetum clandestinum*), Purple Top (*Verbena banariensis*), and Fireweed (*Senecio madagascariensis*) (HWR Ecological 2005).

Exotic Shrubs and Grasses

Exotic shrubs and grasses occur within the eastern portion of the study area in areas that have previously been cleared for agricultural activities. The community is dominated by Kikuyu, Buffalo Grass (*Stenotaphrum secundatum*), Vasey Grass (*Paspalum urvillei*), Pampas Grass (*Cortadieria selloana*) and Rats-tail Grass (*Sporobolus indicus).* Additional species include Blackberry (*Rubus* sp.), Tobacco Bush (*Solanum mauritimum*), Lantana, Paddy's Lucerne *(Sida rhombifolia)* and Purple Top. Small fragments of native species remain within this community where conditions are suitable and include Cumbungi (*Typha orientalis*), Common Reed, Harsh Ground Fern (*Hypolepsis muelleri*) and River Buttercup (*Hydrocotyle inundatus*) (HWR Ecological 2005).

Wetland

The wetland community occur within the western portion of the site in areas of lower elevation that are regularly inundated. The community consists of islands of *Schoenoplectus littoralis* and *Panicum repens,* with some remnant mangroves, surrounded by open water with submerged macrophytes, such as *Myriophyllum* sp. and *Potamogeton* sp. The edge of the wetland community consists of reed swamp dominated by Common Reed with patches of Broad-leaf Cumbungi and dense *Panicum repens* (Cooper N & Winning G 2006).

Birds

A number of bird surveys have previously been undertaken within the vicinity of the study area (HWR Ecological 2005). The results of these studies identified four threatened bird species known or with the potential to occur within the study area, including:

- Latham's Snipe (*Gallinago hardwickii*) - listed as Migratory under the EPBC Act;
- Australian Painted Snipe (Rostratula australis) - listed as Vulnerable and Migratory under the EPBC Act and Endangered under the TSC Act;
- Australasian Bittern (Botaurus poiciloptilus) - listed as Endangered under the EPBC Act and TSC Act; and
- Magpie Goose (Anseranas semipalmata) - listed as Vulnerable under the TSC Act.

Green and Golden Bell Frogs

A core population of the Green and Golden Bell Frog was historically known from the 2HD Swamp area, with the open water and reed patches considered the primary breeding habitat and the surrounding areas of grasslands and swamps acting as secondary habitat. In the 2001/2002 breeding season, 100 Green and Golden Bell Frogs were captured in the 2HD Swamp (Cooper and Winning 2006). The species was last recorded in the 2HD Swamp complex during the 2003/2004 breeding season, over eight years ago. Drought conditions, disease (chytrid fungus), salinity and Mosquitofish are potential causal factors for the decline of the population.

The Green and Golden Bell Frog is listed as Endangered under Schedule 1 of the NSW TSC Act and Vulnerable under Schedule 1 Part 2 of the Commonwealth EPBC Act.

Groundwater Dependent Ecosystems

The NSW Office of Water has recently released risk assessment guidelines for GDEs (Serov *et al.* 2012). According to the classification system in the guidelines, two types of GDE were recorded in the study area:

- Wetland Ecosystem: The wetlands surrounding the site are considered to be GDEs. These wetlands are likely to be dependent on both surface water and groundwater for survival and impacts to groundwater such as pollution may impact these communities; and

- Terrestrial Ecosystem: Stands of Swamp Oak in the study area are likely to be dependent on groundwater, although these stands are small and isolated and generally infested by exotic weeds species. These areas are likely to be subject to the same hydrological cycles as the adjacent wetland areas described above, but without having the groundwater reaching the surface.

The groundwater associated with the GDEs in the study area is part of a shallow alluvial aquifer system. These systems are often in direct connection with surface water bodies such as rivers and wetlands. The natural variability of these systems allows them to tolerate fluctuating water levels, however significant changes to water regimes, such as the operation of dams, can cause damage to the system and subsequently the dependent ecosystems (DLWC 2002). Operations are not likely to result in significant changes to the water regime of the surrounding area, and significant impacts to GDEs are not expected.

Field Investigations

Field investigations recorded four frog species and 40 bird species within the Study Area. Two threatened species listed under the TSC Act were recorded; Black-necked Stork (*Ephippiorhynchus asiaticus*) (Endangered) and Magpie Goose (Vulnerable). A full inventory of flora and fauna at the site was not undertaken for the reasons discussed at the start of *Section 5.5.1*. The results of the field investigations are discussed in more detail in the following paragraphs.

Vegetation Communities and Mapping

The existing mapping from HCCREMS (2003) has poor coverage of the Study Area well and is very broad in scale and low in detail. Previous ecological assessments provide more accurate and detailed mapping of some parts of the Study Area, however to develop coverage of the entire Study Area for this assessment and to maintain consistency, new mapping was developed during field surveys for this project and is detailed in *Figure 5.14*.

The Study Area is dominated by exotic species in many areas, particularly around the edges of industrial properties and the Panicum repens wet grassland which dominated the 2HD Swamp area. Native reed swamps dominated by Broad-leaf Cumbungi and Common Reed are also present with a large stand extending from the north of the Crawfords property all the way to Ironbark Creek, this area also includes patches of Swamp Oak forest.

PACIFIC HIGHWAY

'2HD' SWAMP

SHED 'C'

MAIN NORTHERN RAILWAY

SCAFFLINK

SHED 'A'

SHED 'B'

SHED 'D'

SHORTLAND TO SANDGATE BYPASS

FORMER ASTRA STREET LANDFILL

NEWCASTLE GOLF PRACTICE CENTRE

SANDGATE CEMETERY

Legend

- Study Area
- Site Boundary
- *Typha/Phragmites* - Reedswamp
- *Panicum repens* - Wet Grassland
- Exotic Shrubs and Grasses
- Swamp Oak
- Buffalo Grass/*Juncus kraussii* - Wet Grassland
- *Panicum repens* - Wet Grassland with Exotic shrubs and Grasses

N

0 50 100m

Source:
© 2010 Google Earth Pro

Client:	Crawfords Freightlines Pty Ltd		
Drawing No:	0143175h_EIS_C036_R0.cdr		
Date:	12/12/2012	Drawing size:	A3
Drawn by:	JD	Reviewed by:	TS

Figure 5.14 - Vegetation Communities in The Study Area

Crawfords Freightlines Pty Ltd - Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Green and Golden Bell Frog

- Green and Golden Bell Frogs were not recorded in the Study Area during the surveys, but the results of habitat assessments and other survey methods are described in the sections below. Four frog species were recorded in the Study Area namely:Eastern Dwarf Tree Frog (*Litoria fallax*);
- Striped Marsh Frog (*Limnodynastes peronii);*
- Peron's Tree Frog (*Litoria peronii);* and
- Common Eastern Froglet (*Crinia signifera).*

Suitable areas of breeding habitat for the Green and Golden Bell Frog were identified in the Study Area; these areas were associated with the swamp complex to the east of the Crawfords property. Potential non-breeding habitat exists throughout the wetland areas and in adjacent vegetated areas. The introduced Mosquitofish was observed in all aquatic habitats within the Study Area. Studies have shown Mosquitofish predate on Green and Golden Bell Frog tadpoles (*Morgan and Buttemer* 1996) and have also suggested that presence of the Mosquitofish in permanent water bodies reduces their suitability as breeding sites (*Hamer* et al. 2002). The presence of Mosquitofish in very high abundance within water bodies of the Study Area is considered to significantly reduce its suitability for the Green and Golden Bell Frog.

Birds

A total of 40 bird species were recorded in the Study Area during the field surveys. Two species listed as threatened under the TSC Act were recorded in the Study Area; the endangered Black-necked Stork and the vulnerable Magpie Goose.

The Black-necked Stork has not previously been recorded in the Study Area but has been recorded in the locality. One adult male was observed foraging throughout the 2HD Swamp complex on 12 June 2012.

Water quality

Water quality was sampled at five sites (refer *Figure 5.15)*. At each site *in-situ* water quality parameters were measured with a multiparameter probe and water samples were collected and sent for laboratory analysis. Site 1 is designated as a reference site because it is located upstream from the Project area according to the hydraulic study undertaken by BMT WBM.

Client:	Crawfords Freightlines Pty Ltd		
Drawing No:	0143175h_EIS_C023_R0.cdr		
Date:	17/12/2012	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JC

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.15 - Aquatic Sampling Locations

Crawfords Freightlines Pty Ltd - Environmental Impact Statement

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

In-Situ Water Temperature

Water temperatures were variable between sampling sites within a range of 13.6 – 15.6 C (see *Table 5.8* and *Table 5.9)*. The variability in water temperature is likely to depend on a number of variables including the depth and movement of water, time of sampling and shading by local vegetation. The absence of distinct spatial patterns in water temperature at the five sampling sites indicates that there is no obvious impact of site activities on the temperature of surface water in the vicinity of the site.

Table 5.8 In-situ Water Quality Measurement Results

Site	Temp (°C)	Salinity (µS/cm)	DO (%/mg/L)	pH	ORP (mV)
1	13.9	764.4	19/1.92	7.22	107.0
2	14.2	764.2	25.6/2.63	7.93	82.3
3	13.6	763.5	9.4/0.98	7.65	63.3
4	14.8	763.2	19.4/1.95	7.85	47.5
5	15.6	762.3	31.1/3.10	8.06	57.7

Table 5.9 ANZECC Guidelines – Coastal and lowland Rivers, and lakes

Parameter	Value
Salinity	200 – 300 µS/cm
Dissolved Oxygen (DO)	85 – 110% DO
Water pH	6.5 to 8.0
Oxidation-reduction potential (ORP)	-100 and +300 mV

Source: ERM Ecology Assessment 2012

In-Situ Salinity

Salinity, measured as electrical conductivity, across the five sampling sites was within a narrow range of 762 – 764 µS/m indicating a similar level of dissolved salts within the water at each sampling site. Natural salinity of freshwater varies between regions and is related to the salt content of soils and the relative influence of fresh (or salt) water from within the catchment. The ANZECC (2000) guidelines indicate that NSW coastal rivers are typically in the range 200 – 300 µS/cm. Given the closeness of tidal waterways and the likelihood of regular tidal surges occurring in the immediate vicinity of the Study Area, it is not surprising that the electrical conductivity of the surface water is above what is expected for typical coastal rivers.

Importantly in this instance, the electrical conductivity at the reference location (Site 1) is similar to the measurements obtained at the other four sites. This suggests no obvious impact of site activities on the electrical conductivity of surface water in the vicinity of the site.

In-Situ Dissolved Oxygen

Dissolved oxygen (DO) refers to the concentration of oxygen dissolved in the water. A sufficient level of DO is essential for the health of aquatic species such as fish and invertebrates. DO concentrations can reduce below critical levels when excessive nutrients enter a water body causing a bloom in algae and/or aquatic plants that utilise DO for growth. Once DO levels fall below critical levels the aquatic fauna may become stressed and die.

DO concentrations varied between the sampling sites within a range of approximately 9 – 30% of saturation (1 – 3 mg/L) which are quite low for aquatic environments. The ANZECC (2000) guidelines state that NSW lowland rivers could be expected to have between 85 – 110% DO; however, non-flowing ponds and low flow drainage channels such as those sampled in this study would be expected to have significantly lower DO percentages.

Importantly for this study, the reference site (Site 1) has DO percentages in the middle range compared to DO at the other sampling sites, which suggests these low DO percentages are typical for surface waters in the vicinity of the site at the time of sampling.

In-Situ pH

Water pH is an indicator of the acidity/alkalinity of the water. The typical pH range is approximately 6.5 to 8.0 and pH is usually maintained within this narrow range due to the buffering capacity of the salts and other chemicals naturally occurring in water.

The range of pH evident at the five sampling sites is within the expected range for lowland rivers and lakes according to ANZECC (2000). Interestingly, pH was noticeably lower at the reference site (Site 1) and similar at all other sites. These results indicate that the water at Sites 2 – 5 are more alkaline than the reference site which may indicate some form of contamination from human activities near to Sites 2 -5; however, as already stated, the range of pH across all five sites is considered to be within natural ranges.

In-Situ Oxidation-Reduction Potential

Oxidation-reduction potential (ORP) of water is an indication of the ability of the water to oxidise contaminants and reflect the level of freely available oxygen in the water. The typical range of ORP readings for freshwater systems is between -100 and +300 mV. Where oxygen levels are low or utilisation through macrobenthic activity and microbial action is high, ORP readings are typically low. An ORP measurement below zero indicates that all freely available oxygen has been removed from the water and the environment is anoxic. Anaerobic decomposition of organic materials in the water body may create an oxygen demand and lower ORP levels.

ORP results for the five sampling sites indicate that the water at each site contains sufficient free oxygen for a healthy system and, at the time of sampling, the water was aerobic.

Importantly for the current study, the ORP level at the reference site (Site 1) was at least 20% higher than the ORP level at all other sampling sites. These results may indicate that there is a greater level of oxidation occurring at Sites 2 – 5 compared to Site 1, which may indicate some form of impact to the water at Sites 2 – 5. However, as mentioned above, the range of ORP evident at the five sampling sites is within the expected range for lowland aquatic environments.

Laboratory Analysis Results

The results of the laboratory analysis of water quality samples against ANZECC guidelines are summarised in *Table 5.10.*

Table 5.10 Water Quality Laboratory Analysis Results

Analyte	Units	Site 1	Site 2	Site 2-A	Site 3	site 4	Site 5	ANZECC
Ammonia as N	µg/L	80	120	30	30	40	30	900
Nitrite as N	µg/L	70	30	30	<10	20	20	N/A
Nitrate as N	µg/L	270	700	710	2520	380	520	700
Total Nitrogen as N	µg/L	1800	1600	1600	3900	1200	1300	500
Total Phosphorus as P	µg/L	70	300	320	220	300	250	50

Ammonia

Ammonia (as N) concentrations in water collected from each sampling site ranged between 30 and 120 µg/L. The highest ammonia concentration was reported in water from Site 2, which was 40 µg/L (or 50%) higher than reported for the reference site (Site 1); however ammonia concentrations at Sites 3 – 5 were between 30 and 40 µg/L or about half the concentration reported at the reference site. All results are within one order of magnitude of each other and no sites are significantly higher than any others or the reference site.

Ammonia concentrations were well below the 900 µg/L ANZECC (2000) guideline trigger value for the protection of 95% of freshwater species (for slightly - moderately disturbed systems). This indicates that despite spatial differences evident across the survey area, there is low risk of the ammonia concentrations evident in water at the time of sampling to impact most freshwater species.

Nitrite

Nitrite concentrations in water collected from the five sampling sites ranged from <10 to 70 µg/L. The highest nitrite concentration was reported for the water sample collected from the reference site (Site 1) which was more than

double the concentrations measured at all other sites. Assuming the concentration at Site 1 is close to background, these results indicate that there is no nitrite contamination evident at the sampling sites at the time of sampling. It is noted that ANZECC (2000) does not specify trigger values for nitrite.

Nitrate

Nitrate concentrations in water collected from the five sampling sites ranged from 270 to 2,520 µg/L. The highest nitrate concentration was reported for the water sample collected at Site 3 which was 1,800 µg/L or 257% higher than the next highest concentration (Site 2). This significantly higher nitrate concentration at Site 3 indicates a strong signature of nitrate contamination at that site. Interestingly, Site 3 is furthest away from the site and its location may suggest cumulative impacts from several upstream sources. However, the high nitrate content does indicate potential impacts from a nitrate source.

Nitrate concentration was lowest at the reference site (Site 1) which is likely to indicate natural background levels for the local area, and nitrate concentrations at the other sampling sites vary between 380 and 705 µg/L which are between 140% and 260% higher than the reference site. These results do indicate a distinct elevation of nitrates in surface waters adjacent to the site.

Nitrate concentrations at Sites 4 and 5 are below the 700 µg/L ANZECC (2000) guideline trigger value for the protection of 95% of freshwater species (for slightly - moderately disturbed systems) and the nitrate concentration at Site 2 (mean of two samples) is marginally above the ANZECC trigger value.

Total Nitrogen

Total nitrogen concentrations in water collected from the five sampling sites ranged from 1,200 to 3,900 µg/L. The highest total nitrogen concentration was reported for the water sample collected at Site 3 which was higher than the next highest concentration (Site 1) by 2,100 µg/L (or 117%).

Total nitrogen is the sum of all nitrogen products, including ammonia, nitrite and nitrate, so it is not surprising that the trend in total nitrogen concentrations often reflects any significantly high concentrations of any of the other nitrogen compounds. In this case, the high nitrate concentration evident at Site 3 adds significantly to the total nitrogen concentration at that site.

The ANZECC (2000) default trigger level for total nitrogen in slightly disturbed lowland river ecosystems is 500 µg/L and the trigger value specified under the Hunter River water quality objectives is 350 µg/L. All total nitrogen concentrations from the survey area are well above both these trigger values and therefore the local aquatic environment would appear to have a significantly higher total nitrogen loading than expected.

Total Phosphorus

Total phosphorus concentrations in water collected from the five sampling sites ranged from 70 to 310 µg/L. The highest total phosphorus concentration was reported for the water sample collected at Site 2 (mean of two samples). Compared to the total phosphorus concentration at the reference site, total phosphorus concentrations at all other sites were between 214% and 440% higher which indicates possible phosphorus contamination of the surface waters adjacent to the site. The ANZECC (2000) default trigger level for total phosphorus in slightly disturbed lowland river ecosystems is 50 µg/L and the trigger value specified under the Hunter River water quality objectives is 25 µg/L. All total phosphorus concentrations from the survey area are well above both these trigger values and therefore the local aquatic environment would appear to have a significantly higher total phosphorus loading than expected.

Aquatic Macroinvertebrates

Assessment of macroinvertebrates in a waterway can provide an indication of water quality. Different macroinvertebrates have different tolerances to pollution and diversity of macroinvertebrates is also an indicator ecosystem health.

SIGNAL 2 (Chessman 2003) is a simple scoring system for macroinvertebrate sampling in Australian rivers. Combining SIGNAL score calculations and consideration of diversity can give an indication of water quality and levels of pollution in a river system. The applicability of SIGNAL 2 to wetlands has not been tested and most of the macroinvertebrate orders that have the highest SIGNAL 2 sensitivity grades are naturally rare in wetlands such as stoneflies and mayflies and as such wetlands are likely to have naturally lower scores than streams in the same region. Therefore, SIGNAL 2 calculations were not undertaken for this assessment however grades for each macroinvertebrate group were recorded to help develop an understanding of the sensitivity of the species which were recorded in the Study Area.

The f macroinvertebrates recorded during the field surveys were:

- Water Boatmen;
- Water Flea;
- Freshwater Mite;
- Non-biting Midges;
- Diving Bettle;
- Dragonfly;
- Damsefly 1;

- Damselfy 2;
- Snail;
- Mosquito; and
- Flatworm.

The abundance of aquatic macroinvertebrates varied between the different species at the sampling sites. The most abundant macroinvertebrates were water fleas (Order Cladocera), water boatmen (Family Corixidae), non-biting midges (Family Chironomidae) and freshwater mites (Order Acarina), with only a few individuals of the other seven invertebrate groups.

Two macroinvertebrates recorded (freshwater mite and a damselfly (Synlestidae)) are included in the sensitive category (SIGNAL 2). The freshwater mite species was recorded at all sites and in reasonable abundance, while the Synlestid damselfly was recorded as one individual only at Site 4. These results indicate that the water quality in the Study Area is of sufficient quality to support sensitive species. Diversity of macroinvertebrates at all sites was generally quite low (11 different macroinvertebrates in total), this may reflect the time of year that the aquatic samples were undertaken (winter) and or a result of the uniform habitat of the sampling sites which were all dominated by dense *Panicum repens*.Macrophytes

A low diversity of macrophytes was recorded in the Study Area. Macrophytes were surveyed at the five aquatic sampling locations. Species recorded at each site include:

- *Panicum repens;*
- *Typha orientalis* (Broad-leaf Cumbungi);
- *Phragmites australis* (Common Reed);
- *Azolla filiculoides;* and
- *Spirodela sp.*

Panicum repens was dominant at all sites with the exception of Site 3 which was located in a dense reed swamp and not adjacent to open water; at this site Broad-leaf Cumbungi was dominant. Duckweed and *Azolla filiculoides* are abundant among mats of *Panicum repens* adjacent to open water areas of the 2HD Swamp. No submerged macrophytes were recorded during the sweep surveys for macroinvertebrates which may be an indication of this exotic species outcompeting native macrophytes.

5.5.3 Potential Impacts

The site is highly degraded and has been developed for industrial use. The vegetation within the site is limited to small areas of disturbed plantings and

patches of exotic grassland. Considering the poor biodiversity values present, the impact of the proposed works will be minimal, with no loss of important flora or fauna habitat anticipated.

Despite being heavily degraded from industrial activity and rail corridor expansion, the wetland habitats surrounding the Study Area are considered likely to represent two EECs listed under the TSC Act:

- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (Swamp Oak Floodplain Forest); and

- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Freshwater Wetlands on Coastal Floodplains).

The wetlands adjacent to site provide known and potential habitat for threatened fauna species and migratory birds including the Black-necked Stork and Magpie Goose.

The proposed activity has the potential to introduce limited disturbance to these habitats which are unlikely to cause significant impacts to the EECs. The proposal is a continuation of existing activities and therefore noise and light pollution are expected to remain at similar levels. There is also a significant of light and noise pollution from the Maitland Road, Pacific Highway to the east, the Great Northern Railway line to the west and other industry to the north. The wetland birds using the habitats surrounding the industrial site are highly mobile and the site is not considered to provide important habitat for a significant proportion of a local population of these species.

Elevated concentrations of nitrates and total phosphorus were recorded in the surrounding water bodies with increased pH levels at the 2HD swamp. It is difficult to determine the level of nutrient input from the site due to the lack of any baseline data, prior to AN storage, and other potential inputs from off site including other industry and runoff from adjacent properties. As a continuation of current activities there will not be any additional stormwater runoff or changes to the current hydrological regime. A range of WSUD measures are proposed on site to improve water quality, including retaining and filtering stormwater runoff to reduce the concentrations and loads of stormwater pollutants discharging from the site.

The potential remains for a large scale flood event at or above the 2% AEP level resulting in inundation of the site. The 1% AEP will lead to inundation of the site by 1 – 1.8 metres for greater than 72 hours, which may lead to significant damage to property and infrastructure as well as stored goods and materials. Given that AN is highly toxic to a wide range of aquatic fauna (ANZECC, 2000), the consequences for downstream ecosystems are likely to be significant (refer to *Section 5.3.4)* This is because, even under a 1% release scenario (Scenario 1), the simulations predict that the ammonia TTV would be exceeded for more than two kilometres downstream of the site. The other

scenario predicts even larger zones of confluence where the TTV is likely to be exceeded, including all the way to the mouth of the Hunter River (Scenario 2).

If stored AN material is leached from the site during a flood there is a high likelihood that increased AN levels in the surrounding EECs will lead to eutrophication, weed proliferation and anoxic conditions in wetland and aquatic habitats. This has the potential for a reduction in habitat suitability for threatened flora and fauna including Black-necked Stork and Magpie Goose. Indirect impacts that could influence EECs and their inhabitants as a result the proposed activity include eutrophication, weed proliferation, changes in water chemistry and impacts to primary productivity of wetlands and aquatic environments. This could subsequently impact prey availability for threatened fauna such as large waterbirds within the EECs.

5.5.4 Summary and Mitigation Measures

The Crawfords operation is generally surrounded by wetland habitats which although disturbed, provide known and potential habitat for threatened fauna species. Impacts to surrounding ecological habitats include weed infestation and water quality. The proposal is a continuation of existing activities on the industrial site and although no additional surface runoff will be generated by the development, the development provides an opportunity to improve the way that stormwater is currently managed within the site

Stormwater quality modelling results indicate that the stormwater management measures proposed for the site would achieve the NCC storm water pollutant load reduction targets for Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) when considering the full site. The proposal includes environmental controls such as a range of WSUD measures. These are proposed within the site to retain and filter stormwater runoff to reduce the concentrations and loads of stormwater pollutants discharging from the site. The measures include the capture and storage of stormwater from roof areas; construction of a wheel wash bay; construction of five sedimentation and biofiltration basins; site regrading for effective site drainage; and layering of aggregate over unsealed trafficable areas to reduce erosion and sedimentation disturbance. The design and construction, of these devices is in accordance with best practice engineering solutions and stormwater management. With these improvements along with regular monitoring and reporting on performance in accordance with licencing conditions continuing current operations is not expected to significantly impact features of ecological significance.

5.6 AIR QUALITY

An Air Quality Impact Assessment (AQIA) has been prepared by ERM (2012) to assess the impacts to the surrounding environment from the proposed AN storage and distribution facility. A copy of the AQIA is located in *Annex G.* The scope of the AQIA included:

- an evaluation of the existing conditions at the site;
- a review of the potential emissions to atmosphere;
- an assessment of the air quality impacts from operation of the facility at sensitive receptors; and
- the identification of possible site-specific ameliorative measures based on the outcomes of the air quality assessment.

The AQIA was undertaken as a 'Level 2' impact assessment as described by the Environment Protection Authority (EPA) publication '*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales'*, NSW DEC, August 2005. This approach was selected as it is a more refined modelling method and considered appropriate given the relatively close proximity of nearby sensitive receptors.

Works were undertaken in consideration to *Part 5: Emission of Air Impurities from Activities and Plant in the Protection of the Environment Operations (Clean Air) Regulation (2010);* and *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales*, NSW DEC, August 2005. The AQIA also considered the National Environment Protection Measure for Ambient Air Quality (AAQ NEPM) as well as 'Action for Air', a 25 year plan for the management of air quality in the Greater Metropolitan Region.

Potential air quality impacts resulting from site activities include:

- ambient concentrations of total suspended particulates (TSP);
- ambient concentrations of particulate matter less than 10 microns (PM_{10}); and
- total deposited dust resulting from TSP emissions.

5.6.1 Existing Environment

A review of background conditions was undertaken to determine the existing background conditions prior to the commencement of the proposed facility. Newcastle City Council has undertaken air monitoring for TSP and PM_{10} at Mayfield located approximately 4.75 km to the southeast of the site. The 2009 annual average for TSP and PM_{10} respectively was 35µg/m^3 and 21µg/m^3 (daily data not available). A desktop review of the National Pollutant Inventory (NPI) of reported emissions from six fixed and mobile sources in the vicinity of the site was also undertaken. The review found 28,000,000kg of PM_{10} reported for the 2010/11 reporting year from point and diffuse sources, equating to an estimated emissions factor of 887.87g/s assuming constant operations for 24 hours per days for 365 days of the year.

Information from the NSW EPA monitoring location at Wallsend was also reviewed given its close proximity to the site (4.5 km), flat terrain and limited

industry between the site and the monitoring station. Annual average and maximum 24 hour average concentrations of PM_{10} measured at Wallsend in 2009 were used to provide a cumulative assessment. Background values used were: annual average –26.9µg/m^3; and a maximum 24 hour average – 42.9µg/m^3. There were 10 exceedances of the PM_{10} 24 hour criteria during 2009 at the Wallsend Tapered Elemental Oscillating Microbalance (TEOM) station. In order to determine if any additional exceedances would occur as a result of the proposed operations, the highest concentration below the criteria has been adopted as the maximum concentration for comparison.

There is no dust deposition monitoring currently undertaken in the vicinity of the site with no public data available. Given this, a cumulative assessment of dust deposition has not been undertaken. Criteria for dust deposition, specified in the 'Approved Methods', allows an annual mean deposition rate of 4g/m^2/month, no more than 2g/m^2/month above background. A criteria of an annual mean generated concentration of 2g/m^2/month has been used to ensure the a cumulative impact from the site will remain below 2g/m^2/month above background.

5.6.2 Potential Impacts

Identified sources of potential particulate emissions from site include:

- wheel generated dust from trucks delivering and distributing product on semi paved areas;
- mobile equipment such as forklifts on unpaved areas moving shipments of product around the site;
- dust from transfer of ammonium nitrate from flexible bags into bulk trucks through a small hopper; and
- wind generated dust from unpaved areas.

Vehicle movements located on site are confined to sealed surfaces. Normally sealed surfaces have a control factor of 100% applied. As the site is not currently swept and particulate matter has accumulated on the site surface, a control factor of 50% has been applied to the asphalt and cement stabilised road base. Emissions have been estimated using published emission factors from the Australian NPI emission estimation technique manual for *Mining* (2011) and the US EPA AP 42 document *'Compilation of Air Pollutant Emission Factors'*.

In this assessment the NSW EPA approved dispersion model CALPUFF has been used to model emissions from the proposed operations. This model was selected due to the relatively high number of calm days experienced at the site which impacts the results of other models.

The modelling parameters used include: meteorological data modelling, terrain, model receptors, background concentrations, and particle size distribution. Five years of available historical meteorological data from Nobbys Head, NSW was reviewed. It was determined 2009 provided the most representative year for dispersion modelling. A site-specific meteorological file has been generated using a combination of observed meteorological data, synoptic data, terrain data and land use. For details of sensitive receptors refer to *Table 5.11* and *Figure 5.16*

Table 5.11 Sensitive Receptor Locations

Receptor Number	Description	AMG Coordinates		Distance from site (km)	Direction from site
R1	19 Astra St, Sandgate	378562	6362165	0.32	S
R2	108-112 Maitland Rd Sandgate	379194	6362445	0.60	SE
R3	166 Maitland Rd Sandgate	378917	6362962	0.29	NE
R4	St Josephs Home, Old Maitland Rd, Sandgate	378624	6363527	0.55	NNE
R5	43 Blanch St, Shortland	377768	6362257	0.82	SW

1. AMG Australian Map Grid Coordinates

Emission estimates have been based on fifteen truck movements a day across the whole site and an operating schedule of 6 days per week; however, for modelling purposes operations are assumed to occur for all days of the year. Therefore, dust generating activities are assumed to be undertaken for 14 hours per day (6.00 am to 8.00 pm) Monday through Sunday. Whilst this approach provides a conservative assessment for annual mean concentrations, it enables the model to 'test' emissions against the year-round meteorology on any given day that occur during normal operational hours for shorter averaging periods. This means that results for the annual mean will be overestimated by the model.

Table 5.12 and *Table 5.13* present a summary of the maximum predicted incremental ground level concentrations for the modelled receptor where highest concentrations were recorded. *Figure 5.17* to *Figure 5.20* detail the maximum predicted concentration contours.

Client:	Crawfords Freightlines		
Drawing No:	0143175h_EIS_C037_R1.cdr		
Date:	12/12/2012	Drawing size: A4	
Drawn by:	MM	Reviewed by: MC	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.16 - Sensitive Receptor Locations

Crawfords Freightlines
Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Table 5.12 Predicted Maximum Ground Level Concentrations for PM_{10} (24 hour average) Against Corresponding Background Concentration

Receptor	Date	Incremental Concentration (µg/m³)	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Criterion (µg/m³)
1	14/06/2009	6.60	14.7	21.3	50
2	09/06/2009	11.69	6.9	18.6	50
3	27/06/2009	11.62	13.2	24.8	50
4	20/04/2009	7.72	10.6	18.3	50
5	04/06/2009	5.26	10.5	15.8	50

1. Background is recorded at the Wallsend EPA monitoring station
2. Incremental – ground level concentration from the development in isolation
3. Cumulative – ground level concentrations from the development including background concentrations
4. NR – No background result was recorded on this day

Table 5.13 Annual Average Dispersion Modelling Pollutant Concentration and Deposition Rates at Sensitive Receivers

Receptor	PM_{10} Incremental (µg/m³)	PM_{10} Cumulative (Incremental + Background) (29.9 µg/m³)	TSP Incremental (µg/m³)	TSP Cumulative (Incremental + Background) (68.7 µg/m³)	Dust Deposition Incremental (g/m²/month)
1	0.27	27.17	0.39	69.09	0.04
2	1.13	28.03	1.75	70.45	0.19
3	1.08	27.98	1.75	70.45	0.19
4	0.29	27.19	0.37	69.07	0.04
5	0.28	27.18	0.37	69.07	0.05
Criteria	**-**	**30**	**-**	**90**	**2.0**

1. Increment – Concentration resulting from site activities at a modelled sensitive receptors
2. Cumulative – Concentration resulting from site activities plus ambient background concentration

Table 5.14 Maximum Incremental Ground Level Concentrations

Pollutant[1]	Maximum Increment (Receptor ID)[2]	Background[3]	Cumulative	Criteria[4]	% of Criteria
PM_{10} – 24 hour (µg/m³)	11.7 (2)	6.9	18.6	50	37.2%
PM_{10} – 24 hour (µg/m³)[5]	1.9 (2)	42.9	44.8	50	89.6%
PM_{10} – Annual (µg/m³)	1.1 (2)	26.9	28.0	30	93.3%
TSP – Annual (µg/m³)	1.8 (2,3)	68.7	70.5	90	78.3%
Dust Deposition – Annual (g/m²/month)	0.2 (2,3)	N/A	N/A	2	10%

1. Modelling results are presented for the receptors identified as experiencing the highest levels of each contaminant
2. Maximum increment has been estimated based on dispersion modelling
3. Background data derived from the EPA Wallsend TEOM monitoring data
4. Criteria are sourced from DEC (2005) "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"
5. Predicted concentration on day of maximum background (contemporaneous data presented in *Table 7.1)*

Client:	Crawfords Freightlines		
Drawing No:	0143175pm_EIS_C038_R0.cdr		
Date:	12/12/2012	Drawing size:	A4
Drawn by:	MM	Reviewed by:	MC

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.17 - Concentration Contours PM10 24 Hour Average

Crawfords Freightlines
Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Client:	Crawfords Freightlines		
Drawing No:	0143175pm_EIS_C039_R0.cdr		
Date:	12/12/2012	Drawing size: A4	
Drawn by:	MM	Reviewed by: MC	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.18 - Concentration Contours PM10 Annual Average

Crawfords Freightlines
Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Client:	Crawfords Freightlines		
Drawing No:	0143175pm_EIS_C040_R0.cdr		
Date:	12/12/2012	Drawing size: A4	
Drawn by:	MM	Reviewed by: MC	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.19 - Concentration Contours TSP Annual Average

Crawfords Freightlines
Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch,
Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Client:	Crawfords Freightlines		
Drawing No:	0143175pm_EIS_C041_R0.cdr		
Date:	12/12/2012	Drawing size: A4	
Drawn by:	MM	Reviewed by: MC	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.20 - Concentration Contours Dust as TSP (g/m2/month)

Crawfords Freightlines
Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

Table 5.12 to *Table 5.14* and *Figure 5.17* to *Figure 5.20* illustrate that the development is predicted to comply with the short term NSW EPA air quality impact criteria for PM_{10} at all receptors. The development is also predicted to comply with the long term NSW EPA air quality impact criteria for PM_{10}, TSP and dust at all receptors. The project would therefore have no significant impact on the long term air quality parameters of dust deposition, annual average PM_{10} and TSP. Concentration contours seen in *Figure 5.17* to *Figure 5.20* show that the highest impacts are centred on the site, with the predicted concentrations decreasing rapidly beyond the site boundary. Further reduction in dust generation would be achieved with the regular use of a road sweeper over the sealed surface to remove build-up of any particulate matter.

5.6.3 Mitigation Measures

Mitigation measures that would reduce potential air quality impacts include:

- regular use of a road sweeper over the sealed surface to remove the build-up of any particulate matter;
- continued use of the screw auger when transferring AN from flexible IBCs into bulk trucks which limits the amount of emissions generated; and
- continued use of sealed off areas on site to limit the generation of emissions.

5.7 GREENHOUSE GAS

A Greenhouse Gas Emissions (GHG) Assessment was undertaken by ERM (2012) for the proposed ammonium nitrate storage and distribution facility. The report is located in *Annex H*. The assessment was undertaken in accordance with the principles of The *Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard;* the DCCEE *National Greenhouse Accounts (NGA) Factors 2011 and* the DCCEE *National Greenhouse and Energy Reporting (Measurement) 2008 (the Determination).* Assumptions and approximations, based on recognised international standards such as the World Business Council Greenhouse Gas Protocol were made in order to obtain a reasonable estimate when data was not available.

5.7.1 Existing environment

A review of the key processes of the proposed facility was undertaken to identify the sites GHG emissions. The scope of the report looked at the direct emissions (scope 1 as defined by the Greenhouse Gas Protocol); indirect emissions (scope 2); and upstream and downstream emissions (scope 3) of greenhouse gas emissions in which Crawfords has some level of control.

The boundary for this GHG assessment has been defined as those emissions directly attributable to the operational activities at the 'site' (see *Table 5.15)*. Emissions from construction activities were not considered as part of this assessment given the site is currently leased by the proponent and no construction at the site is proposed.

Table 5.15 Greenhouse Gas Emission Sources Included and Excluded in this Assessment

	Scope 1 – Direct Emissions	**Scope 2 –Indirect Emissions from Purchased Energy**	**Scope 3 – Other Indirect Emissions**
Emission Sources Included	Fuel use on-site for operational activities (ie diesel, LPG and petrol used in mobile plant, vehicles and other equipment on site). Fuel usage of trucks used to transport ammonium nitrate to and from the site	Electricity usage on-site for operational activities (ie machinery, ancillary plant and administration facilities).	Transport of ammonium nitrate to site by freight train.
Emission Sources Excluded	Fuel use on-site for construction activities (ie diesel and petrol used in mobile plant to erect sheds) Fuel used for decommissioning of the facilities, including the end of life disposal and vehicles and machinery required for decommissioning.	Electricity usage on site for construction activities (ie electric tools used to erect sheds.) Electricity usage for decommissioning of the facilities.	Embodied energy of ammonium nitrate. Emissions associated with support services for the facility (ie marketing and promotional materials, staff business travel and/or visitors travelling to and from the site by any means of transport. Fugitive emissions of refrigerants from refrigeration and air conditioning systems.

Total project lifetime emissions were based on a conservative (worst case scenario) approach, assuming the development operates at 75,000 t per annum for a nominal 25 year period.

Baseline energy consumption data was sourced from the 2011 usage information supplied by the client. This data was used to calculate Scope 1 and 2 emissions using relevant emission factors from the NGA Factors 2011. Data used to calculate Scope 3 emissions for the transportation of AN to the site by train from Sydney was calculated from the average weekly tonnages received and the haulage distance. Diesel consumption rates were taken from *Association of American Railroads USA 2007* and applied to the relevant emission factors from NGA Factors 2011.

5.7.2 *Potential Impacts*

All energy consumption and emissions data has been converted into quantities of carbon dioxide equivalent (CO_2-e). A breakdown of each scope is located within *Annex H.*

The majority of Scope 1 emissions are sourced from diesel usage by trucks used to transport AN to and from the site. Scope 2 emissions associated with consumption of grid electricity. Scope 3 emissions associated with transportation of raw material to the site (upstream) via rail (see *Table 5.16*).

Table 5.16 Summary of Annual Greenhouse Gas Emissions

Source	Estimated Total Annual Emissions (t CO_2-e/annum)
Scope 1	
Fuel used for transport purposes – ie diesel used for trucks and other mobile plant.	6,799
Fuel used for small vehicles	30
Total Scope 1	**6,829**
Scope 2	
Energy from consumption of grid electricity.	174
Total Scope 1 + 2	**7,003**
Scope 3	
Transport of ammonium nitrate by rail to site (from Sydney Port).	603
Total Scope 3	**603**
Annual Total for Scopes 1,2 and 3	**7,606**

1. Source: ERM (2012) Ammonium Nitrate Storage and Distribution Facility *Greenhouse Gas Emissions Assessmen*t

Total annual emissions have been calculated as being 7,606t CO_2–e / annum. Scope 1 and 2 emissions (those under direct control of the proponent) are estimated to be approximately 7,003 tonnes CO_2-e / annum meaning that the greenhouse intensity of the proposed development will equate to approximately 0.093t CO_2-e for each tonne of material that passes through the site.

A search of the *Australian Greenhouse Emissions Information System* showed annual greenhouse gas emissions for NSW to be estimated at 157,435,910t CO_2-e in 2010 (the most recent reporting year Kyoto Protocol Accounting Framework). Therefore, emissions from the proposed development (Scope 1 and 2) represent approximately 0.0044% of the total annual NSW emissions. Comparison to similar 'best practice' facilities was unable to be made, due to lack of published data in Australia.

Total lifetime emissions (Scope 1 and 2), based on a nominal 25 year operating period, are estimated at 175,065 t CO_2-e. Scope 3 (transportation) emissions are not included in the estimation as it is not known with any degree of certainty where the raw materials will be sourced from over the 25 year period.

5.7.3 Mitigation Measures

The main contribution of GHG is associated with the transport of products to and from site. The following mitigation measures have been identified as opportunities to reduce the greenhouse gas intensity of the proposed development:

Maximise vehicle efficiency

- the efficiency of all upgraded mobile and fixed equipment be considered during procurement for fuel-powered equipment;
- investigate opportunities for low emission transportation of ammonium nitrate (ie utilise transport trucks that use biodiesel as opposed to regular diesel);
- investigate opportunities for using increased quantities of biodiesel in on-site plant;
- select vehicle size for purchase based on task ie larger vehicles generally have a lower emissions intensity than smaller vehicles;
- site management will ensure that equipment is maintained to retain energy efficiency; and
- site management to check current vehicle fleet and consider the installation of aerodynamic features to reduce fuel consumption.

Optimal freight loading

- minimise running of empty trucks where possible ie look at back loading vehicles;
- optimise freight loads so that all trucks are full; and
- reduce packaging and packaging weight to maximise use of productive space and minimise waste ie bulk product in place of bulka bags.

Driver behaviour

- slow acceleration to the average driving speed;
- selection of route to optimise driving at speeds that optimise fuel efficiency;
- driving at speeds that avoid the need for heavy braking;
- leaving adequate distance between vehicles to avoid the need for heavy braking;

- using roads at times of least congestion to prevent idling time and stop/start driving; and

- minimise idling loses by turning vehicles off when not driving. Cab comfort can be maintained through the use of generators allowing engines to be switched off.

Although electricity consumption contributed 2% to the final emissions, the following additional mitigation measures have been identified:

- energy audits be held when practicable to ensure that the site is using current practice techniques to minimise energy use and is operating at optimum energy levels; and

- investigate opportunities for purchasing part or all of electricity consumption from renewable sources.

5.8 NOISE AND VIBRATION

A Noise and Vibration Impact Assessment (NVIA) was undertaken by ERM (2012e) to assess the impacts to the surrounding environment from the proposed AN storage and distribution facility. A copy of the NVIA is located in *Annex I*.

The scope of the assessment included:

- a review and familiarisation with the relevant local standards and guidelines, applicable to the project and the assessment;

- a review of any existing project data and/or information relevant to the assessment, including review of project site plans and proposed operational, construction and road traffic scenarios;

- identification of the closest and/or potentially most affected sensitive receiver locations. These locations were adopted as the project-specific assessment locations (potentially sensitive receptors);

- quantification of ambient and background noise levels via measurement at representative potentially sensitive receptors and development of project-specific noise criteria at these locations;

- developing project-specific vibration criteria at the potentially sensitive receptors;

- developing project-specific noise model (refer 'Noise Modelling') to accurately quantify operational and construction noise level contributions including fixed and mobile noise sources associated with the site;

- completion of spread-sheet calculations to quantify road traffic noise level contributions for site vehicles on public roads, and operational and construction vibration levels;

- comparison of resultant noise and vibration levels to the project-specific criteria and determining the impact at the closest and/or potentially most affected sensitive receptor locations in the vicinity of the site; and

- recommending relevant noise and/or vibration control mitigation and/or management measures (and monitoring actions), to be considered by Crawfords for implementation at the site, if required.

5.8.1 Assessment Methodology

Sensitive Receptor Locations

Land uses and activities directly surrounding the site are generally limited to minor industrial and commercial uses, and residential areas. To the west of the Main Northern Railway line (beyond the Hunter Wetlands area) is a residential area with receptors located on Blanch Street, the rear of their properties are approximately 800 m distant from the site. Directly adjacent and west of the site is the Newcastle Golf Range and Practice Centre, to the south of the site is a residential area with receptors located on Astra Street.

Sandgate Cemetery and mixed industrial and residential areas are located to the south east of the site however these are not directly considered in this assessment. Further to the east of the site is the Pacific Highway which has a strip of residential receptors and a commercial development situated directly on the highway. These locations, although in relatively near proximity to the site, experience significant existing road traffic noise from the highway.

To the north of the site are other industrial premises situated within the same industrial area as the Crawfords site and the St Joseph's Home (residential aged care) and St Joseph's Village (independent living), which are on the northern side of Old Maitland Road.

The sensitive receptor locations (nine in total) adopted to assess both noise and vibration impacts are described in *Table 5.17* and visually presented in *Figure 5.21*.

Table 5.17 Sensitive Receptor Locations

ID	Description	GPS Coordinates (56H)		Direction from site	Distance from Site (m)	Elevation (m)
		Easting	Northing			
R1	Residential receptor located on Blanch Street[1]	377728	6362297	South-west	907	2.4
R2	Newcastle Golf Practice Centre	378565	6362177	South-west	213	4.6
R3	Residential receptor located on Astra Street[1]	378807	6362092	South	574	5.8
R4	Residential receptor located on Wallsend Road	379159	6362222	South	726	7.7
R5	Residential receptor located on Wallsend Road	378906	6362965	South-east	842	10.3
R6	Residential receptor located on the eastern side of the Pacific Highway[1]	378970	6363002	East	523	12.2
R7	Residential receptor located on the western side of the Pacific Highway	378622	6363491	East	448	13.5
R8	St Joseph's aged care and independent living	378411	6362560	North	431	4.5
R9	Industrial receptor located within the same industrial area and south of Old Maitland Road	378498	6363182	North	749	5.5

1. continuous unattended environmental noise logging was conducted at this location, refer *Section 3* for details.

Client:	Crawfords Freightlines Pty Ltd	
Drawing No:	0143175h_EIS_C022_R0.cdr	
Date:	12/12/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: NL

Figure 5.21 - Acoustic Assessment

Crawfords Freightlines Pty Ltd - Environmental Impact Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

5.8.2 Assessment Scenarios

Operational Assessment Scenario

To assess operational noise levels in accordance with the EPA's Industrial Noise Policy, a set of operational assessment scenarios were developed which are described in detail in *Table 5.18*. The operational noise assessment scenarios were developed based on the information provided by Crawford's, available at the time of the assessment. These scenarios included all fixed (e.g. air conditioning condenser and split systems) and moving (e.g. forklifts, trucks, trains, conveyor) noise emissions sources. The adopted sound power levels were estimated by a qualified acoustics engineer or obtained from the ERM noise database for similar plant.

Noise levels were predicted (via noise modelling) for each scenario at the closest and/or potentially most affected receiver locations in the vicinity of the site, for both calm and adverse weather conditions and during all applicable INP assessment periods. In accordance with the Industrial Noise Policy (INP), the assessment periods are defined as follows:

- *Daytime*: 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays;
- *Evening*: 6pm to 10pm; and
- *Night time*: all remaining periods.

To determine compliance, the predicted noise levels were compared to the project-specific noise levels (operational noise criteria) developed in accordance with the INP. Normal operational noise was assessed during the daytime and evening periods, and the night time/daytime morning shoulder period for works undertaken between 6am and 7am. Maximum noise level events were also considered in accordance with the INP as part of the assessment for works occurring during the morning shoulder period.

Based on these findings ERM made recommendations for a number of noise management measures and monitoring actions.

Table 5.18 Operational Assessment Scenarios

ID	Description	Noise Emission Centre (m)	Source Type	Adopted Sound Power Level (Lw)[1 2]	Rail Scenario	Trucks Scenario	Rail and Trucks Combined	Trucks (and Conveyor Use)
LFL	36T Forklift	1.5	Point	99	2	2	2	2
MFL	25 t Forklift	1.5	Point	96	1	1	1	1
SFL	5 t Forklift	1.5	Point	94	8	8	8	8
LtVH	Light Vehicle	1.5	Point	74	2	2	2	2
AC1	Air Conditioning Split System	2	Point	72	5	5	5	5
AC2	Air Conditioning Condenser	2	Point	68	1	1	1	1
MA	Motion Alarm	1.75	Point	113	1	1	1	1
TR	Train Engine (1 Loco) Idling	2	Point	103	1	0	1	0
TR_tp	Train Transfer or Load Point	1	Point	97	1	0	1	0
HyVHs	Flat Top Truck	2	Point	100	0	1	1	1
HyVHl	Bulk Truck	2	Point	102	0	1	1	1
CNV_tp	Conveyor Transfer or Load Point	1	Point	97	0	0	0	2
FL_m	All Forklifts	1	Moving[3]	108	1	1	1	1
TR_m	Train Engine (1 Loco)	2	Moving[3]	102	1	0	1	0
LtVH_m	Light Vehicle	0.75	Moving[3]	80	1	1	1	1
HyVH_m	Flat Top and Bulk Truck Combined	1.75	Moving[3]	104	0	1	0	1
CNV	Conveyor	Various	Line	93 (80 dB/m)	0	0	0	1

1. dB re: 20µPa;
2. estimated source terms or obtained from the ERM noise database for similar plant; and
3. moving sources are representative of multiple items of plant and equipment in operation concurrently.

Construction Noise Assessment Scenario

Two construction noise assessment scenarios were conservatively developed by ERM and are considered representative of potential civil works that may be undertaken at the site associated with stormwater infrastructure. These representative and potential worst-case scenarios are presented in *Table 5.19.*

Table 5.19 Construction Assessment Scenarios

Plant and Equipment	Noise Emission Centre (m)	Source Type	Adopted Sound Power Level (Lw)[1 2]	Representative Scenario	Worst-Case Scenario
Metal on Metal Contact	1.5	Point	116	2	2
Ute	1.5	Point	74	2	2
Ute	1.5	Moving	80	2	2
Excavator	1.75	Point	113	0	1
Crane	2	Point	109	0	1
Hand Tools	1	Point	112	4	4
Concrete Pump/mixer truck	1	Point	107	0	1
Concrete Mixer Truck	1.75	Moving	109	0	1

1. LAeq, 15 minute, dB re: 20µPa; and
2. source terms obtained from the ERM noise database.

Road Traffic Assessment Scenario

In considering potential road traffic noise level impacts, ERM adopted the known average heavy vehicle movements presented in the May 2012 hazard analysis, which stated that the number of truck movements per day varies but three to four per day is typical.

For the purposes of Calculation of Road Traffic Noise (CoRTN) (the globally accepted United Kingdom algorithm for the calculation of road traffic noise levels), a flow of eight vehicles per period was adopted. This is representative of eight trucks entering and then exiting the site during the given assessment period. Where one hour assessment parameters are required (local roads) an average flow of four vehicles has been adopted, representative of four trucks entering and then exiting the site.

Noise Modelling

To quantify operational and construction noise level contributions at the closest and/or potentially most affected noise sensitive receiver locations in the vicinity of the site, ERM completed a comprehensive noise modelling assessment for the site. The noise model allowed quantification of noise levels from multiple sources (fixed, moving and line), based on sound pressures or sound power levels emitted from the key plant components.

Vibration Predictions

A conservative vibration impact assessment was undertaken based on measured vibration levels for comparable sources from the ERM database. To calculate vibration dose values in accordance with the vibration guideline, approximate values based on the proposed works were predicted, again based on measured vibration levels in the ERM database.

5.8.3 Existing Environment

Continuous unattended environmental noise logging was conducted to quantify the existing noise environment and to establish the INP Assessment Background Level (ABL), Rating Background Level (RBL) parameters, and the existing road traffic noise level with regard to the requirements specified in the road noise policy. The ABL and RBL parameters are applicable to both the operational and construction noise impact assessments.

Unattended noise logging

Continuous unattended environmental noise logging was conducted at three locations and over two monitoring periods, where required. These unattended monitoring locations were:

- 24 Astra Street, Sandgate;
- 49 Blanch Street, Shortland; and
- 211 Maitland Road, Sandgate.

Figure 5.21 identifies the location of the unattended noise monitoring locations.

At the conclusion of monitoring, noise logging data was combined with local meteorological data (including wind speed and rainfall) obtained from the closest Bureau of Meteorology (BOM) weather observation station (Williamtown RAAF station (ID: 061078)). The overall RBL and L_{Aeq} values for each monitoring location are summarised in *Table 5.20.*

Table 5.20 Overall Ambient and Background Noise Levels

	Measured Overall Noise Levels[1]					
Location	**RBL Day**	**RBL Evening**	**RBL Night**	**Leq Day**	**Leq Evening**	**Leq Night**
49 Blanch Street	33.8	38.3	35.0	48.5	46.1	42.8
24 Astra Street	37.4	40.8	36.9	53.2	47.2	45.6
211 Maitland Road	54.8	51.5	42.5	71.6	68.7	66.7

1. dB(A) re 2 x 10^{-5} Pa;
2. LA90 values (RBL) represent the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level;
3. the LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period;
4. in accordance with the INP the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods.

Attended noise measurements

In order to better understand the existing acoustic environment for the majority of noise sensitive receivers in the vicinity of the site, a series of operator attended environmental noise measurements were completed on Tuesday, 5 June 2012. Attended noise monitoring locations are detailed in *Figure 5.21.* Results of the attended noise measurements (including comparison to the unattended noise logging data) is summarised in *Table 5.21.*

Table 5.21 Attended Noise Measurements

Location	Time	Unattended[2]		Attended[3]		Differential (A – U)	
		LAeq[1]	LA90[1]	LAeq[1]	LA90[1]	LAeq[1]	LA90[1]
Front yard of 49 Blanch Street, Shortland (A1)	09:30 AM	48.2	41.4	62.2	54.7	14.0	13.3
Front yard of 24 Astra Street, Sandgate (A2)	10:45 AM	*No Data*[4]		53.8	47.3	*No Data*[4]	
Southern boundary of St Joseph's, Sandgate (A3)	11:30 AM	72.5	61.5	51.3	44.5	-21.2	-17.0

1. dB re: 2 x 10^{-5} Pa;
2. nearest representative continuous unattended environmental noise logging location;
3. operator attended environmental noise measurement data; and
4. due to the unattended monitoring device failure on this day, no comparison can be made. This is not considered significant.

Meteorological conditions

Meteorological conditions, especially prevailing winds and temperature inversions have the potential to increase noise levels (and impacts) at the closest and/or potentially most affected noise sensitive receiver locations in the vicinity of the site.

The May 2012 hazard analysis presented prevailing meteorological conditions which were measured at the Williamtown RAAF station. Parameters relevant to this acoustic assessment are reproduced in *Table 5.22*.

Table 5.22 Existing Meteorological Conditions

Parameter		Temperature Inversion Category						
		B3 (A and B)	D3 (C and D, wind speeds <4m/s)	D6 (C and D, wind speeds 4 to 10 m/s)	D12 (C and D, wind speeds >4m/s)	E3 (E only)	F2 (F only)	
Ambient temperature (minimum) [1]		6	2	3	8	3	2	
Ambient temperature (maximum) [1]		34	32	36	33	31	28	
Ambient temperature (average) [1]		**20.8**	**16.1**	**18.2**	**16.9**	**16**	**13.2**	
Wind speed (minimum) [2]		0.6	0.6	4.2	10.7	2.2	0.6	
Wind speed (maximum) [2]		4.7	3.6	9.7	16.4	4.7	2.5	
Wind speed (average)	**m/s**	**2.9**	**2.7**	**6.3**	**11.7**	**3.6**	**1.9**	
	N %	1.23	2.66	0.42	0.00	1.32	3.14	**8.77**
	NE %	0.9	3.15	3.08	0.00	3.34	31.7	**13.64**
	E %	0.42	2.08	3.89	0.01	1.04	1.08	**8.52**

Parameter	Temperature Inversion Category						
	B3 (A and B)	**D3 (C and D, wind speeds <4m/s)**	**D6 (C and D, wind speeds 4 to 10 m/s)**	**D12 (C and D, wind speeds >4m/s)**	**E3 (E only)**	**F2 (F only)**	
SE %	0.57	1.29	7.53	0.17	0.89	0.55	**11.00**
S %	0.43	1.55	7.04	0.32	0.4	0.61	**10.35**
SW %	0.55	2.23	3.43	0.13	0.53	0.66	**7.53**
W %	1.43	4.73	10.21	1.11	2.31	1.97	**21.76**
NW %	2.30	6.06	3.58	0.64	2.25	3.60	**18.43**
Total %	**7.83**	**23.75**	**39.18**	**2.38**	**12.08**	**14.78**	

1. degrees Celsius (^{0} C); and
2. Meters per Second (m/s).

The data in *Table 5.22* indicates that in accordance with the INP, prevailing winds are not a feature of the area. However, Class-D temperature inversions may occur more than 30% of the time and are conservatively considered a potential feature of the area.

Ambient Vibration Levels

Ambient vibration levels did not form part of the assessment approach. However, considering that there is limited existing major industry in near proximity to each of the sensitive receptor locations, it is assumed that existing vibration levels are likely to be less than the human threshold for the perception of vibration which is typically considered to be 0.2mm/s.

5.8.4 Project Specific Criteria

Intrusive and Amenity Noise Criteria

The intrusiveness and amenity criteria determined for each assessment location, as well as the Project-Specific Noise Level (PSNL) are presented in *Table 5.23.*

Table 5.23 Project-Specific Noise Levels

ID	Description	Intrusiveness[1]			Amenity[1]			PSNL[1]			
		D	E	N	D	E	N	D	E	N	S[3]
R1	Residential receptor located on Blanch Street	39	43	40	55	44	40	**39**	**39**	**39**	**39**
R2	Newcastle Golf Practice Centre		*n/a*[2]		55	55	55	**55**	**55**	**55**	**55**
R3	Residential receptor located on Astra Street	42	46	42	60	50	45	**42**	**42**	**42**	**42**
R4	Residential receptor located on Wallsend Road	42	46	42	60	50	45	**42**	**42**	**42**	**42**
R5	Residential receptor located on Wallsend Road	42	46	42	60	50	45	**42**	**42**	**42**	**42**
R6	Residential receptor located on the eastern side of the Pacific Highway	60	57	48	60	50	45	**60**	**57**	**48**	**54**
R7	Residential receptor located on the western side of the Pacific Highway	60	57	48	60	50	45	**60**	**57**	**48**	**54**
R8	St Joseph's aged care and independent living	43	40	35	60	48	45	**43**	**40**	**35**	**39**
R9	Industrial receptor located within the same industrial area and south of Old Maitland Road		*n/a*[2]		70	70	70	**70**	**70**	**70**	**70**

1. dB re: 2 x 10^{-5} Pa;
2. not applicable at active recreational or industrial receptors; and
3. "S" is shoulder period PSNL.

Construction Noise Management Levels

The project-specific noise management levels for construction works undertaken during the recommended standard hours of construction are presented in *Table 5.24*.

Table 5.24 Construction Noise Management Levels

ID	Description	Noise Affected Management Level	Highly Noise Affected Management Level
R1	Residential receptor located on Blanch Street	44	75
R2	Newcastle Golf Practice Centre	65	*n/a*[2]
R3	Residential receptor located on Astra Street	47	75
R4	Residential receptor located on Wallsend Road	47	75
R5	Residential receptor located on Wallsend Road	47	75
R6	Residential receptor located on the eastern side of the Pacific Highway	65	75
R7	Residential receptor located on the western side of the Pacific Highway	65	75
R8	St Joseph's aged care and independent living	48	75
R9	Industrial receptor located within the same industrial area and south of Old Maitland Road	75	*n/a*[2]

1. dB re: 2 x 10^{-5} Pa;
2. not applicable at active recreational or industrial receptors.

Road Traffic Noise

The project-specific road traffic noise criteria for existing residences affected by additional traffic on existing freeways/arterial/sub arterial roads generated by land use developments is $L_{Aeq,\ (15\ hour)}$ 60 dB (external) for the daytime assessment period and $L_{Aeq,\ (9\ hour)}$ 55 dB (external) for the night time assessment period.

The criteria for existing residences affected by additional traffic on existing local roads generated by land use developments is $L_{Aeq,\ (1\ hour)}$ 55 dB (external) for the daytime assessment period and $L_{Aeq,\ (1\ hour)}$ 50 dB (external) for the night time assessment period.

Project Specific Vibration Criteria

The project-specific vibration criteria is summarised in *Table 5.25* to *Table 5.27*. These guideline values are applied at each of the assessment locations where applicable.

Table 5.25 Structural Damage Guideline Values

		Vibration Velocity in mm/s			
		At Foundation at a Frequency of:			Plane of Floor of Uppermost Storey
Line	Type of Structure	Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz [1]	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15

1. at frequencies above 100Hz, the values given in this column may be used as a minimum.

Table 5.26 Guideline Values for Impulsive Vibration

		Assessment Criteria	
		Peak Velocity (mm/s)	
Place	Time	Preferred	Maximum
Residences	Daytime	8.60	17.0
	Night-time	2.80	5.60
Offices	Day or Night-time	18.0	36.0

1. rms velocity (mm/s) and vibration velocity value (dB re 10-9 mm/s); and
2. values given for most critical frequency >8Hz assuming sinusoidal motion.

Table 5.27 Guideline Values for Intermittent Vibration

	Daytime		Night-time	
Location	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and placed of worship	0.40	0.80	0.40	0.80

1. daytime is 7am to 10pm and Night-time is 10pm to 7am; and
2. these criterions are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

5.8.5 Potential Noise Impacts

Operational Noise

The results of the operational noise impact assessment including results for all scenarios during both calm and adverse meteorological conditions, and comparison to the PSNL at each assessment location are presented in *Table 5.28* and *Table 5.29*. These results are visually presented as noise contour maps in *Figure 5.22* to *Figure 5.29*.

Table 5.28 Operational Noise Levels (Calm) and INP Compliance Assessment

Scenario	Receptor	Calculated Noise Level[1]	Daytime PSNL[1]	Evening PSNL[1]	Morning Shoulder PSNL[1]	Daytime Compliance	Evening Compliance	Morning Shoulder Compliance
Rail	R1	29.9	39	39	39	-9.1	-9.1	-9.1
	R2	48.7	55	55	55	-6.3	-6.3	-6.3
	R3	38.7	42	42	42	-3.3	-3.3	-3.3
	R4	32.0	42	42	42	-10	-10	-10
	R5	32.8	42	42	42	-9.2	-9.2	-9.2
	R6	44.5	60	57	54	-15.5	-12.5	-9.5
	R7	46.2	60	57	54	-13.8	-10.8	-7.8
	R8	41.6	43	40	39	-1.4	**1.6**	**2.6**
	R9	49.6	70	70	70	-20.4	-20.4	-20.4
Trucks	R1	30.3	39	39	39	-8.7	-8.7	-8.7
	R2	47.0	55	55	55	-8.0	-8.0	-8.0
	R3	38.1	42	42	42	-3.9	-3.9	-3.9
	R4	32.7	42	42	42	-9.3	-9.3	-9.3
	R5	33.3	42	42	42	-8.7	-8.7	-8.7
	R6	45.2	60	57	54	-14.8	-11.8	-8.8
	R7	46.9	60	57	54	-13.1	-10.1	-7.1
	R8	42.8	43	40	39	-0.2	**2.8**	**3.8**
	R9	50.5	70	70	70	-19.5	-19.5	-19.5
Rail and Trucks Combined	R1	31.0	39	39	39	-8.0	-8.0	-8.0
	R2	49.0	55	55	55	-6.0	-6.0	-6.0
	R3	39.1	42	42	42	-2.9	-2.9	-2.9
	R4	33.2	42	42	42	-8.8	-8.8	-8.8
	R5	33.7	42	42	42	-8.3	-8.3	-8.3

Scenario	Receptor	Calculated Noise Level[1]	Daytime PSNL[1]	Evening PSNL[1]	Morning Shoulder PSNL[1]	Daytime Compliance	Evening Compliance	Morning Shoulder Compliance
	R6	45.4	60	57	54	-14.6	-11.6	-8.6
	R7	47.1	60	57	54	-12.9	-9.9	-6.9
	R8	43.0	43	40	39	0.0	**3.0**	**4.0**
	R9	50.6	70	70	70	-19.4	-19.4	-19.4
Trucks (and conveyor use)	R1	30.6	39	39	39	-8.4	-8.4	-8.4
	R2	49.2	55	55	55	-5.8	-5.8	-5.8
Trucks (and conveyor use)	R3	40.7	42	42	42	-1.3	-1.3	-1.3
	R4	33.7	42	42	42	-8.3	-8.3	-8.3
	R5	33.7	42	42	42	-8.3	-8.3	-8.3
	R6	45.2	60	57	54	-14.8	-11.8	-8.8
	R7	46.9	60	57	54	-13.1	-10.1	-7.1
	R8	42.8	43	40	39	-0.2	**2.8**	**3.8**
	R9	50.5	70	70	70	-19.5	-19.5	-19.5

1. dB re: 2 x 10^{-5} Pa and Leq, 15 minute or Leq, period where applicable; and
2. exceedances to PSNL in **bold** typeset.

Table 5.29 Operational Noise Levels (Adverse) and INP Compliance Assessment

Scenario	Receptor	Calculated Noise Level[1]	Daytime PSNL[1]	Evening PSNL[1]	Morning Shoulder PSNL[1]	Daytime Compliance	Evening Compliance	Morning Shoulder Compliance
Rail	R1	30.0	39	39	39	-9.0	-9.0	-9.0
	R2	48.7	55	55	55	-6.3	-6.3	-6.3
	R3	38.7	42	42	42	-3.3	-3.3	-3.3
	R4	32.1	42	42	42	-9.9	-9.9	-9.9
	R5	32.9	42	42	42	-9.1	-9.1	-9.1
	R6	44.5	60	57	54	-15.5	-12.5	-9.5
	R7	46.2	60	57	54	-13.8	-10.8	-7.8
	R8	41.7	43	40	39	-1.3	**1.7**	**2.7**
	R9	49.5	70	70	70	-20.5	-20.5	-20.5
Trucks	R1	30.4	39	39	39	-8.6	-8.6	-8.6
	R2	47.0	55	55	55	-8.0	-8.0	-8.0
	R3	38.1	42	42	42	-3.9	-3.9	-3.9
	R4	32.8	42	42	42	-9.2	-9.2	-9.2
	R5	33.4	42	42	42	-8.6	-8.6	-8.6
	R6	45.2	60	57	54	-14.8	-11.8	-8.8
	R7	46.9	60	57	54	-13.1	-10.1	-7.1
Trucks	R8	42.9	43	40	39	-0.1	**2.9**	**3.9**
	R9	50.5	70	70	70	-19.5	-19.5	-19.5
Rail and Trucks Combined	R1	31.1	39	39	39	-7.9	-7.9	-7.9
	R2	49.0	55	55	55	-6.0	-6.0	-6.0
	R3	39.2	42	42	42	-2.8	-2.8	-2.8
	R4	33.3	42	42	42	-8.7	-8.7	-8.7

Scenario	Receptor	Calculated Noise Level[1]	Daytime PSNL[1]	Evening PSNL[1]	Morning Shoulder PSNL[1]	Daytime Compliance	Evening Compliance	Morning Shoulder Compliance
	R5	33.8	42	42	42	-8.2	-8.2	-8.2
	R6	45.4	60	57	54	-14.6	-11.6	-8.6
	R7	47.1	60	57	54	-12.9	-9.9	-6.9
	R8	43.1	43	40	39	**0.1**	**3.1**	**4.1**
	R9	50.6	70	70	70	-19.4	-19.4	-19.4
Trucks (and conveyor use)	R1	30.7	39	39	39	-8.3	-8.3	-8.3
	R2	49.2	55	55	55	-5.8	-5.8	-5.8
	R3	40.8	42	42	42	-1.2	-1.2	-1.2
	R4	33.8	42	42	42	-8.2	-8.2	-8.2
	R5	33.7	42	42	42	-8.3	-8.3	-8.3
	R6	45.2	60	57	54	-14.8	-11.8	-8.8
	R7	46.9	60	57	54	-13.1	-10.1	-7.1
	R8	42.9	43	40	39	-0.1	**2.9**	**3.9**
	R9	50.5	70	70	70	-19.5	-19.5	-19.5

1. dB re: 2 x 10^{-5} Pa and Leq, 15 minute or Leq, period where applicable; and
2. exceedances to PSNL in **bold** typeset.