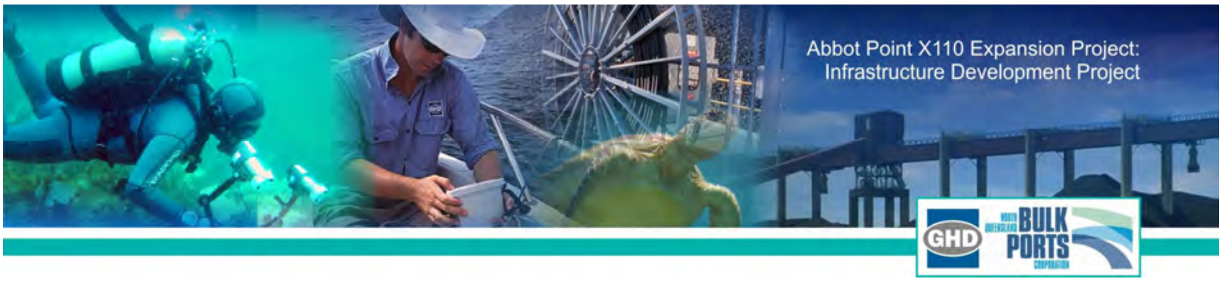


4.11 Marine Ecology

4.11.1 Description of Environmental Values

4.11.1.1 Benthic Habitat

In 2005, QPIF undertook the first dedicated benthic investigation of the Port of Abbot Point (Rasheed *et al.*, 2005). This study identified and mapped seagrass, macroalgae and benthic macroinvertebrate communities within the northern section of the port limits (extending from the seaward and western boundaries of the Port Limits, to approximately 3 km east of Euri Creek). To compliment these results and provide information on the temporal characteristics of these ecosystems, further studies were undertaken in 2008.

Seagrass and Algal Communities

McKenna *et al.* (2008; Appendix F) undertook studies to describe the seasonal abundance, species composition and distribution of seagrass and algal communities in the northern section of the port limits. The results of these studies also provides a foundation for the establishment of a long-term seagrass monitoring program. Seven species of seagrass, covering 42% of the survey area, were observed during these surveys including:

- *Cymodocea serrulata*;
- *Cymodocea rotundata*;
- *Halodule uninervis*;
- *Zostera capricorni*;
- *Halophila decipiens*;
- *Halophila ovalis*; and
- *Halophila spinulosa*.

Two seagrass meadows identified within the Study Area included a light density *H. uninervis* (thin) coastal meadow and a light *H. spinulosa* deepwater meadow. These results were similar to the 2005 findings (Rasheed *et al.*, 2005) with respect to location, distribution and species composition. A full report outlining the methodology and findings of these surveys is available in Appendix F.

Benthic Macroinvertebrate Communities

GHD were commissioned to determine the nature and extent of benthic macroinvertebrate communities in the port, in particular, soft and hard coral communities within the northern section of the port limits, hereafter referred to as the Project Area (extending from the seaward and western boundaries of the port limits, to approximately 3 km east of Euri Creek).

The percentage cover of the following geomorphological and benthic classes was examined at 300 sites within the Project Area:

- Geomorphological classes (adopted from Mumby and Harborne, 1999):
  - Back reef;
  - Reef crest;

- Spur and groove;
  - Low relief (<5 m in height); or
  - High relief (>5 m in height);
- Fore reef;
- Escarpment;
- Patch reef;
  - Dense (>70% cover of coral); or
  - Diffuse (<30% cover of coral);
- Lagoon Floor;
  - Shallow (<12 m depth); or
  - Deep (>12 m depth).

» Benthic classes (adopted from Rasheed *et al.*, 2005 and from Abdo *et al*. (2004):

- Dead coral;
- Reefal substrate;
- Rubble;
- Sand;
- Seagrass;
- Algae;
- Soft coral;
- Echinoids;
- Seapens;
- Sponge;
- Hard coral;
  - *Acropora* corals (Bottle Brush, Branching, Digitate, Tabulate, Encrusting, Monitpora); or
  - Non-*Acropora* corals (Branching, Encrusting, Foliaceous, Massive, Submassive, Mushroom, Solitary).

Three hundred sites were examined to determine the nature and extent of benthic macroinvertebrate communities, particularly soft and hard coral communities which occur within the study area. Benthic macroinvertebrates occurred at 53% of the sites investigated (160 sites). Algae and/or seagrass occurred at 25% of the sites investigated (76 sites) and bare substrate occurred at all 300 sites.

To assess the extent of benthic biota likely to be influenced by the potential development footprint, all benthic biota classes were combined to a 'benthic biota present or absent' classification across all sites. Examination of the data indicates that benthic biota (>1% coverage) was present at 44% (or 132) of the sites investigated. The remaining sites (168) supported less than 1% coverage of benthic biota. The spatial distribution of this benthic biota is presented in Figure 4-46.

Spatial contour modelling was utilised to display the different densities of the biotic features recorded in the survey (Figure 4-47). The area of each of the densities was also determined and is outlined in Table 4-30.

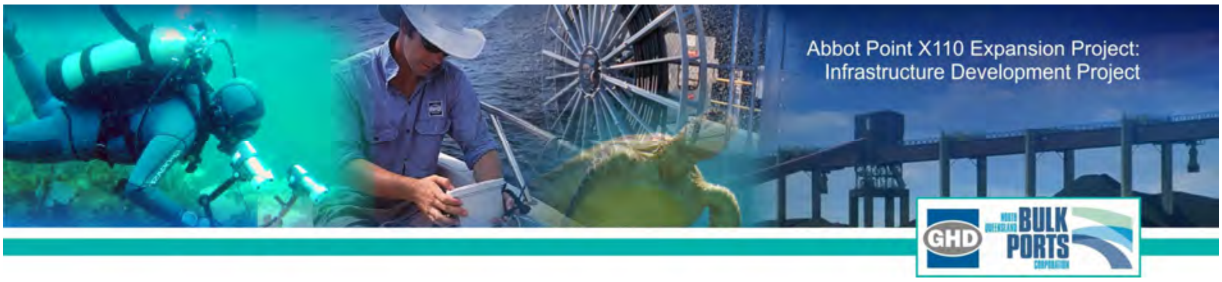
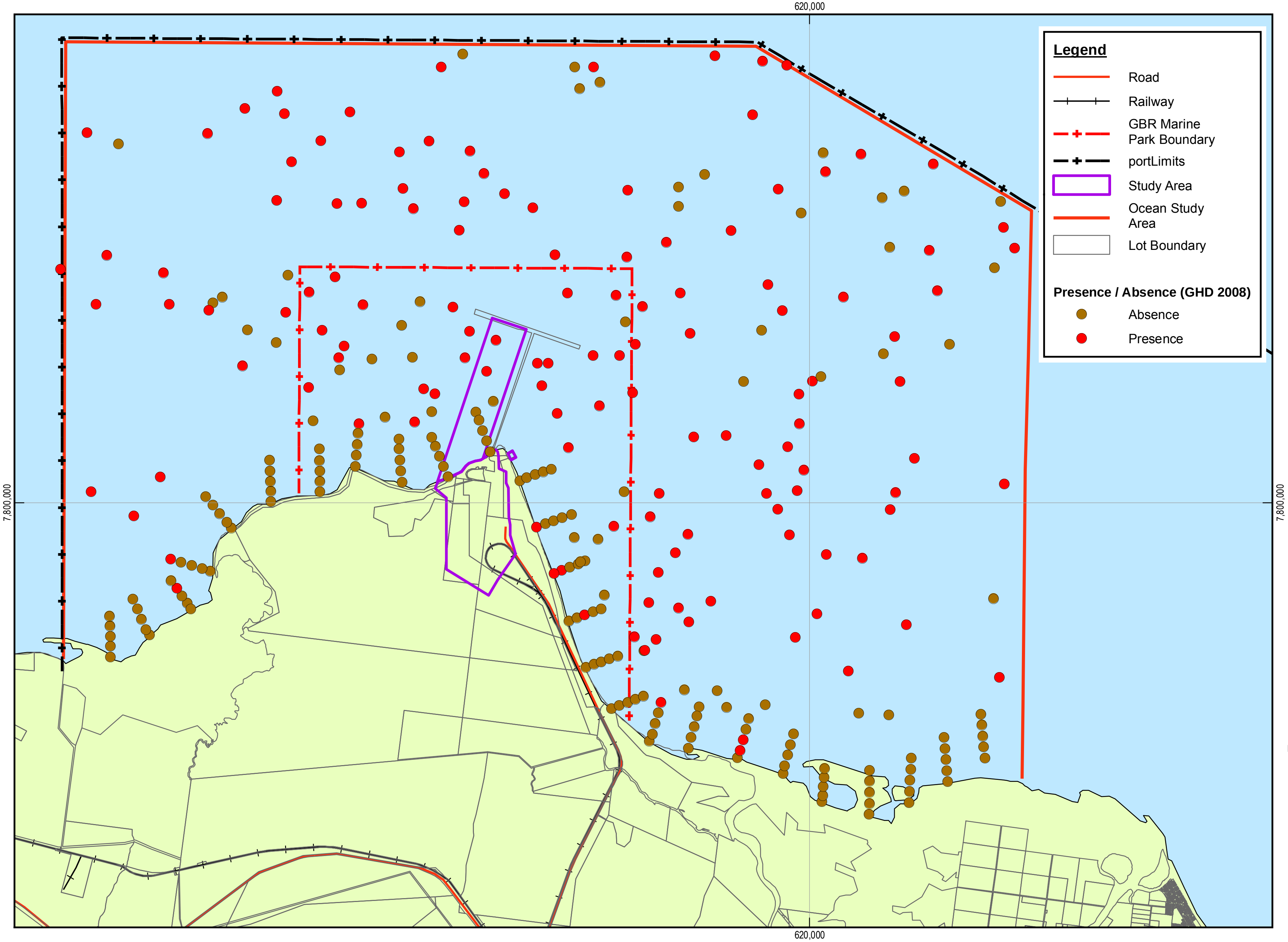


Table 4-30 Area (ha) and number of sites contributing to each identified density class

Density Class	Number of Sites	Area (ha)
Absent – no biotic features recorded at the site	129	1,375
Open substrate – dominant feature is bare substrate with occasional isolated benthic macroinvertebrate individuals (<1%)	39	4,474
Low density – benthic macroinvertebrates present in <10% of each site	101	12,230
Medium/low density – benthic macroinvertebrates present in 10-20% of each site	13	7,942
Medium density – benthic macroinvertebrates present in 20-80% of each site	18	2,552
High density – benthic macroinvertebrates present in >80% of each site	0	0



GHD
CLIENTS | PEOPLE | PERFORMANCE

NORTH QUEENSLAND BULK PORTS CORPORATION

ABBOT POINT X110 EXPANSION

N

Job Number	41-20175
Revision	B
Date	06 OCT 2009

1:120,000 (at A4)

0 1 2 3 4 5

Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

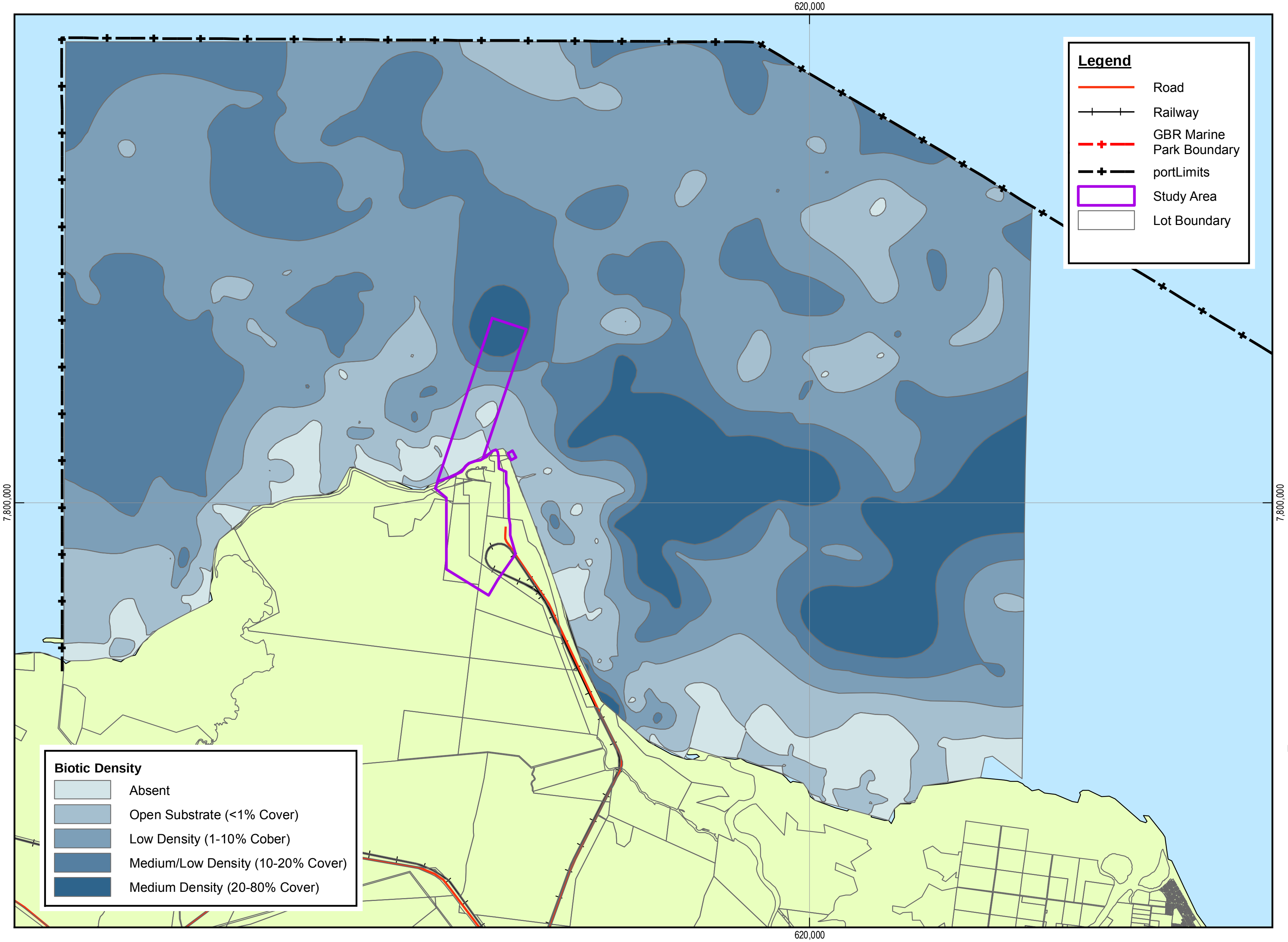
PRESENCE AND ABSENCE OR BIOTIC FEATURES

FIGURE 4-46

G:\41\20175\05 GIS\Projects\mxd's\41-20175-052_biotic_Fig4-46_revB.mxd

Level 4, 201 Charlotte St Brisbane QLD 4000 T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com.au W www.ghd.com.au

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc



GHD
CLIENTS | PEOPLE | PERFORMANCE

NORTH QUEENSLAND BULK PORTS CORPORATION

ABBOT POINT X110 EXPANSION

N

Job Number	41-20175
Revision	B
Date	06 OCT 2009

1:120,000(at A4)

0 1 2 3 4 5
Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

DENSITY OF BIOTIC FEATURES

FIGURE 4-47

G:\41\20175\05 GIS\Projects\mxd's\41-20175-053_bioticDensity_Fig4-47_revB.mxd

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc

Level 4, 201 Charlotte St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

4.11.1.2 Benthic Macroinvertebrates

A wide range of benthic macroinvertebrate taxa were found to occur within the Project Area. These taxa have been listed in Table 4-31 and include, but are not limited to, hard and soft corals, worms, crustaceans and seastars.

Benthic macroinvertebrates were found at approximately half the sites investigated, with a corresponding level of bare, open substrate. The majority of the sites that supported species, only supported a low density of benthic macroinvertebrates (Figure 4-48). No areas were found with a high density of species and very few sites supported a medium density of coverage (Figure 4-48).

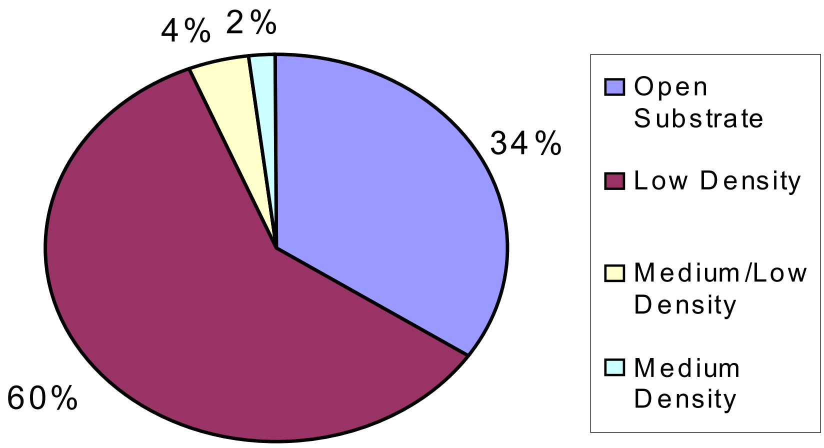
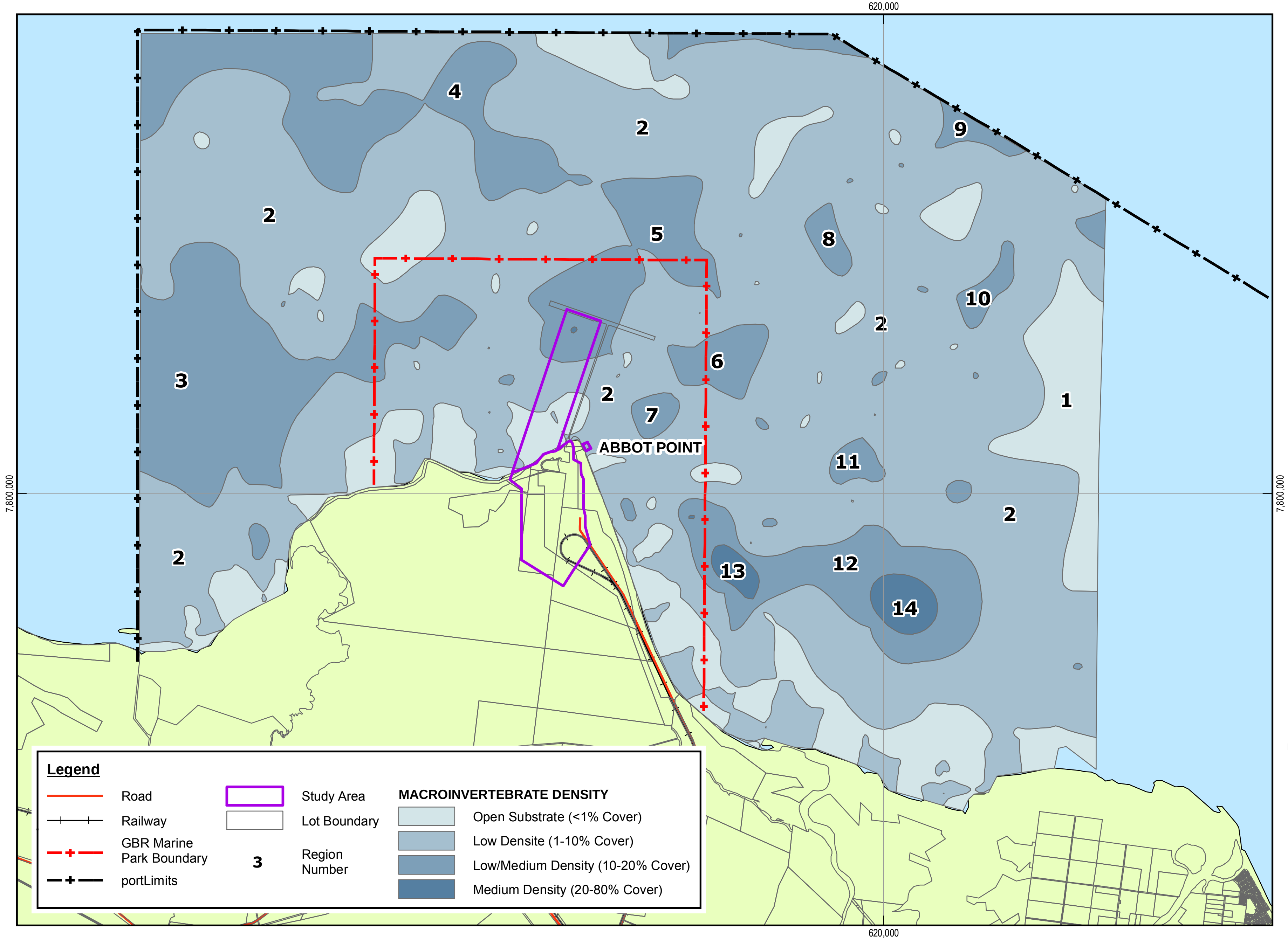


Figure 4-48 Distribution of benthic macroinvertebrate density classes

Figure 4-49 illustrates the distribution of the 14 benthic macroinvertebrate regions that were identified to occur within the Project Area. Of these 14 regions, three occur partially or wholly within the Study Area.



ABBOT POINT X110 EXPANSION

Job Number 41-20175
Revision B
Date 06 OCT 2009

1:120,000(at A4)

0 1 2 3 4 5
Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

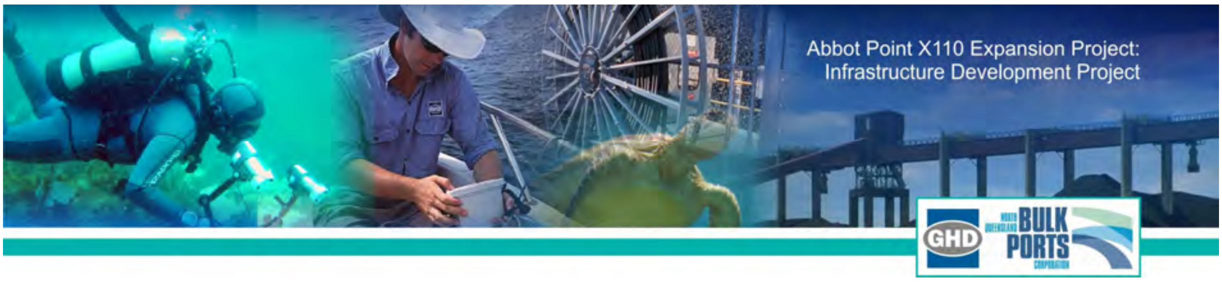
DISTRIBUTION OF BENTHIC MACRO-INVERTEBRATE REGIONS

FIGURE 4-49

G:\41\20175\05 GIS\Projects\mxd's\41-20175-055_benthic_Fig4-49_revB.mxd

Level 4, 201 Charlotte St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc



Open Substrate with Occasional Individuals

This class is defined as having bare substrate as the dominant feature, with the occurrence of isolated benthic macroinvertebrate individuals (<1% cover). There were numerous regions in this category within the Project area (Figure 4-49), however, given that the communities that characterise this density class were similar across the Project Area, it was decided to treat all of the regions as one (Region 1). The taxonomic groups contributing to this region are outlined in Table 4-31. Twelve of the 14 taxa classified in this region are mobile and likely to be transient within the spatial distributions presented.

Low Density Benthic Macroinvertebrate Region

This class is defined as having a percent cover of 1-10% of benthic macroinvertebrates. As with the Open substrate class, there were numerous regions in this category within the Project area (Figure 4-49), with 13 of the 22 taxa that characterise this category being mobile. Due to the low cover and patchy distribution of these taxa, it was decided to treat all of the regions as one (Region 2). The taxonomic groups contributing to this region are outlined in Table 4-31.

Medium/Low Density Benthic Macroinvertebrate Region

This class is defined as having a percent cover of 10-20% of benthic macroinvertebrates. There were ten regions in this category within the Project area (Regions 3-12; Figure 4-49). The taxonomic groups contributing to these community types are outlined in Table 4-31. A number of these regions supported both mobile and sedentary benthic macroinvertebrates.

Medium Density Benthic Macroinvertebrate Region

This class is defined as having a percent cover of 20-80% of benthic macroinvertebrates. There were two regions in this category within the Project Area (Regions 13 and 14; Figure 4-49). The taxonomic groups contributing to these community types are outlined in Table 4-31. These regions were defined by moderate densities of asteroid seastars, ascidians and foraminifera. No cnidarians (corals) were observed within these higher density habitats.

Table 4-31 Taxa present in each benthic macroinvertebrate region

			Open Substrate	Low Density	Medium / Low Density										Medium Density	
			Region Number													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Annelida		Polychaeta	x	x	x	x	x			x	x	x	x	x		
Cnidaria																
	Zoantharia	Zoanthid		x												
		Anemone	x	x		x										
	Anthozoa	Mushroom Coral	x	x	x		x							x		
		Non-Acropora Submassive Coral												x		
		Sea Pens	x	x	x	x						x		x		
		Soft Coral		x		x	x		x					x		
	Hydrozoa	Hydroids		x		x				x						
Echinodermata																
		Asteriod	x	x			x	x	x				x	x	x	
		Ophuroid	x	x	x	x	x				x					
		Echinoid	x	x	x	x	x	x	x				x			
		Holothuroid	x	x	x	x	x	x	x	x			x	x		

			Open Substrate	Low Density	Medium / Low Density										Medium Density	
			Region Number													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
		Crinoid		x	x							x		x		
Urochordata		Ascidian		x	x			x					x	x		x
Porifera		Sponge		x		x	x	x								
Arthropoda																
	Crustacea	Crab	x	x	x	x	x	x		x	x	x	x	x		
		Prawn	x	x	x	x	x				x	x	x			
Mollusca		Bivalvia	x	x	x	x	x	x	x	x	x	x		x		
		Gastropoda	x	x	x	x	x	x			x	x	x	x		
		Opistobranchia		x		x										
Vertebrata		Fish	x	x	x	x		x		x	x	x				
		Sea snake	x	x		x										
Foraminifera		Forams	x	x	x	x	x	x	x				x	x	x	x

x indicates presence within the specified region

4.11.1.3 Ranking of Benthic Macroinvertebrate Regions

The identified benthic macroinvertebrate regions have been ranked according to their relative environmental value within the Project Area. The scoring system, outlined in Table 4-32, is based on the size of the identified community, the density of the organisms that make up the community and the diversity of the community. It should be noted that the results of this ranking system are based only on the benthic macroinvertebrate regions identified and do not take into account other ecosystem features such as seagrass and algal beds.

Each criteria was assigned a rank based on the scoring system with a low score (e.g. 1) representing a low benthic macroinvertebrate environmental value and a high score (e.g. 5) representing a relatively high benthic macroinvertebrate environmental value.

The region with the highest total score, Region 2, is therefore allocated the rank of 1. This indicates the highest relative benthic macroinvertebrate environmental value within the Project Area. Conversely the region with the lowest total score, Region 8, has been allocated the rank of 14, indicating the lowest relative benthic macroinvertebrate environmental value within the Project Area.

Table 4-33 shows the area of each defined benthic macroinvertebrate region (Figure 4-49).

Coral Presence and Coral Bleaching

Of the 300 sites investigated, coral was determined to be present at 41 sites (Figure 4-50) but in very low densities (<10% cover), with only two sites classified as medium/low density.

Five coral taxa were observed within the Project Area including:

» Soft corals;

» Seapens;

» Submassive non-*Acropora* corals;

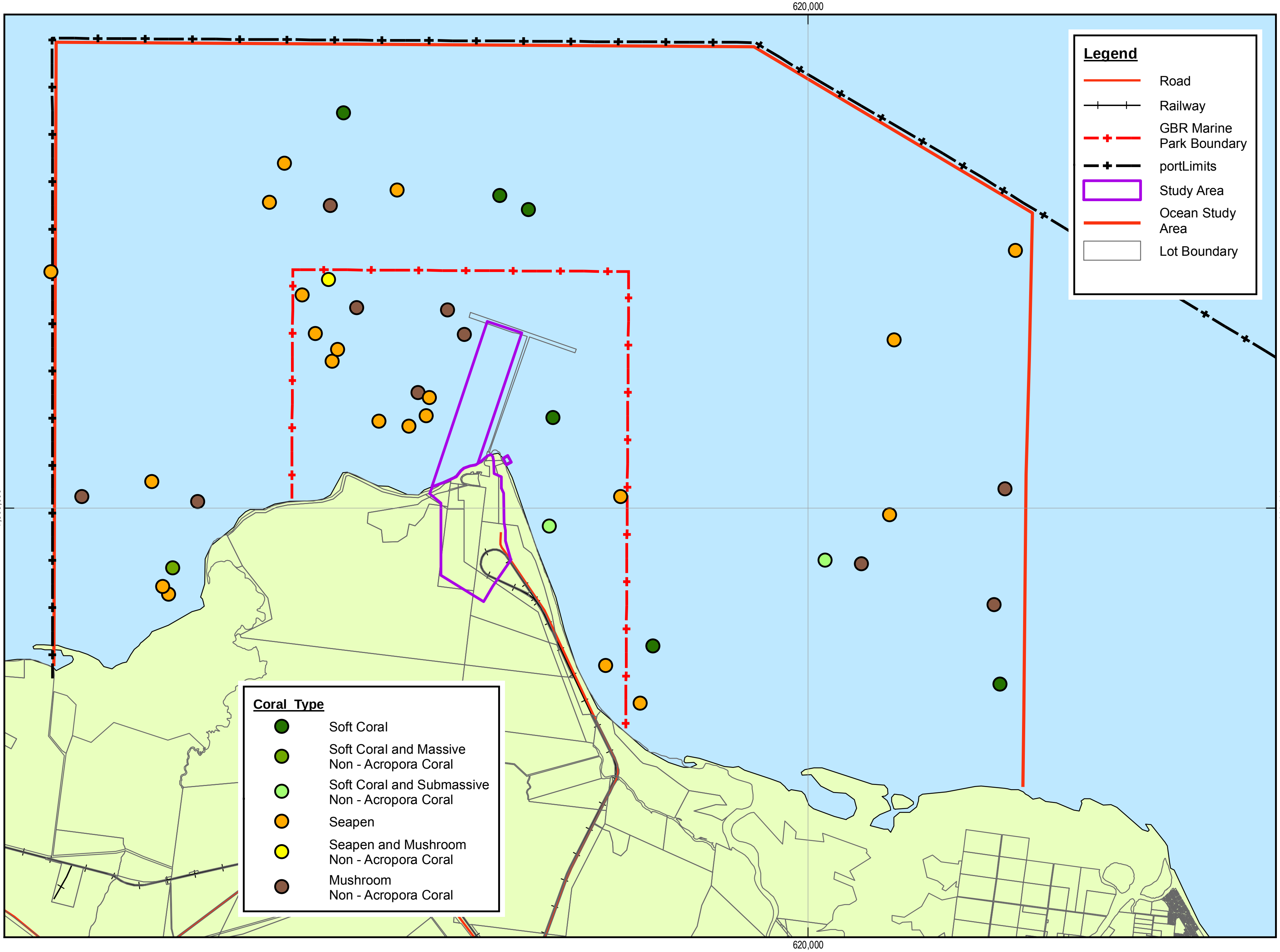
» Massive non-*Acropora* corals; and

» Mushroom non-*Acropora* corals.

Despite this apparent diversity across the Project Area, actual within site diversity was very low. 37 of the sites contained only one coral taxon, (21 sites contained only seapens; 10 sites contained only mushroom non-*Acropora* corals and 6 sites contained only soft corals) and the remaining 4 sites contained only 2 coral taxa. The above taxa were sparsely distributed.

Seapens, the most frequently occurring taxa, were recorded at 22 sites and are commonplace within soft-sediment tropical benthic systems. Mushroom non-*Acropora* corals are also common and were present at 11 sites. Soft corals were present at 9 sites, submassive non-*Acropora* corals were present at 2 sites and massive non-*Acropora* corals were present at one site.

On the few occasions when coral was observed, it was also examined to determine if any bleaching was present. No bleaching of any corals was observed during the field investigation.



GHD CLIENTS|PEOPLE|PERFORMANCE

NORTH QUEENSLAND BULK PORTS CORPORATION

ABBOT POINT X110 EXPANSION

N

Job Number	41-20175
Revision	B
Date	06 OCT 2009

1:120,000(at A4)

0 1 2 3 4 5
Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

PRESENCE OF CORAL

FIGURE 4-50

G:\41\20175\05 GIS\Projects\mxd's\41-20175-056_coral_Fig4-50_revB.mxd

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc

Level 4, 201 Charlotte St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Table 4-32 Ranking system for the benthic macroinvertebrate regions

	Description	Score	Region													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Size of Region																
	Small (< 100 ha)	1	-	-	-	-	-	-	1	1	-	-	1	-	1	-
	Medium (100 - 500 ha)	2	-	-	-	-	-	2	-	-	2	2	-	-	-	2
	Large (> 500 ha)	3	3	3	3	3	3	-	-	-	-	-	-	3	-	-
Density																
	Open (<1%)	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Low density (1-10%)	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
	Medium - Low density (10-20%)	3	-	-	3	3	3	3	3	3	3	3	3	3	-	-
	Medium Density (20-80%)	4	-	-	-	-	-	-	-	-	-	-	-	-	4	4
	High Density (>80%)	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diversity																
	Very Low (<5 taxa present)	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	Low (5 - 7 taxa present)	2	-	-	-	-	-	-	2	2	2	-	-	-	-	-
	Medium – Low (8-10 taxa present)	3	-	-	-	-	-	3	-	-	-	3	3	-	-	-

	Description	Score	Region													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	Medium (11 - 16 taxa present)	4	4	-	4	-	4	-	-	-	-	-	-	4	-	-
	Medium – High (17 – 20 taxa present)	5	-	-	-	5	-	-	-	-	-	-	-	-	-	-
	High (>20 taxa present)	6	-	6	-	-	-	-	-	-	-	-	-	-	-	-
Total Score		8		11	10	11	10	8	6	6	7	8	7	10	6	7
RANK		**6**		**1**	**3**	**2**	**4**	**7**	**12**	**14**	**9**	**8**	**10**	**5**	**13**	**11**

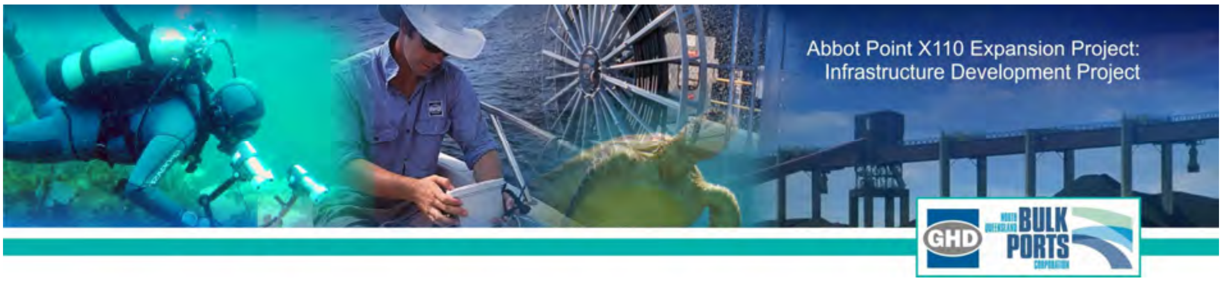
Table 4-33 Area (ha) and ranks of identified benthic macroinvertebrate regions

Benthic Macroinvertebrate Region	Area (ha)	Rank
Open Substrate (<1% cover)		
Region 1	832	6
Low Density (1-10% cover)		
Region 2	18013	1
Medium/Low Density (10-20% cover)		
Region 3	1924	3
Region 4	1561	2
Region 5	842	4
Region 6	242	7
Region 7	82	12
Region 8	99	14
Region 9	210	9
Region 10	105	8
Region 11	89	10
Region 12	985	5
Medium Density (20-80 % cover)		
Region 13	77	13
Region 14	158	11
High Density (>80% cover)	0	N/A

Benthic Results Summary

When comparing benthic macroinvertebrate areas with the aim of highlighting high environmental value areas and areas of high and low potential for environmental impact, it is important to take three factors into consideration:

1. The abundance of benthic macroinvertebrates at each area;
2. The taxa contributing to the macroinvertebrate assemblage at each area; and
3. The size of the area of potential impact.



In this survey, the abundance of benthic macroinvertebrates, particularly hard and soft corals, was recorded as percent cover and presented as a measure of density according to predefined criteria against a backdrop of other benthic macroinvertebrate taxa that characterise the study area.

Although benthic macroinvertebrates of varying densities occurred throughout the study area, high densities of benthic macroinvertebrates were not recorded. A total of 14 macroinvertebrate regions were defined based upon the density results. Within site coral diversity was very low, as was the density of observed coral species. Therefore, no coral areas of high environmental value were observed within the Project Area.

The predefined density classes were used as a base for the production of the benthic macroinvertebrate map and thus as a basis for defining the 14 macroinvertebrate regions.

The relative environmental value of the 14 regions was identified and Region 2 (low density substrate) was ranked as having the highest environmental value. This region is classed as a large region (>500 ha), with low density (1-10%) and high diversity (>20 taxa present) including a number of cnidarian (coral) species. Conversely, the region with the lowest ranking environmental value was Region 8. This region is classed as a small region (<100 ha), with medium/low density (10-20%) and low diversity (5-7 taxa present).

4.11.1.4 Marine Fauna

Overview

Prior to recent marine megafauna baseline studies, substantial information gaps existed in the Abbot Point region on the presence of key marine fauna species. The Great Barrier Reef World Heritage Area supports a variety of critical habitats for marine megafauna populations. Such habitats include large turtle rookeries, extensive seagrass beds, coral reefs, creek and river mouths, sheltered embayments, most of which are found within and adjacent to the Abbot Point area. Megafauna species considered in this section are threatened and protected marine animals of high conservation value. They include cetaceans (whales and dolphins), dugongs and marine turtles.

Some data has been collected on marine turtle foraging and nesting at Abbot Point (Bell 2003) and in adjacent areas (Edgecumbe Bay and Cape Upstart). Important feeding areas have been identified for green turtles and low density nesting by green and flatback turtles occurs within the Abbot Point area, with medium – high density nesting habitats found in Mackay and regions further south (Peak Island and Woongarra coast). Beaches adjacent to the Abbot Point port facility that support small annual turtle nesting include southern Cape Upstart, Camp Island. Rita Island in the mouth of the Burdekin River, supports the highest observed nesting of this local region (Bell, pers. comm, 2008).

Regional datasets exist for dugong distribution in the Great Barrier Reef. Researchers from James Cook University have undertaken systematic aerial surveys of the GBRWHA approximately every five years between 1986 and 2005, by flying transects across the depth gradient (Marsh and Saalfeld, 1989; Marsh *et al*., 1993; Marsh *et al*., 1996; Marsh and Lawler, 2001, 2002). Grech and Marsh (2007) use the composite, spatial information on dugong distribution and relative abundance from these surveys to develop a spatially explicit dugong population model. The model highlights areas on a scale of high to low conservation value to dugongs and identifies the waters surrounding Abbot Point as medium conservation value with adjacent areas (and Dugong Protection Areas), Cape Upstart and Edgecumbe Bay ranging from medium to high conservation value for dugongs.

Dugongs can travel distances of several hundred kilometres (Marsh & Corkeron 1997) and as such, these scales pose difficulty in terms of their management the far northern section of the GBRMP is the most important dugong habitat in the GBRWHA, with a relatively large and stable dugong population (approximately 10000 animals; Marsh & Corkeron 1997). The dugong population from Cooktown to the southern boundary of the GBRWHA is smaller and from 1986 to 1994, has been critically reduced by approximately 50% to about 1700 animals (Marsh & Corkeron 1997). Generally the coastal dugong habitats correspond with the distribution of shallow water seagrasses in the GBR. However, dugongs have also been observed feeding on deep water seagrass meadows at depths of more than 20 metres (Lee Long *et al*. 1989, 1996a).

No documented baseline information on cetacean distribution within the Project area existed prior to the recent megafauna survey, however, good baseline information is available for other regional areas (Townsville and the ‘Sandy Straits’). There are no current estimates of population sizes or trends for Australian snubfin and humpback dolphins at a national level. Estimates of population size are, however, available for Cleveland Bay, Moreton Bay and recently have been developed for the Great Sandy Straits/Hervey Bay, Queensland.

Estimates of population size for both species in the Cleveland Bay and for Indo-Pacific humpback dolphins in The Sandy Straits are considerably small, numbering only 67 snubfin (95% CI = 51-88) dolphins and 54 humpback (95% CI = 38-77) dolphins in 2002 for Cleveland Bay (Parra *et al*. 2006). The Sandy Straits/Hervey Bay population has been suggested as the largest humpback dolphin population in Australia. Two communities have been identified in Sandy Straits/Hervey Bay region; a northern community numbering 72 (95% CI = 68- 81) and southern community numbering 55 (95% CI = 50-69) and they are believed to have little mixing (Cagnazzi *in review*), rendering them vulnerable to local impacts. Such small populations are more prone to local extinction than large stable populations due to a loss of genetic variability and environmental and demographic stochasticity (Caughley and Gunn 1996).

The humpback whale is found with some regularity and often in large numbers in the Great Barrier Reef (GBR). These species migrate annually from summer feeding grounds in Antarctic waters to winter breeding grounds within the GBR. Individuals enter the GBR in May, with numbers peaking in August and most whales out of the region by late October. Abbot Point is within the migratory path of humpback whales and as a deep water port, encounters during migration season are likely.

All of the species described above have life history characteristics that render them vulnerable to threatening processes. These include long life spans, late maturity, low reproduction rates, low fecundity and long parental care. These characteristics result in slow rates of population growth and vulnerability, to rapid population declines that are often not detectable for generations (Taylor 2002). Table 4-34 outlines marine megafauna species of high conservation value that potentially occur in the area, or those that have been recorded on survey.

Table 4-34 Listed and threatened marine species observed on survey or potentially found within the Project area

Scientific Name	Common Name	EPBC	NCA	IUCN (World Conservation Union)[1]	Likelihood of occurrence or observed on survey
Threatened marine mammals					
Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory (Bonn), Cetacean	Vulnerable	Least Concern	Observed
Balaenoptera musculus	Blue Whale	Endangered; Migratory (Bonn), Cetacean		Endangered	Unlikely
Threatened marine reptiles					
Natator depressus	Flatback turtle	Vulnerable, Migratory (Bonn), Marine	Vulnerable	Data Deficient	Observed
Chelonia mydas	Green turtle	Vulnerable, Migratory (Bonn), Marine	Vulnerable	Endangered	Observed
Eretmochelys imbricata	Hawksbill turtle	Endangered, Migratory (Bonn), Marine	Endangered	Endangered	Observed
Caretta caretta	Loggerhead turtle	Endangered, Migratory (Bonn), Marine	Endangered	Endangered	Observed
Lepidochelys olivacea	Olive ridley turtle	Endangered, Migratory (Bonn), Marine	Endangered	Vulnerable	Possible
Dermochelys coriacea	Leatherback turtle	Vulnerable, Migratory (Bonn), Marine	Endangered	Critically Endangered	Unlikely
Migratory marine mammals					
Sousa chinensis	Indo-Pacific humpback dolpin	Migratory (Bonn), Cetacean	Rare	Data Deficient	Observed
Orcaella heinsohni	Australian snubfin dolphin	Migratory (Bonn), Cetacean	Rare	Near Threatened	Observed

Scientific Name	Common Name	EPBC	NCA	IUCN (World Conservation Union)[1]	Likelihood of occurrence or observed on survey
Dugong dugon	Dugong	Migratory, Marine	Vulnerable	Vulnerable	Observed
Listed Cetaceans					
Delphinus delphis	Common dolphin	Cetacean		Least Concern	Observed
Tursiops sp.	Bottlenose dolphin	Cetacean		Data Deficient	Observed

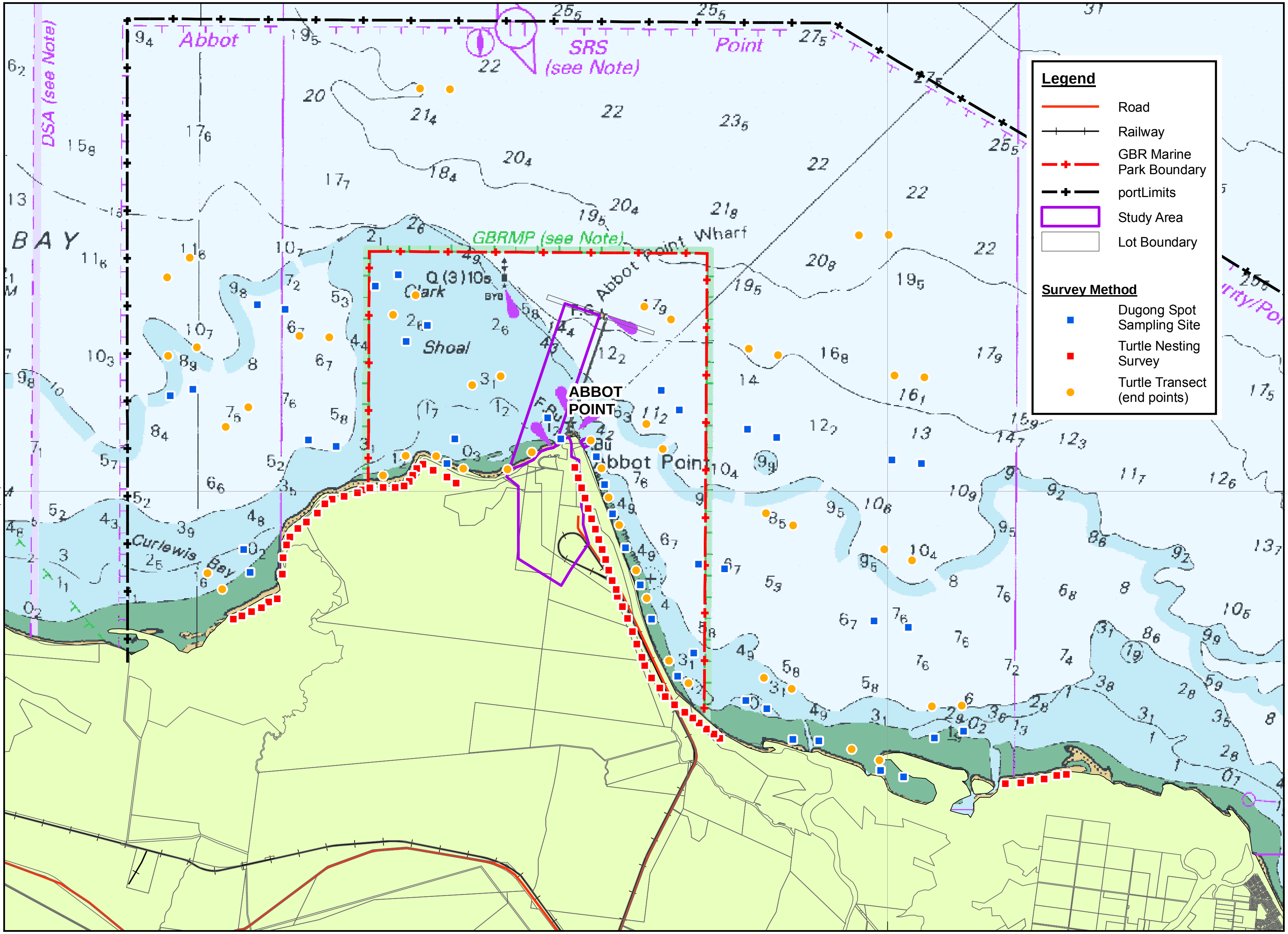
[1] IUCN Red List categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Lower Risk, Data Deficient (Source: 2002 IUCN Red List of Threatened Animals).

Survey Scope and Approach

A dedicated marine megafauna survey was undertaken over a period of 12 months to sample for the presence of these species within the Project Area, develop an understanding of their habitat utilisation and identify any temporal trends that may exist. The knowledge base developed from these surveys intends to inform decisions for future environmental management in the Abbot Point area.

Megafauna species included in this survey include marine turtles, dugong, cetaceans, sea snakes and elasmobranchs. The survey design considered the behaviours of inshore cetaceans, dugongs and turtles (species that require frequent surfacing intervals) and was adapted to examine a relatively small spatial scale (Lukoscheck and Chilvers, 2008, Chilvers *et al*. 2004, Groom *et al*. 2004; Parra *et al*. 2006). The surveys captured temporal and spatial trends by consistently sampling the same sites monthly over a 12 month period. Sites were unable to be sampled during the wet season (January – March) due to flooding and unsafe boating conditions.

A stratified boat-based survey across a variety of depths (refer Figure 4-51) was designed taking into consideration habitat information resulting from epibenthic habitat mapping (reported above and also Rasheed *et al.* 2005) and personal communication with Ian Bell (2008). A monthly sampling combination of 50 timed transects and 42 spot sampling sites over 12 months was determined as the best method to capture the diversity of species in the area. This design covers the heterogenous and patchy habitat in the environment, in the context of available marine fauna aerial survey data for this region. This approach provides for a theoretical increase in detectability within the survey area. As a multi-species survey, this is necessary as most species will exhibit a degree of seasonality in their movements over time.



GHD
CLIENTS PEOPLE PERFORMANCE

NORTH QUEENSLAND BULK PORTS CORPORATION

ABBOT POINT X110 EXPANSION

N

Job Number	41-20175
Revision	B
Date	06 OCT 2009

1:120,000(at A4)

0 1 2 3 4 5

Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

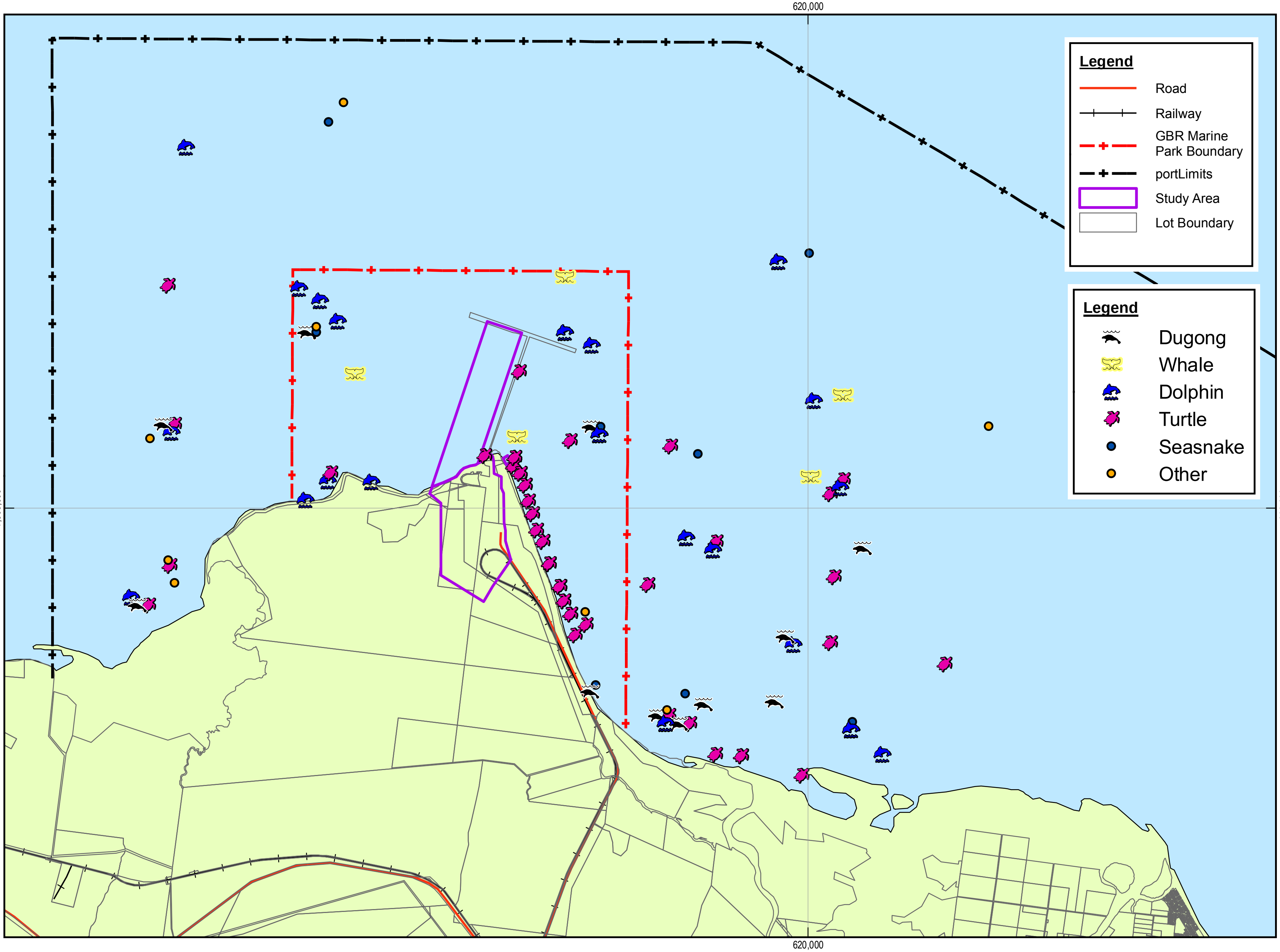
MEGAFAUNA SURVEY SITES

FIGURE 4-51

G:\41\20175\05 GIS\Projects\mxd's\41-20175-057_MegaFauna_Fig4-51_revB.mxd

Level 4, 201 Charlotte St Brisbane QLD 4000 T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com.au W www.ghd.com.au

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc



ABBOT POINT X110 EXPANSION

Job Number 41-20175
Revision B
Date 06 OCT 2009

1:120,000(at A4)

0 1 2 3 4 5
Kilometers

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

MARINE FAUNA SURVEY SIGHTINGS OF ALL MARINE FAUNA

FIGURE 4-52

G:\41\20175\05 GIS\Projects\mxd's\41-20175-069_marineFaunaSurvey_Fig4-52_rev_B.mxd

Data Source: GA: road, rail, coastline - 2006, Seafarer: Hygrographis Charts AUS 826 - 2007. Created : jvc

Level 4, 201 Charlotte St Brisbane QLD 4000 T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com.au W www.ghd.com.au

Fifty line transects were timed at five minutes each whilst maintaining a constant speed of 10 km/hr, enabling a survey distance of approximately three kilometres (equating to approximately 0.6 km^2 area of detectability). Transects were surveyed over two to three days each month (dependent on weather and number of sightings) and to date, nine surveys have been undertaken and reported from July 2008 to June 2009. Over the six month period, this accounts for 2,475 minutes of timed transects and 3,780 minutes of spot sampling within the Abbot Point survey area.

The sampling of sites is dependent upon tidal state, where shallower sites (< 5 m LAT) are sampled at a high tide to account for animals that may be accessing food resources that would otherwise be tidally restricted. The surveys use a 6 m rigid boat with a high canopy (above sea elevation approximately 2.5 m). Two experienced observers visually surveyed the surrounding waters and the presence of marine fauna was recorded. Where fauna was present, the following data was recorded:

- G.P.S location;
- Time;
- Date;
- Depth;
- Species; and
- Age class of species (where discernable).

Species age class was defined as per Table 4-35.

Table 4-35 Age class categories for Green Turtle, the dugong and inshore dolphin species

Species	Age class	Size (curved carapace length for turtles)	Age range (years)
Green turtle (*Chelonia mydas*)	Adult	85 – 120 cm	32 +
	Sub-adult	65 – 90 cm	18 – 35
	Juvenile	40 - 65 cm	5 – 18
Dugong (*Dugong dugon*)	Adult	240 - 300 cm	6 – 70 +
	Calf	100 cm – 200 cm (closely associated with adult)	0.1 – 1.5
Indo-Pacific humpback dolphin *(Sousa chinensis)*	Adult	200 - 320 cm	
	Juvenile	150 – 200 cm	
	Calf	100 cm – 200 cm (closely associated with adult)	

Species	Age class	Size (curved carapace length for turtles)	Age range (years)
Snubfin dolphin (*Orcaella heinsohni*)	Adult	200 - 275 cm	
	Juvenile	150 – 200 cm	
	Calf	<100 cm – 200 cm (closely associated with adult)	

Source: Adapted from - Chaloupka and Limpus (2005) and Jefferson *et al.* (1993).
Note: Age class categories are not well understood for species other than green turtle.

Key Findings

Marine fauna surveys to date have recorded sightings of 14 different species in the Abbot Point area (excluding fish). These animals include four species of turtle, three species of dolphin, one species of whale, two species of shark and one species of ray. Turtle mating was recorded in September and nesting activity has been recorded in November and December.

The presence of observed species in the Abbot Point area over the six month survey period is presented below (Figure 4-53). The graph shows that the Indo-Pacific humpback dolphin (*Sousa chinensis*) is most frequently sighted (n = 79) with varying prevalence, with marine turtles also being regularly observed with varying frequency over the six months (n = 72).

A notable increase in turtle presence within the area during November and December, including sighting of turtle tracks on beaches, is likely attributed to nesting season (November – February). Importantly, however, species that are not known to nest in the area (such as Loggerhead and Hawksbill turtles) were also recorded in December, indicating the area is not only important for nesting turtles.

Humpback whales also exhibited seasonality in their presence at Abbot Point, with recorded sightings in September only (n = 14) during the whale migration period. The observed humpback whales were most often adult and calf pairs, at recorded depths of 5 – 20 m. The whales observed in 5 m of water were found on Clark Shoal and consisted of two adults and two calves, likely to be resting or feeding (see Photo 4-14).

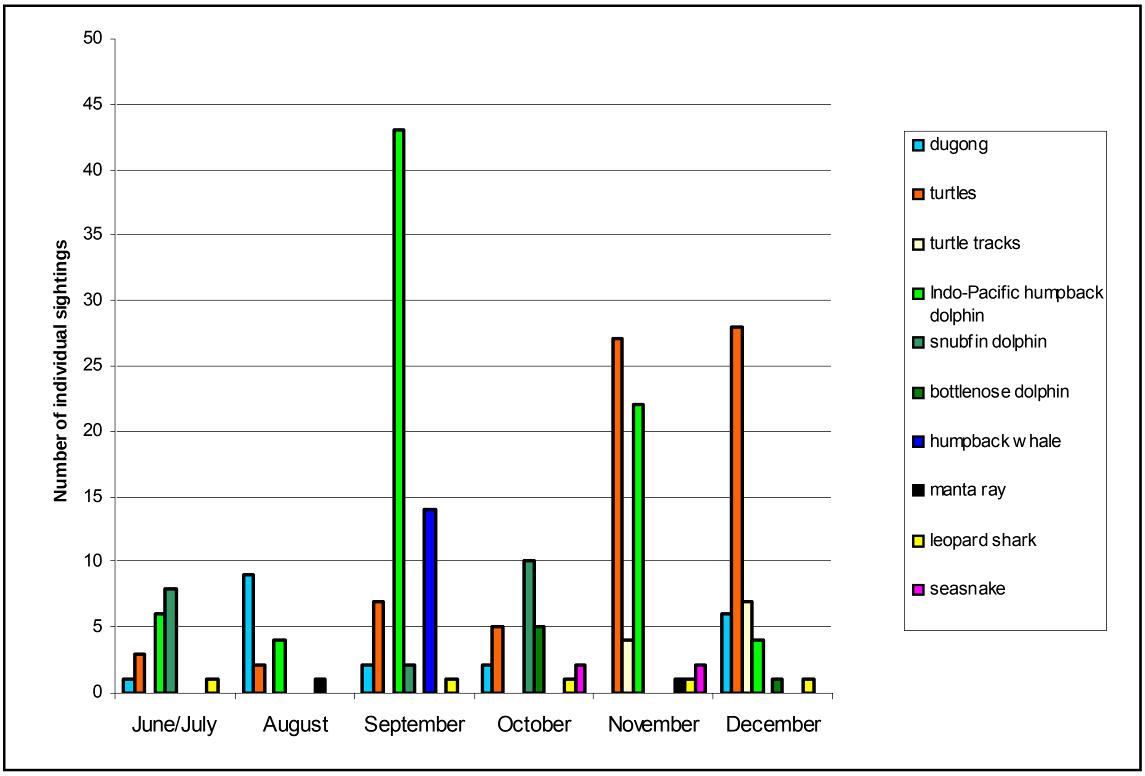


Figure 4-53 Frequency of marine fauna sightings across monthly surveys (2008)

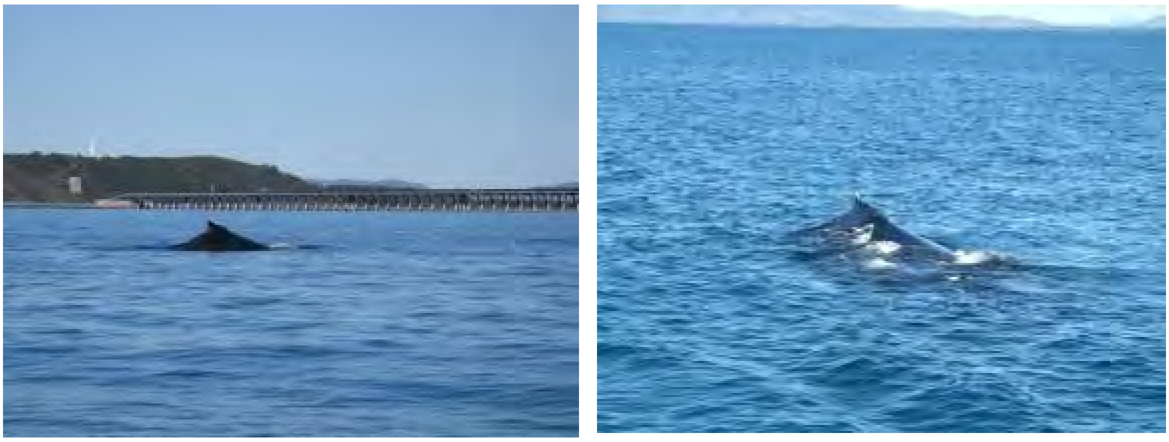


Photo 4-14 Humpback whales observed near the existing jetty (left) and Clark Shoal right)

Table 4-36 shows the number of animals and their observed depths over the first six month period of marine fauna surveys. Dugongs were recorded using depths between 2.5 – 14 m. Green turtles (*Chelonia mydas)* were the most abundant species recorded, followed by flatback turtles (*Natator depressus*). Loggerhead (*Caretta caretta*) and hawksbill turtles (*Eretmochelys imbricata*) were uncommon. Eight turtles sighted were not able to be identified due to distance and short surfacing periods. Turtles were also noted to use a wide depth range (between 1.1 – 14.9 m).

Table 4-36 Observed depth range of species observed on survey

Species	Observed species frequency	Depth range
Green turtle *(Chelonia mydas)*	52	1.1 m – 14.9 m
Flatback turtle (*Natator depressus)*	11	1.2 m – 12 m
Loggerhead turtle (*Caretta caretta*)	2	3 m – 10 m
Hawksbill turtle (*Eretmochelys imbricate)*	1	3 m
Unidentified turtle species	8	5 m – 12 m
Indo-Pacific humpback dolphin (*Sousa chinensis)*	79	4.5 m – 19 m
Bottlenose dolphin *(Tursiops aduncus)*	6	6.3 m - 22.8 m
Australian snubfin dolphin *(Orcaella heinsohni)*	20	9 m – 13 m
Humpback whale *(Megaptera novaeangliae)*	14	5 m – 20 m
Dugong (*Dugong dugon)*	19	2.5 m – 14 m
Olive-headed sea snake (*Disteira major)*	10	1.2 m – 12 m
Manta ray *(Manta birostris*)	3	2.6 m – 7 m
Leopard shark (*Stegostoma fasciatum)*	5	1.2 m – 21 m

Indo-Pacific humpback dolphins (*Sousa chinensis*) were recorded often during the six month monitoring period (n=79). The snubfin dolphin (*Orcaella heinshoni*) (n=20) and the bottlenose dolphin (*Tursiops aduncus*) (see Photo 4-15) (n=6) were recorded on more than one occasion, but not as frequently. Dolphins showed variability in their pod structures at different survey times, with pods ranging from 22 animals consisting of adults, juveniles and calves, to a single adult. A mixed pod of snubfin (see Photo 4-16) and Indo-Pacific humpback dolphins was also recorded on one occasion. The depth range where all dolphin species were found was between 4.5 – 22.8 m.

Photo 4-15 Bottlenose dolphins to east of the coal terminal and jetty

Photo 4-16 Snubfin dolphins observed to east of the coal terminal and jetty

Ten sea snakes (see Photo 4-17) were recorded during the survey and found in waters ranging in depth from 1.2 m to 12 m. One sea snake was observed eating an eel. Five leopard sharks were recorded within a depth range of 1.2 – 21 m. All of these sightings were of sharks at the waters' surface (see Photo 4-18). Two manta rays were recorded feeding over relatively shallow habitats of 2.6 – 7 m depth (see Photo 4-19). The targeted marine species observed on survey were found to utilise a range of depths in the Port of Abbot Port, ranging from 1.1 m to 22.8 m across the extent of the survey area.

Photo 4-17 Olive-headed sea snake seaward of Kings Beach

Photo 4-18 Leopard shark observed at Clark Shoal

Photo 4-19 Manta rays observed at Camp Island (left) and Abbot Bay (right)

Dugongs were more frequently sighted in areas where seagrass had previously been recorded than where seagrass was absent. Although turtles were found to use habitats where seagrass was present, there appeared to be an aggregation of turtles around rocky reef areas to the south of the Abbot Point terminal. This area does not have extensive seagrass habitat, however, the rocky reef extends for approximately four kilometres along the shoreline, with an approximate depth of six metres at the seaward edge. This reefal habitat has previously been identified by Bell (pers. comm., 2008) as an important foraging habitat for turtles. The utilisation of this habitat by turtles was also found to increase over time, with more observations being recorded in November and December than other months. The habitat also supported a range of turtle age classes. All four species of turtle recorded in the survey area were found here.

Figure 4-54 shows the biotic densities of the epi-benthic environment as surveyed by GHD (2008). Marine fauna species distribution with respect to this habitat identifies areas of interest that the seagrass plot may not identify for some species. In many cases, species presence is observed where the structural densities of the benthic environment change from a greater to a lesser density. The observed distribution of whales does not appear to be strongly associated with any particular habitat type. Sea snakes and elasmobranches were also recorded in a variety of habitats, suggesting no particular habitat type is preferential. Sightings were often recorded in association with other fauna sightings. All species of dolphin were found to occur in a range of habitat types. Of interest, the snubfin dolphins were repeatedly observed over medium/low biotic density (see Figure 4-54). The majority of species observations occurred over open substrate, with very little cover of benthos and very few animals, comparatively, observed in areas with complex benthic habitat.

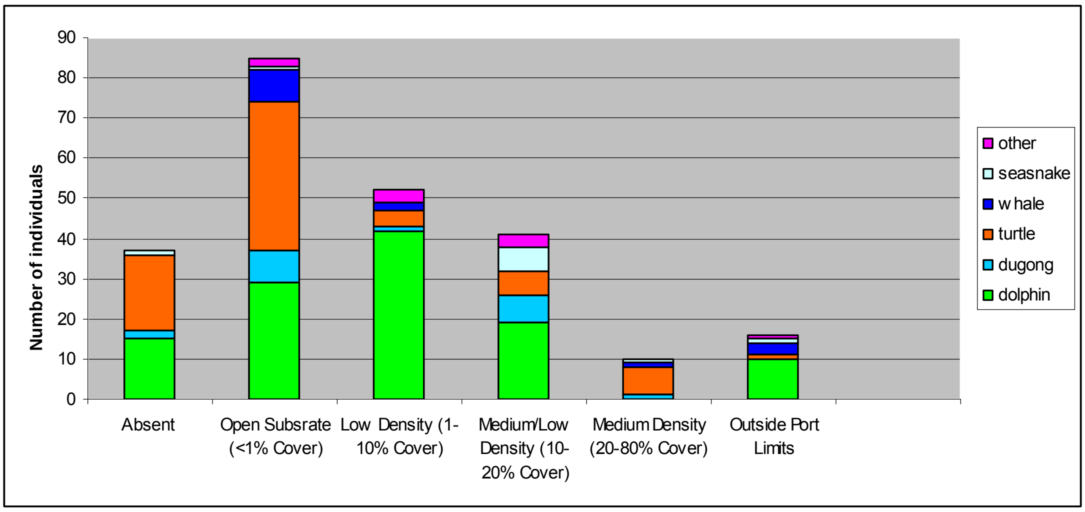


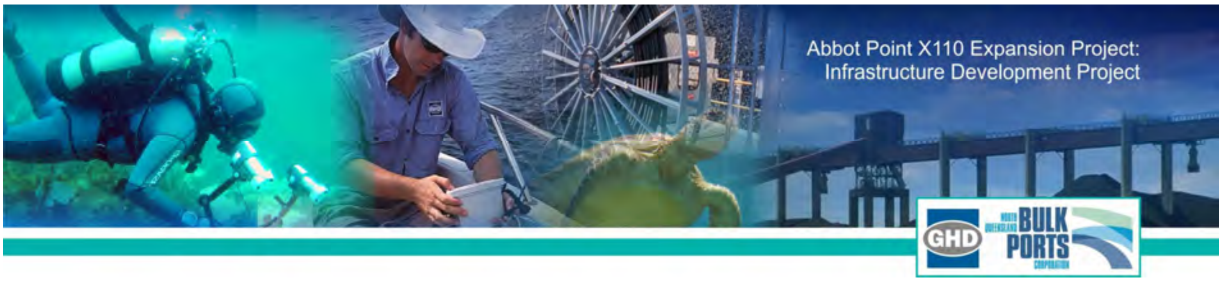
Figure 4-54 Benthic habitat density and marine fauna utilisation

To date, the survey has recorded a larger proportion of adult marine fauna than any other age class. Table 4-37 below, outlines the population composition of key marine fauna groups. Observed whales were most likely migrating adult females and calves, given the proportion of calves present with adults. Green turtles had representation of all age classes (except for hatchlings). The hawksbill, loggerhead and flatback turtles were only observed as adults during the six month period. Dolphins and dugongs observed had similar age class structures, with approximately 75% adults, 15 – 18% calves and 5 – 10% juveniles.

Table 4-37 Age class composition of observed key marine fauna

	Adult	Sub-adult (turtles)	Juvenile	Calf	Total
Whales	8			6	14
Dugong	15		1	3	19
Dolphins	76		10	19	105
Turtles	52	10 (all green turtles)	12 (all green turtles)		74

An increase in species diversity was recorded in November and December (Figure 4-55).



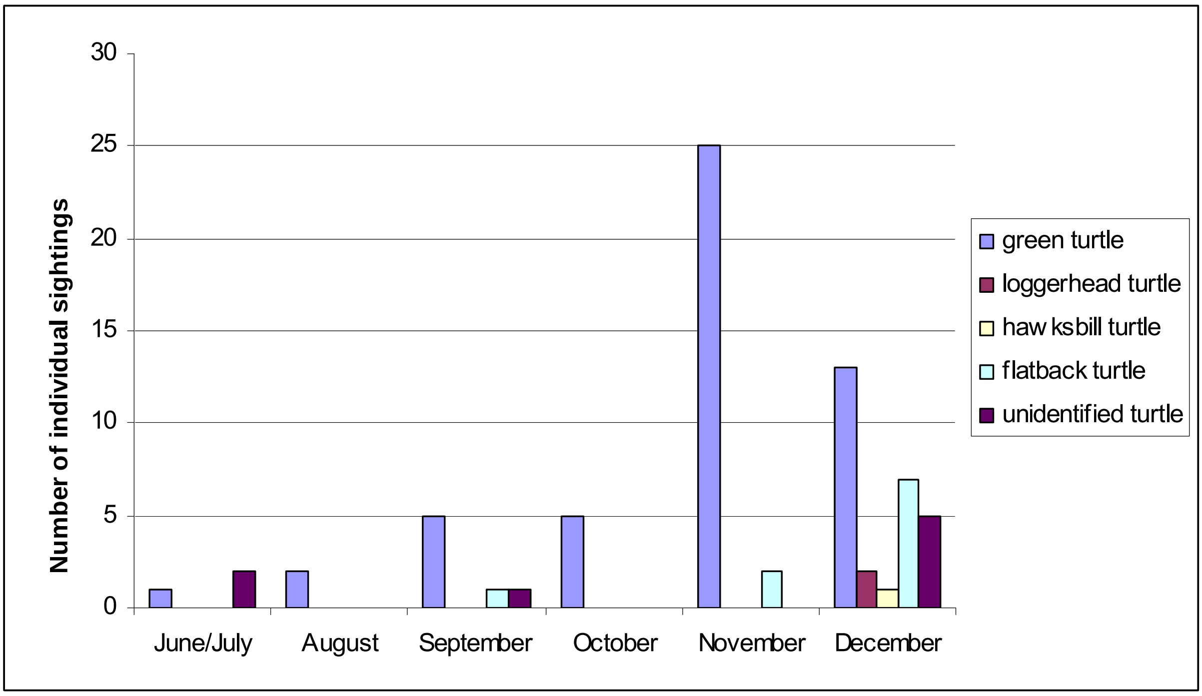


Figure 4-55 Observed frequency of turtle species on survey over a six month period

Turtle nesting was recorded along the Abbot Point beaches (Photo 4-20 and Photo 4-21) during November (n = 4) and December (n = 7). The tracks observed at these beaches resembled flatback and green turtle tracks; both have a symmetrical gait and are rarely distinguishable. Track widths ranged in size from 74 – 99 cm and appeared to be at least a couple of days old. Two nests had been predated by wild dogs and possibly foxes. The remaining eggshells at these sites were identified as flatback eggs, being distinctly larger than green turtle eggs.

Low density marine turtle nesting activity is known to occur on the beaches surrounding the Project footprint. The coal terminal is well lit, however, impact of this on marine turtles at Abbot Point is not quantified. The impact associated with X50 expansion was addressed in the EIS for this project. The sea-finding process by turtles is directed by several cues; light brightness, shape and form of the beach environment and to a lesser extent beach slope (Lohmann *et al.* 1996). Bright lights interrupt the natural light horizon that turtles navigate to after nesting or hatching.

Photo 4-20 Tracks and nests recorded at Kings Beach, west of proposed jetty

Photo 4-21 Predated nests recorded near Abbot Bay

4.11.1.5 Marine Pests

Presence of Marine Pests at Abbot Point

None of the target marine pest species (as listed in Hayes *et al*., 2005) were detected during the marine ecological surveys recently conducted at Abbot Point. This finding supports that reported previously from the targeted marine pest survey conducted at Abbot Point in July 1998 (refer Hoedt *et al*. 2000). During that survey, a total of 569 taxa were sampled using a range of techniques. None of these were targeted marine pest species. A cryptogenic species, which was not identified as either native or introduced, was detected during the first survey in 1998. This species, *Charybdis annulata,* was noted to have a widespread distribution in the Indo-Pacific region, but had not previously been recorded in Australia. This species was not detected during the latest survey (refer GHD 2008) and is also now recognised to not be of concern for Australia (refer Hayes *et al.* 2005).

Although the findings from the survey were consistent with other surveys for marine pests conducted within northeastern Australia, including that conducted previously at Abbot Point, the survey was a baseline ecological survey and not targeted at marine pests. The methodologies adopted were in accordance with, but not as extensive as, those identified under the National System for the Prevention and Management of Marine Pest Incursions (the National System). As ships arriving at Abbot Point are known to be loading cargo, there is a potential for ballast water pest species to be discharged in this location on a regular basis. However, Abbot Point is not identified as a priority location for ongoing monitoring of marine pests under the National System. Accordingly, not finding marine pests using the survey approaches undertaken here is considered reasonable and not deficit given the different methodological approach implemented.

To maintain the status of ‘no marine pest species’ at Abbot Point, management of international ballast water should continue in accordance with legislated requirements in Australia. Consideration should also be given to adopting strategies identified in the recently implemented border control guidelines for management of pest introduction via biofouling (available from www.marinepests.gov.au).

The following section describes possible vectors for the introduction of marine pests, possible impacts of a marine pest incursion and proposed mitigation measures.

Prevention and Management of Marine Pests in Australia

Various definitions of what constitutes a marine pest exist within the literature. Typically, a pest is recognised to be a non-indigenous taxon that threatens human health, economic or environmental values (Carlton 1996, 2002 among others). This is in contrast to introduced or cryptogenic taxa that are considered to be taxa that have been introduced (but may not negatively affect a system they have been introduced to), or species that are neither demonstratively native nor introduced.

In Australia, to assist in clarifying taxa that are considered to be pests for Australia’s coastal marine ecosystems, recognised pest Introduced Marine Species (IMS) have been identified on target lists constructed by the Australian Ballast Water Management Advisory Committee (ABWMAC) and the Australian National Introduced Marine Pest Coordination Group (NIMPCG). Additional research conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has also provided an indication of what species are likely to be introduced to Australia and have the potential to become pests (Hayes *et al*. 2005). Knowledge of what species may become pests in Australian waters is subject to change on a regular basis as a new understanding of risks develops. As such, legislation makes reference to target lists, the most up to date versions of which need to be accessed through the appropriate management agency when assessing concerns (eg refer http://www.daff.gov.au/__data/assets/pdf_file/0011/551864/ccimpe-trigger-list.pdf).

Legislative Framework

An integrated approach to managing IMS and their vectors is being developed for Australia through the National System for the Prevention and Management of Marine Pest Incursions (the 'National System'). The Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) is the lead agency responsible for coordinating the development of policy approaches to address the issue of introduced marine pests in Australian waters. The Invasive Marine Species Program within DAFF coordinates the development and implementation of the National System, with the responsibility of implementation shared between the Australian, State and Northern Territory Governments. DAFF coordinates marine pest management with relevant Australian Government agencies, including DEWHA, the Department of Transport and Regional Services (DOTARS), the Australian Maritime Safety Authority, the Australian Quarantine and Inspection Service (AQIS), the Department of Industry, Tourism and Resources and the Defence Science and Technology Organisation. DEWHA is managing the development of the Ongoing Management and Control element of the National System.

The National System has three main components (prevention, emergency response and ongoing control and management) and is supported by an Intergovernmental Agreement that has been signed by the Australian Government and the governments of Victoria, Tasmania, South Australia, Western Australia the Northern Territory and Queensland (http://www.daff.gov.au/animal-plant-health/pests-diseases-weeds/marine-pests/national-system accessed 10 June 2008). Under this agreement, the Australian Government is responsible for implementing arrangements to manage the risk of marine pests being introduced to Australia from other countries. It will also have several supporting components that are currently being developed, including strategies for research and development, communication, monitoring, evaluation and review. The States and the Northern Territory are responsible for managing the risks of a marine pest translocation within Australian waters.

The various national and state responsibilities for managing IMS matters in Queensland are exercised through a range of Commonwealth and Queensland State legislative tools.

Of relevance to the management of marine pests within Queensland waters is the GBRMP Act. Although it does not specifically contain legislative tools directed at marine pests, it does contain provisions directed at vessel activities and their potential impact on the marine environment.

Border Control Requirements

The introduction of marine pests to Australian waters may occur via a number of different vectors, however, ballast water and biofouling of vessel hulls are widely considered as the most significant of these vectors and are of relevance to commercial shipping activities at the Port of Abbot Point.

An International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Convention) has been developed through the International Maritime Organization (IMO). The text of the Convention was adopted at a Diplomatic Conference in February 2004. The Convention provides for consistent ballast water management requirements to be implemented worldwide. Australia signed the Convention subject to ratification in May 2005.

The Australian Government, through AQIS, is responsible for managing the day-to-day actions to enable border control of marine pest incursions from internationally sourced ballast water. AQIS implemented mandatory ballast water management arrangements under the *Quarantine Act 1908* in July 2001, following a period of voluntary implementation. Under these requirements, ballast water must be exchanged at sea unless it is determined to be low risk for carrying select IMS. A Ballast Water Decision Support System (DSS) is in place that provides an assessment of the risk of marine pest introduction through a ship's (international) ballast water, based on a number of factors including species present at origin and destination ports, journey duration, ballast water exchange history and species survivability. The DSS currently screens for a select list of species known to be pests of concern for Australia and if determined to be a likely risk, appropriate management action of the ballast must be undertaken. Taxa not on the DSS list, regardless of their invasion potential through ballast water, are currently not screened for. It is assumed, however, that current ballast water management arrangements would be effective for these other taxa if they were effective for the target taxa.

Under this legislative requirement (*Quarantine Act 1908*), any vessel carrying international ballast water seeking to enter Australian waters would need to either voluntarily exchange their ballast at sea according to minimum exchange requirements (refer AQIS for current requirements), or undertake an assessment of its ballast water through the DSS. If that ballast was not deemed as low risk, the vessel would need to adopt a management strategy for the ballast water that may include exchange of the ballast at sea (>200 nautical miles from Australian waters) or non-disposal. If the ballast was deemed as low risk, then exchange within Australian waters may be permitted by AQIS. Currently, exchange of high risk ballast water is considered unacceptable within the GBRMP, irrespective of vessel positioning in regards to land. This process is considered by the Australian Government to currently be adequate to mitigate risks associated with introduction of high-risk species via ballast water to Australian waters.

Border Control Biofouling Management

National marine pest incursion prevention efforts have, to date, focussed on the risks associated with ballast water from international shipping. The gap in relation to controlling introductions as a result of biofouling of vessels and equipment is being addressed under the National System through the development of best practice guidelines and codes of conduct for various sectors for certification procedures, treatment and inspection protocols. These codes of conduct will apply to commercial vessels and non-trading vessels such as oil rigs, barges, dredges, fishing vessels and recreational boats.

The national biofouling guidelines currently being developed through NIMPCG will be implemented progressively, with subsequent evaluation to assess the degree of uptake of the measures. They will also be designed to be consistent with any international guidelines that might be developed into the future. The level of compliance and uptake of these agreed national guidelines and their effectiveness at preventing incursions through biofouling vectors would need to be monitored.

Biofouling inspection protocols for border control management of marine pests for small (<25m in length) international vessels have been developed and trialled. AQIS, under the *Quarantine Act 1908,* currently has the legislative responsibility for undertaking these inspections, however, the small vessel inspection protocols would unlikely apply to any vessels entering Australian waters to access the Port of Abbot Point. Currently, the codes of conduct and certification procedures for management of biofouling that could apply to the vessels using this facility are yet to be implemented. Although AQIS has legislative responsibility under the *Quarantine Act 1908* for inspecting vessels for pests as part of their international border biosecurity management, standardised mechanisms for successful inspection and detection of marine biofouling pests on larger barges, dredges, and commercial vessels are not yet established.

Inspections of some barges and other vessel types (eg defence force vessels) that were considered at risk of carrying marine pest biofouling have occurred to date at various locations (both Australia and internationally), as a biofouling border control mechanism for Australia, either immediately prior to, or post vessel entry into Australian waters. Such inspections of the hull areas have occurred either through in-water inspections by divers of visible surfaces or by dry-dock inspections where feasible.

NQBP would require that vessels adhere to legislated controls for biofouling IMS.

Domestic Border Control Legislation

Prior to 1 March 2007, Queensland adopted a multi-agency approach to marine pest management and prevention between DERM, DEEDI and the Department of Transport and Main Roads (DTMR). On 1 March 2007, a new division of DEEDI, Biosecurity Queensland, was established and responsibilities for marine pest management now fall under the jurisdiction of that agency. Biosecurity Queensland's charter is to coordinate the Queensland Government's efforts to prevent, respond to and recover from pests and diseases that threaten Queensland's economy and environment. In prevention matters, they interact with Commonwealth platforms, including NIMPCG and the Consultative Committee for Introduced Marine Pest Emergencies (CCIMPE), to support development and implementation of border control in a congruent manner for Australia across all states and territories. Effort within Queensland, therefore, focuses on post entry prevention of spread, impact mitigation and management.

Until recently, pest management efforts within Queensland Government focused primarily on terrestrial pests and management of marine pest species has only recently formed part of the biosecurity agenda. With the establishment of Biosecurity Queensland, capacity under the *Queensland Fisheries Act 1994* has been assessed to deal with marine pest matters. Previously, the disease management provisions of the *Queensland Fisheries Act 1994* (Sections 94 and 95) have been invoked to control marine pest incursions. It is expected that Biosecurity Queensland will examine and address any gaps in legislative need for marine pest management. Close interaction with Queensland Fisheries is maintained on all aquatic biosecurity matters to improve the capacity for maintenance of Queensland's biosecurity.

NQBP would require that vessels seeking access to facilities at the Port of Abbot Point would adhere to all legislative requirements provided by Queensland Biosecurity in regards to marine pest matters. If any marine pests were detected within the Port of Abbot Point, Queensland Biosecurity reporting requirements would be followed with notification of a potential suspected marine pest to this agency.

Summary

NQBP is aware of Commonwealth and Queensland State marine pest prevention, mitigation and management requirements as they relate to commercial vessels likely to utilise the Port of Abbot Point.

NQBP will seek to maintain currency of their knowledge of these matters through communication with relevant Commonwealth and State marine pest management agencies.

NQBP would require all vessels seeking to utilise the Port of Abbot Point to adhere to Australia's mandatory ballast water reporting system and would not accept high risk ballast water exchange within the Port of Abbot Point, in accordance with the DSS.

NQBP would require all vessels seeking to utilise the Port of Abbot Point to adhere to any established guidelines, protocols or legislation for management of marine pest introduction risks associated with commercial vessel biofouling.

NQBP will follow Biosecurity Queensland reporting requirements for notification of any suspected marine pest species if they are detected within the Port of Abbot Point.

4.11.2 Potential Impacts and Mitigation Measures

4.11.2.1 Overview of Potential Impacts

The Project will have a number of impacts on the marine ecological values of the area in which it is located. These impacts primarily relate to the removal of a small amount of benthic habitat due to driving of wharf piles. In addition, a range of temporary impacts are expected as a result of construction activities, principally noise impacts from pile driving. These potential impacts include:

» Direct Impacts:
  – Removal of or damage to benthic communities (including seagrass, algae and macroinvertebrates);
  – Noise impacts on marine megafauna; and
  – Impacts to water quality.
» Indirect Impacts:
  – Disturbance of benthic communities via an increase in vessel traffic;
  – Impacts to water quality resulting from operational activities;
  – Altered patterns of beach nesting due to Port light sources;
  – Noise and vibration impacts to marine reptiles and mammals from in-water construction; and
  – Low risk of altered patterns of habitat utilisation by mobile marine fauna in response to increased presence of in-water infrastructure and any associated influences on prey species.

4.11.2.2 Benthic Communities

Potential Impacts

Fourteen different benthic macroinvertebrate regions were identified at the Port of Abbot Point, however no coral areas of high environmental value were observed within the Project Area. Further, the Project Area was found to support low density, sparsely distributed benthic fauna that are well represented in the Abbot Point area. The study area encompasses approximately 281 ha of the total area of benthic macroinvertebrate regions and comprises of:

» 107 ha, representing 2.9 percent of Region 1 (<1% cover);
» 85 ha, representing 0.5 percent of Region 2 (1-10% cover);
» 89 ha, representing 1.4 percent of Region 5 (10-20% cover; and
» 1.5 ha, representing 0.6 percent of Region 14 (20-80% cover).

However, given the nature of the Project footprint (wharf pylons), only a small portion of this study area will be impacted. Ottaway *et al.* (1989) demonstrated that following construction of the existing port facilities and the provision of new habitats, the biodiversity of the Abbot Point area increased. However, Hoedt *et al.* (2000) did not find a biodiversity that was significantly different to that detected during the earlier surveys.

No net loss of marine flora is expected to occur from this Project. Any incidental loss resulting from the Project construction is expected to recover quickly in adjacent habitats. Some net loss (very minor) of benthic soft sediment fauna is expected. This is balanced by additional provision of hard substrates associated with the in-water structures of the Project, which provide new habitat for hard substrate taxa, including corals and can act as fish aggregation areas.

Mitigation Measures

No mitigation measures are proposed for reducing impact to benthic communities, given the minor nature of potential impacts.

4.11.2.3 Marine Fauna

Potential Impacts

The waters in the immediate vicinity of the Project Area and those surrounding it provide a foraging habitat and migratory pathway for many marine species of conservation priority. The heterogeneity of habitat types and depths within the Port limits provide an ideal matrix for foraging and refuge and indirectly affords a protective environment for the habitats and species within. Marine fauna survey results to date suggest seasonality influences the presence of some species such as nesting turtles and whales, whilst others show a degree of site fidelity (foraging turtles, dugongs and coastal dolphins).

No impacts on migratory patterns of megafauna are expected as a result of the X110 project as the development will be adjacent to existing infrastructure. Megafauna already use this area demonstrating their ability to co-habit.

The study area is a shallow water coastal environment. Ambient noise levels in shallow water vary widely in frequency and level distributions depending on time and location (Richardson *et al.* 1995). The primary sources of noise in most shallow water regions are distant shipping, industrial, or geophysical-survey noise; wind and wave noise; and biological noise. The Environmental Protection (Noise) Policy 2008 (Noise EPP) provides the regulatory detail under the EP Act, but an underwater noise limit is not specifically detailed. The environmental values to be considered in the Noise EPP are the ‘health and biodiversity of ecosystems’ and the acoustic quality objective is achieved by preserving the ‘amenity’ of the area (WHA, for example).

There is a large volume of literature concerned with the description of various impacts upon marine fauna species (Richardson *et al.* 1995, McCauley 1994, Tasker & Weir 1998, Gisiner 1998, McCauley & Duncan 2001, and O'Brien 2002). Table 4-38 outlines the acoustic intensity and frequency of those sources of marine noise for which there is data, relative to the call and vocalisation ranges of marine mammals.

Table 4-38 Summary table of acoustic intensity and frequency of noise sources relative to those for marine mammals (approximated from literature)

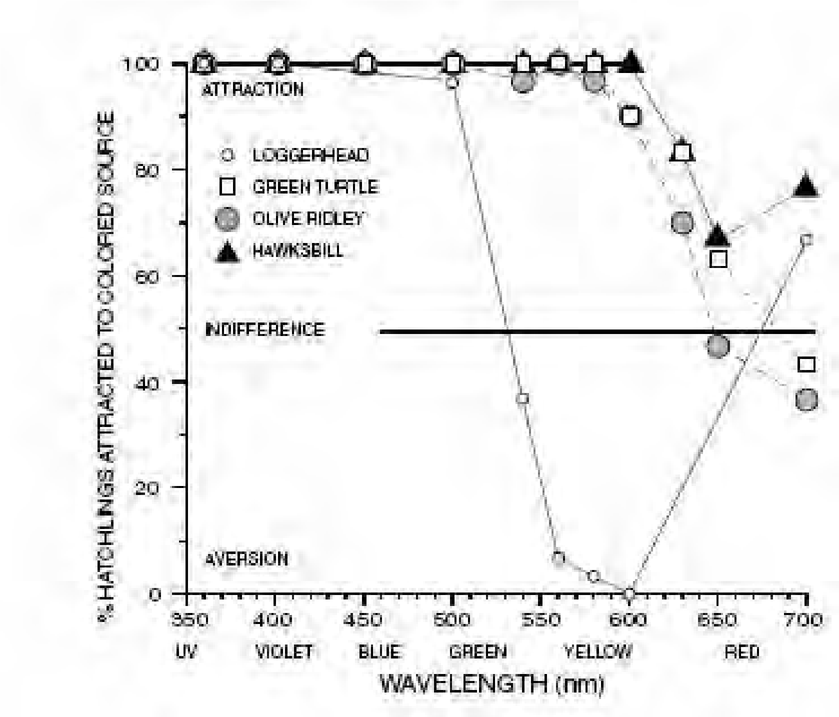
Source	Acoustic Intensity (dB re 1μPa)	Frequency Range (Hz)
Great whales	130 – 188	16 – 8,000
Toothed whales/dolphins (vocal)	125 – 180	1,600 – 120,000
Toothed whales/dolphins (echolocation)	180 - 228	6,000 – 130,000
Dugongs	unknown	1,000 – 8,000
Earthquakes (≤4)	35 - 199	10 - 50
Ships	177	5 - 100
Seismic	215 – 230	10 – 300
Extraction operations	182	unknown
Boats	130 – 180	50 – 1000

An assessment of pile driving noise in the Gladstone area was recently undertaken (Connell Hatch 2006) to assess piling activities using a 9 t and 14 t hammer, assuming piling noise levels ranging from 197 dB (re 1μPa) up to 226 dB (re 1μPa) at a distance of 1m from the source. The underwater sound propagation used for this assessment is consistent with the method commonly used in shallow water less than 40 m deep (Urich 1983). The assessment determined an impact zone, which is an area where peak pressure levels from pile driving are predicted to be lower than the 218 dB (re 1μPa (peak)) threshold. The purpose of this impact zone is to prevent death or injury to marine mammals, fish and sea turtles. The assessment (Connell Hatch, 2006), found that using a 14 t hammer for pile driving, the maximum range for the impact zone is predicted to be less than 5 m.

Physiological impacts on marine mammals arising from underwater noise were assumed to be insignificant, as the noise would be detected well before the animals would reach the distance from the source established as the 'impact zone'.

Mitigation Measures

To minimise the impact of Port lighting on marine turtles utilising surrounding beaches as nesting sites, it is recommended that low pressure sodium (LPS) lights are used, based on studies that show that green turtles are less attracted to them than other types and colours (Figure 4-56). The loggerhead differed from other species, in that it showed an aversion to light in the yellow region of the spectrum. Flatback turtles have not yet undergone studies for their reaction to various lighting impacts.



Source: Witherington and Martin, 1996

Figure 4-56 Hatchling response to coloured light sources

Construction activities are temporary noise sources which emit noise for specific, short term periods during the project construction phase. Noise mitigation can be achieved either by implementing source control methods, or strategic planning of activities to avoid known times of potential marine fauna sensitivity. Unnecessary restriction on construction activities can prolong the overall project impact to an area as well as significantly increase costs. In order to mitigate against potential construction noise impacts on marine species, it is proposed that pile driving does not occur whilst mega fauna are visible in the immediate area.

Piling will occur during the construction phase. Piling utilises a low energy start procedure where the energy is gradually increased as the toe of the pile is secured in the bed, this occurs over a period of several minutes. This is expected to alert animals to the presence of the piling activities and enable animals to move to a distance where the likelihood of injury is reduced. The construction area should also be actively observed to ensure that species are not in the area during pile driving activities.

4.11.2.4 Marine Pests

Potential Impacts

The proposed development is not expected to change the current level of threat for introduction of marine pests to the Port if the standard National measures for prevention are implemented.

Mitigation Measures

To maintain the status of ‘no marine pest species’ at Abbot Point, management of international ballast water should continue in accordance with legislated requirements in Australia.

4.12 Air

4.12.1 Overview

An Air Quality Assessment was undertaken by Katestone Environmental for the Project, and is included as Appendix G. The purpose of this assessment was to:

» Describe the regulatory requirements for protecting environmental values for the atmosphere, such as achieving state and national air quality objectives and standards;

» Describe the meteorology and existing air quality that may be affected by the Project;

» Evaluate the air quality impacts of the Project on the existing environment; and

» Detail proposed impact management techniques.

4.12.2 Air Quality Criteria

Coal dust is the primary air pollutant emitted at coal terminals. It has the potential to cause nuisance from settling on material surfaces and can reduce visibility as a result of dust particles in the atmosphere.

Management of air quality in Queensland is defined under Section 3 of the EP Act. The objective is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The EP Act gives the Minister for Environment and Resource Management the power to create Environmental Protection Policies that identify environmental values to be enhanced or protected and aim to protect environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity.

The Queensland Environmental Protection (Air) Policy 2008 (EPP (Air)) (Queensland Government, 2008) specifies air quality indicators and objectives for the air environment of Queensland. The EPP (Air) objectives are used to assess impacts at sensitive locations (such as residential areas and isolated dwellings), that are located near industrial sites and extractive industries. The EPP (Air) objectives are therefore applicable to the Abbot Point Coal Terminal Project. Indicators and objectives that are relevant for this Project are reproduced in Table 4-39.

The National Environment Protection Council defines national ambient air quality standards and objectives in consultation and with agreement from, all state governments. These were first published in 1998 in the National Environment Protection (Ambient Air Quality) Measure (NEPM (Air)) (NEPM, 1998).

Compliance with the NEPM (Air) standards is determined via ambient air quality monitoring undertaken at locations prescribed by the NEPM (Air) and the standards are used to assess the exposure of large residential populations in urban centres. The NEPM (Air) standards have been incorporated into the EPP (Air).

Dust nuisance can occur due to the deposition of larger dust particles in residential areas. Elevated dust deposition rates can cause reduced public amenity through, for example, soiling of clothes, building surfaces and other surfaces. Table 4-39 shows the dust deposition guideline commonly used in Queensland as a benchmark for avoiding amenity impacts due to dust. The dust deposition guideline is not defined in the EPP (Air) and is therefore not enforceable by legislation, but was recommended by the EPA during consultation as a design objective and has been adopted for this project.

Table 4-39 Existing ambient air quality objectives and guidelines applicable to the project

Parameter	Averaging period	Source	Value[1]	Units
Total suspended particulates (TSP)	Annual	EPP(Air)	90	µg/m³
Particulate matter less than 10 µm (PM_{10})	24-hour	EPP(Air)[2]	50	µg/m³
Particulate matter less than 2.5 µm ($PM_{2.5}$)	24-hour	EPP(Air)	25	µg/m³
	Annual	EPP(Air)	8	µg/m³
Dust deposition rate	Annual	Recommended, DERM[4]	120	mg/m²/day

Notes:

[1] No exceedences allowed unless otherwise indicated.

[2] Five exceedences per year.

[4] EPA Informal advice from the Queensland Environmental Protection Agency. This is equivalent to the dust deposition goal used in NSW for mining projects (DECC, 2005).

24-hour PM_{10} objective

This section seeks to explain why the current US EPA standard and former EPP (Air) (Queensland Government, 1997) goal of 150 µg/m³ is the appropriate objective, rather than the new EPP (Air) objective of 50 µg/m³ that has been taken from the NEPM (Air).

The NEPM (Air) standards for PM_{10} and $PM_{2.5}$ are based on studies of exposure to urban air pollutants that includes the very fine particles associated with motor vehicle exhaust. Particulate matter from motor vehicles consists almost entirely (76%) of dust particles that are smaller than 2.5 micrometres in diameter and contain soot, hydrocarbons, metals and other materials. The very small size of the particles and the chemical constituents of those particles are thought to explain the community health impacts that can occur in urban areas.

Consequently, the application of these standards to larger sizes of particulate matter from coal stockpiles and coal handling activities is likely to overestimate the potential for adverse impact. Therefore, it is appropriate to use the former EPP (Air) objective for PM_{10} to assess impacts at sensitive locations that are located near coal handling industries in a rural environment. Due to the difference in the particle sizes and chemical composition of coal dust, this objective provides a similar level of protection against human health effects as the NEPM (Air) objective does when applied to particulate matter from vehicle exhaust and tyre wear.

4.12.3 Description of Environmental Values

4.12.3.1 Location of Observation Stations and Surrounding Land Use

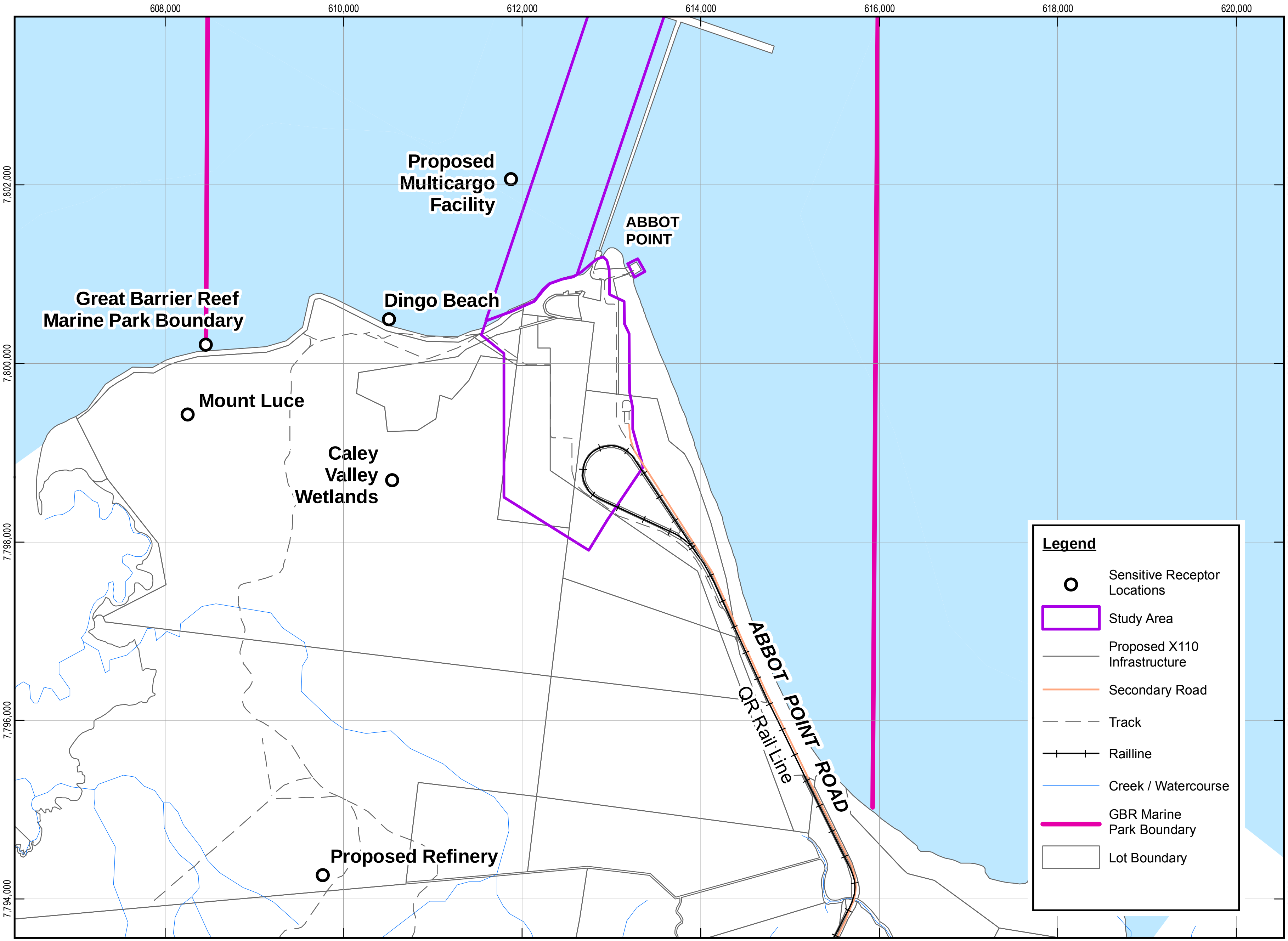
In conducting an analysis of air quality impact, sensitive receptors (such as residential properties) are usually identified for monitoring and observation of impacts. In the case of Abbot Point, no sensitive receptors are proximate to the study area, therefore observation stations have been identified representing areas which may be impacted due to air quality impacts. The locations of the relevant observation stations are presented in Table 4-40 and Figure 4-57.

Table 4-40 Location of observation stations

Receptor	Easting AGD (km)	Northing AGD (km)	Approximate distance from site
Dingo Beach	610.511	7800.492	1.1 km east
Mt Luce	609.969	7794.27	4.4 km southwest
Proposed Industrial Development	609.766	7794.265	3.6 km southwest
Proposed Multi Cargo Facility	611.8735	7802.063	1.7 km northeast
Great Barrier Reef Marine Park Boundary	608.3256	7799.968	3.8 km east
Caley Valley Wetlands	610.5452	7798.693	Within the adjacent wetlands at a point 1.1 km east of site

The closest residential dwellings are located approximately 4.5 km southeast on the Abbot Point Road and approximately 5.6 km southwest at Mount Luce Station.

The closest existing industrial activity to the site is at Bowen, approximately 19 km south of the Project site. Proposed developments in the Abbot Point area, such as the Multi Cargo Facility and industrial development, have been included in this study to assess potential impacts of the coal terminal on these industries.



GHD
CLIENTS | PEOPLE | PERFORMANCE

NORTH QUEENSLAND BULK PORTS CORPORATION

ABBOT POINT X110 EXPANSION

N

Job Number	41-20175
Revision	B
Date	06 OCT 2009

1:60,000 (at A4)

0 500 1,000 1,500 2,000
Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

SENSITIVE RECEPTOR LOCATIONS

FIGURE 4-57

G:\41\20175\05 GIS\Projects\mxd's\41-20175-059_sensitiveRecpt_Fig4-56_revB.mxd

Level 4, 201 Charlotte St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

Data Source: DERM: cadastre - 2009, GA: road, rail, watercourse - 2006, Connel Hatch: proposed layout - 2008. Created : jvc

4.12.3.2 Existing Ambient Air Quality

With the exception of the existing coal terminal, particulate sources within the Abbot Point region are likely to be natural features of the environment, such as salt spray, pollens, grass seeds and wind erosion of bare ground. The existing air quality is characterised below and describes the predicted coal terminal emissions to indicate a cumulative impact of particulate emissions on the site on surrounding areas.

Particulate Matter as PM_{10}

Ambient monitoring of particulate matter as PM_{10} does not occur at the site. The nearest DERM monitoring station for PM_{10} is located at Mackay and has been used as an indication of levels expected at Abbot Point.

Included in Table 4-41 is the maximum 24-hour average and annual average concentration of PM_{10} calculated from measurements at the Mackay DERM monitoring station, for each year that data is available.

Table 4-41 Maximum 24-hour average and annual average concentration of PM_{10} at Mackay

Year	24-hour average PM_{10} (µg/m^3)	Annual average PM_{10} (µg/m^3)	Data availability (%)
1998	28.9	15.5	41.9
1999	50.4	17.4	98.4
2000	51.6	18.9	100.0
2001	52.6	22.0	100.0
2002	475.4	24.6	100.0
2003	85.0	21.5	94.5
2004	45.3	20.7	99.7
2005	146.0	21.9	100.0
2006	106.0	19.6	100.0
2007	40.2	18.0	96.7

There have been a number of exceedences of the EPP (Air) objective of 50 µg/m^3 at Mackay. The years 2002, 2003 and 2005 were exceptional, with relatively high peak concentrations of PM_{10} recorded at all sites. These high events were attributed to dust storms that occurred for two to three days over a significant portion of Queensland.

The background dust level is generally defined as the level of dust that would exist in the absence of anthropogenic sources. DERM recommends using the 95th percentile of the 24-hour average PM_{10} concentration to represent the background level for air quality assessments. Table 4-42 represents the 95th percentile for each year. The maximum value of 39.1 µg/m^3 will be used in this study to represent the background level of 24-hour average PM_{10}.

Table 4-42 95th Percentile for the 24-hour average PM_{10} concentration at Mackay

Year	95th percentile 24-hour average PM_{10} (µg/m^3)
1998	22.1
1999	27.7
2000	33.8
2001	38.4
2002	37.1
2003	39.1
2004	32.9
2005	36.1
2006	31.2
2007	29.8

Particulate Matter as $PM_{2.5}$

Background levels of $PM_{2.5}$ are difficult to determine because $PM_{2.5}$ is not measured at Abbot Point or by DERM at the Mackay monitoring station. $PM_{2.5}$ occurs mainly as a result of combustion and through chemical reactions of gaseous air pollutants in the atmosphere. As such, DERM monitors $PM_{2.5}$ in industrialised and urban areas. The use of data from such locations will give a large overestimate of $PM_{2.5}$ levels expected at Abbot Point. For the purposes of this study, the $PM_{2.5}$ emissions predicted to arise from the coal terminal operations have been presented without the inclusion of a background level.

Particulate Matter as TSP

There are no known measurements of Total Suspended Particulate (TSP) in the region. Previous assessments by Katestone Environmental and standard conversion ratios detailed in the US EPA's (1998, 2006) Compilation of Air Pollution Emission Factors Volume 1 (AP-42) and in the National Pollutant Inventory (NPI) Handbooks (2001), have found that PM_{10} is usually 50% of the TSP concentration. This ratio has been employed here, giving an annual background level of 49.2 µg/m^3 for TSP.

Dust Deposition Rate

Previous studies conducted in Australia have estimated a background dust deposition level of between 20 and 40 mg/m^2/day for rural areas in the absence of anthropogenic activities. Therefore based on available data, a dust deposition rate of 40 mg/m^2/day has been chosen as a conservative background level of natural dust deposition. The potential impact of existing approved activities at the coal terminal have been modelled explicitly.

4.12.3.3 Dust from Coal Terminal Operations

The expansion of the coal terminal has been assessed in terms of potential impacts of dust off-site from the existing approved 50 Mtpa coal terminal and the proposed 110 Mtpa expansion.

The proposed coal terminal expansion will employ a range of best practice measures for controlling dust emissions (see Section 3.7). These have been accounted for as far as is possible in the emissions estimation, given the availability of emissions data.

4.12.3.4 Emission Estimation

Estimation of emissions has been undertaken for the operational phase of the project only, as this is the most significant contributor to emissions.

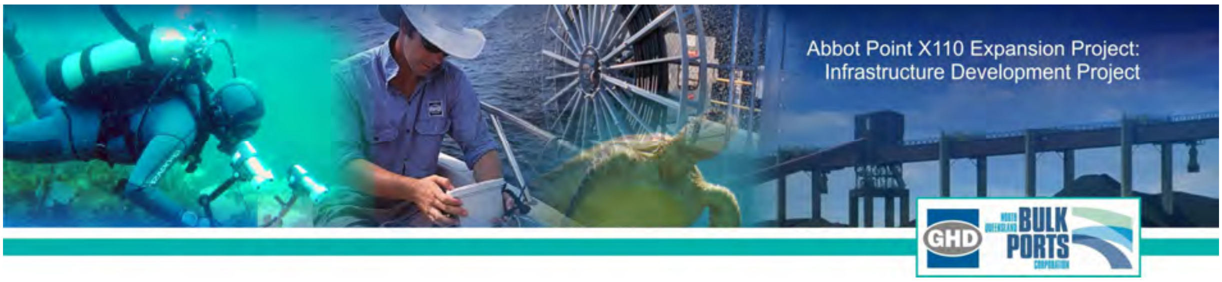
Activities for X110 Expansion that are expected to be the most significant sources of dust emissions are wind erosion of coal stockpiles, rail receival, the movement of coal through transfer stations, conveyors, stacking, reclaiming and shiploading. Wind-blown dust will also occur due to wind erosion of exposed bare ground.

Dust emission rates from the coal terminal have been calculated using emission factors published by the United States Environmental Protection Agency (USEPA) and the NPI (US EPA, 1998; US EPA, 2006; NPI, 2001). For the majority of dust-producing activities, the dust emission rate is dependent upon the wind speed with little or no dust emissions occurring for some activities below a threshold wind speed. For some dust sources such as coal conveyors, the frequency of utilisation and coal throughput are also important determinants of the dust emission rate. For conveyors, an emission factor has been derived from studies by GHD and Oceanics Australia. Table 4-43 summarises the emissions of TSP, PM_{10} and $PM_{2.5}$ from the expanded coal terminal for peak operations. Peak coal terminal emissions are based on four stackers working simultaneously and four reclaimers working simultaneously, with corresponding activity at train dump stations, conveyors and shiploaders. Modelling results have been presented here to represent worst-case inputs. As a consequence, annual average ground-level concentrations of TSP, $PM_{2.5}$ and dust deposition rates are likely to be an over-estimate.

Other factors that determine the dust emission rate are the coal type, coal moisture content, coal particle size distribution, rainfall and the mitigation measures that may be employed. These key factors have been accounted for in estimating the dust emissions for the X110 Expansion. Details of the methodology and the emission factors used for estimating dust emissions are included in Appendix G.

Table 4-43 Estimated TSP, PM_{10}, $PM_{2.5}$ emission rates in grams per second (g/s) for site activities

Activity	TSP	PM_{10}	$PM_{2.5}$
Wind erosion of incoming coal wagons	0.14	0.07	0.01
Material handling at rail receival	0.36	0.17	0.03
Material handling at transfer stations	9.33	4.41	0.67
Conveyor emissions	3.97	1.88	0.28
Wind erosion of stockpiles	15.15	9.88	1.28
Wind erosion of exposed areas	5.04	2.52	0.38
Material handling at surge bins	3.83	1.18	0.27
Stacking coal at stockpiles	1.49	0.52	0.08



Activity	TSP	PM_{10}	$PM_{2.5}$
Reclaiming coal at stockpiles	1.39	0.49	0.07
Material handling at ship loading	0.34	0.16	0.02
Total	41.04	21.28	3.09

Model Configuration

The dispersion of dust emitted from the X110 component of the expanded coal terminal was modelled using the CALPUFF dispersion model (Earth Tech Inc, 2006). CALPUFF is an advanced non-steady-state meteorological and air quality modelling system. The model has been adopted by the USEPA in its Guideline on Air Quality Models as the preferred model for assessing long range transport of pollutants and on a case-by-case basis for certain near-field applications involving complex meteorological conditions.

The CALPUFF model was configured to include a number of ground-level or near ground-level “area” sources of dust. Each area source represents one or a number of coal dust producing activities at the coal terminal. For each dust producing activity, dust emission rates have been calculated for a full year of coal stockpiling and shipping activities at the coal terminal, in conjunction with the hourly average wind speed.

The modelling considered a 24-hour average simulation for $PM_{2.5}$ and PM_{10} and an annual average simulation for $PM_{2.5}$, TSP and dust deposition. Meteorological input for CALPUFF was derived from a coupled TAPM/CALMET approach to generate a three-dimensional wind field, including observational data assimilation. Twelve months of modelled meteorological data was used as input for the dispersion model. Details of the modelling are provided in Appendix G. Results are presented below including ambient background levels to assess the potential impacts that the coal terminal activities may have on the surrounding areas.

Conservatism of Emission Estimation Methodology

Previous studies have estimated the emission rates of dust from the RG Tanna coal terminal and Barney Point coal terminal for the Central Queensland Port Authority’s (CQPA) NPI reporting. These studies utilised the coal dust deposition monitoring network and meteorological monitoring conducted by CQPA to quantify the dust emission rate from each coal terminal. These studies show that the dust emission rate from each of the coal terminals is variable and suggests that the dust emission rates estimated were possibly overestimated by a factor of 2 to 4 times. This overestimation of dust emission rates is equally applicable to this study and is attributed to the following:

- The emission factor equations that have been used to calculate the emission rates from reclaiming are based on dustier coal than are transported through the coal terminals.
- The emission factor equations that have been used to calculate the emission rates from stacking are based on stacking emission rates measured at the Hay Point Coal Terminal. Whilst allowance has been made for the difference between stacking activities at Hay Point compared with the Abbot Point stacking, further refinement is difficult without site specific measurements of stacking emissions.
- The utilisation rates that have been applied to calculate dust emissions from the conveyors are likely to be higher than what will occur in practice.

- The stockyards at each of the coal terminals have been assumed to be full to capacity at all times. Whilst this is a theoretical possibility, it will rarely occur in practice.
- The coal stockpiles will, in practice, shelter stacking and stockpiling operations from the wind and prevent some of the dust emissions. The sheltering effect of stockpiles has not been accounted for in the emission estimates.

In addition to the above, this assessment has used monitoring data from the peak year from Mackay. The monitoring station in Mackay is located in an industrial area and, hence, is likely to overestimate background dust levels at Abbot Point.

Dust Suppression Measures

Full details of the dust control assumptions utilised in the model are provided in Section 3.7. Briefly these include:

- Automated dust suppression water sprays in new X110 stockyards.
- Design to incorporate measures for minimising spillage.
- All new idlers to be low noise (aluminium) idlers, with idler wind guards unless inside a clad structure.
- Sealed floors for elevating (rising elevated) conveyors, draining to sump at bottom of incline. One side (typically windward) and roof cladding to all elevated conveyor galleries regardless of height, except where operational requirements preclude such measures, eg: travelling tippers or shuttles. Cladding may be locally omitted where necessary for maintenance access to pulleys, over drive stations and the like.
- Pavement beneath all ground conveyors to facilitate clean up of carry back deposition.
- Concrete main floors (head of incoming conveyor and tail of outgoing conveyor) with splash turn-up on sides, with hose-down facility to collection sump.
- Paved area at ground level of on-ground towers.
- Provide water sprays at each transfer chute to control dust.
- Dust extraction system at inloading dump station.
- Idler wind guards on both sides of conveyor on tripper and elevator of stacker / reclaimers.
- Misting spray equipment to minimise dust generation at the stacking head pulley.
- Bitumen pavement provided on bund within stockyard.
- Stockpile spray system on new X110 stockpiles.
- Perimeter wall of cladding at feeder floor level to reduce wind velocities and to contain material on floor, but provide open roof (other than surge bin above) for lighting level and maintenance access by ground mounted crane.
- Concrete pavement on ground beneath Surge Bin, with collection sump.
- Concrete floor at feeder floor level draining to ground collection sump.
- Fully sealed full length belt feeder skirts for surge bins 3 and 4.
- Water wash and scraper belt cleaning at head end discharging to the coal stream.

- Concrete floors at jetty head tower discharge to slurry return system.
- One side (far side of roadway) and roof cladding for entire length of jetty conveyors, except for the following locations, where reduced cladding is necessary for maintenance / operational access.
- Tail end and belt splicing bay along jetty conveyors. No roof or wall cladding proposed other than protection provided by transfer tower above tail.
- Onshore tail end slurry return off-take. No local roof or wall cladding proposed, due to equipment access needs.
- Idler wind guards fitted open side of jetty conveyors.
- Southern-side and roof cladding on wharf conveyors for rising section up to extent of tripper travel.
- Idler wind guards fitted both sides for open length of wharf conveyors, open side for clad-other-side length.
- Roof and cladding on all except northern side of drive tower of wharf conveyor.
- Idler wind guards typically fitted both sides of shiploaders.

4.12.4 Potential Impacts and Mitigation Measures

4.12.4.1 Overview

Site activities include the loading and unloading of coal, coal handling through transfer stations and conveyors and the stacking and reclaiming of coal at stockpiles. The impact of wind erosion has been determined in relation to the coal stockpiles and bare ground surrounding them. All relevant sources of fugitive dust emissions have been accounted for in the development of the dispersion model results (refer Appendix G).

The CALPUFF dispersion model has been used to predict ground-level concentrations of TSP, PM_{10}, $PM_{2.5}$ and dust deposition rates at Abbot Point and surrounding areas. These were compared with the objectives defined in the EPP (Air). This section presents the potential impacts due to dust from modelled site activities. Figure 4-57 shows the locations of sensitive receptors that have been specifically considered in the air quality study.

4.12.4.2 Predicted Dust Emissions

Particulate Matter as $PM_{2.5}$

The maximum 24-hour average and annual average ground-level concentrations of $PM_{2.5}$ that are predicted to occur at the location of the observation stations are presented in Table 4-44.

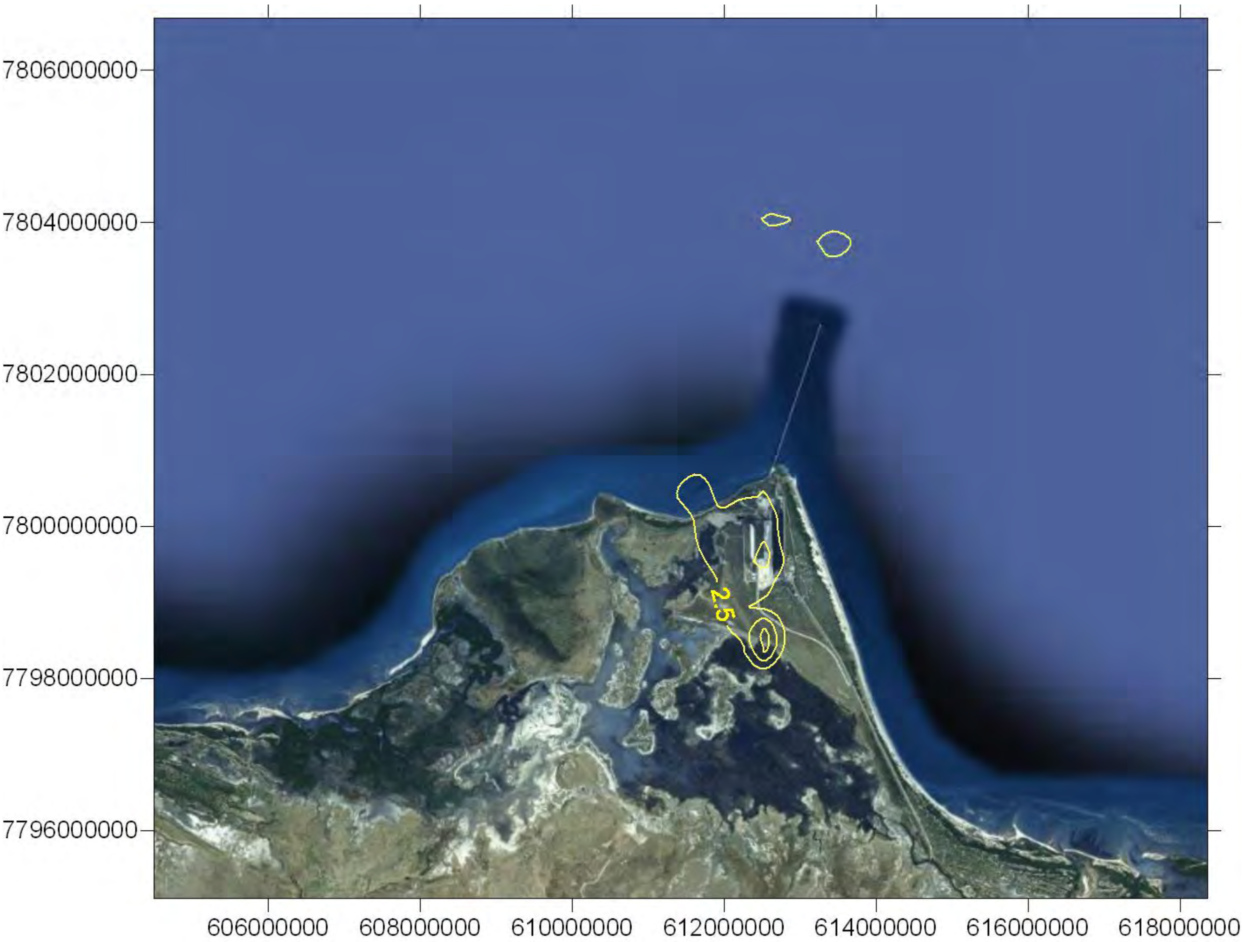
The maximum 24-hour average ground-level concentrations of $PM_{2.5}$ at the sensitive receptors are below the EPP (Air) objective of 25 µg/m^3. The highest 24-hour average ground-level concentration of $PM_{2.5}$ of 6.9 µg/m^3 is predicted to occur at Dingo Beach, located 1.1 km east of the site. The annual average ground-level concentrations of $PM_{2.5}$ are well below the EPP (Air) objective of 8 µg/m^3. The highest concentration predicted at a receptor is 1.3 µg/m^3. Figure 4-58 and Figure 4-59 show the maximum 24-hour average and annual average ground-level concentrations of $PM_{2.5}$, predicted due to the coal terminal in isolation.

Table 4-44 Predicted 24-hour average and annual average ground-level concentrations of $PM_{2.5}$ due to site activities

Receptor	Predicted ground-level concentrations	
	Maximum 24-hour average $PM_{2.5}$ (µg/m^3)	Annual average $PM_{2.5}$ (µg/m^3)
	Coal terminal in isolation	Coal terminal in isolation
Dingo Beach	6.9	1.1
Mt Luce	1.9	0.1
Proposed Industrial Development	1.8	0.1
Proposed Multi Cargo Facility	3.5	1.3
GBRMP Boundary	2.9	0.3
Caley Valley Wetlands	3.6	0.4
Air quality objective	25	8

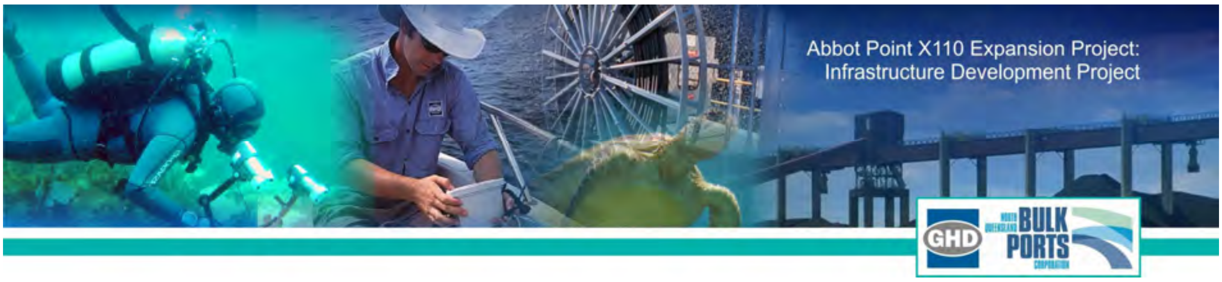
Note: Source CALPUFF, units µg/m³

Figure 4-58 Predicted maximum 24-hour average ground-level concentrations of $PM_{2.5}$ due to site operations



Note: Source CALPUFF, units µg/m³

Figure 4-59 Predicted annual average ground-level concentrations of $PM_{2.5}$ due to site operations



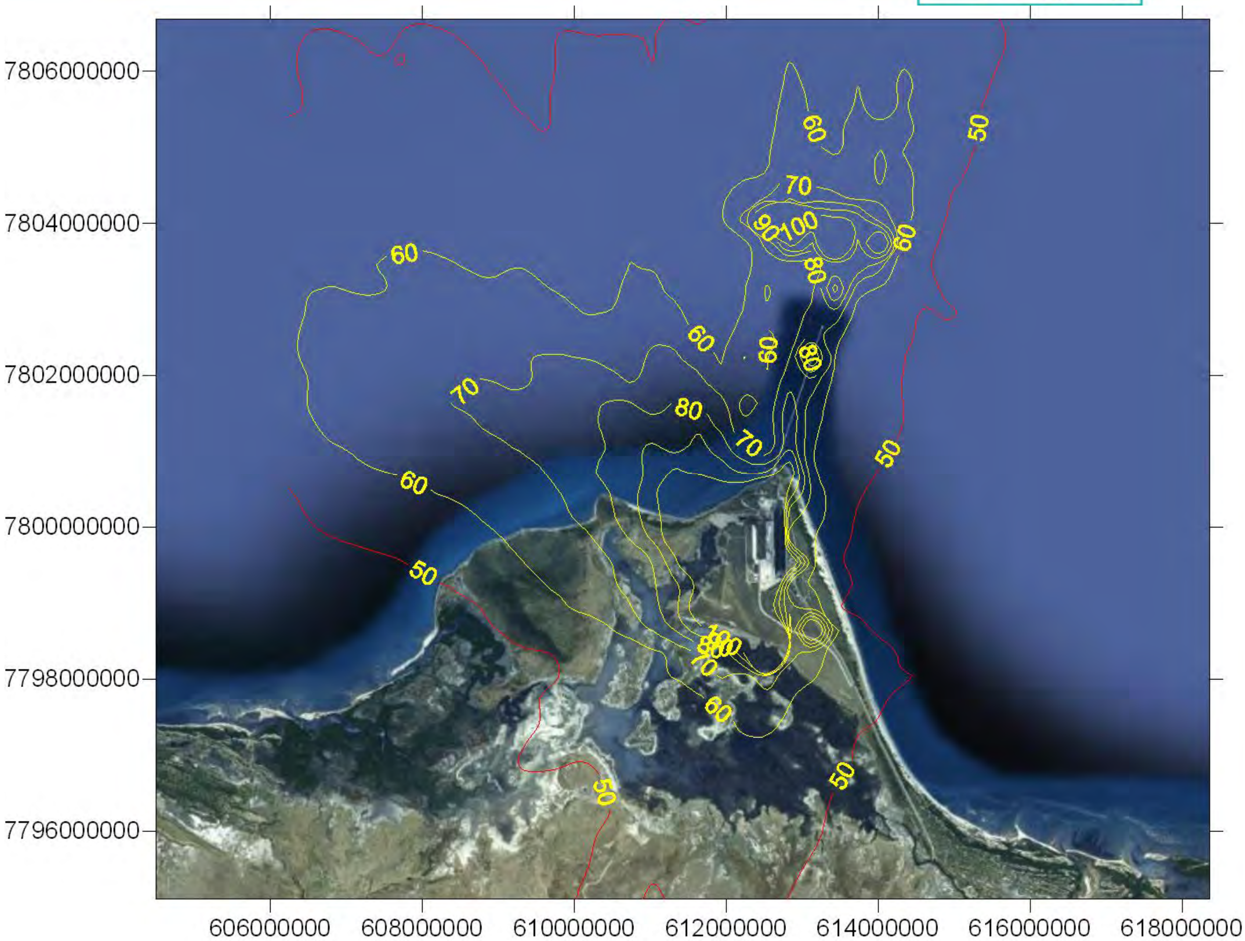
Particulate Matter as PM_{10}

The maximum 24-hour average ground-level concentrations of PM_{10} that are predicted to occur at the location of the observation stations are presented in Table 4-45. Figure 4-60 shows the maximum 24-hour average ground-level concentrations of PM_{10} predicted, including a background level of 39.1 µg/m^3. The results show that the maximum 24-hour average ground-level concentrations of PM_{10} at the observation stations are below the former EPP (Air) goal of 150 µg/m^3, including a background level of 39.1 µg/m^3, but are above the new EPP (Air) objective of 50 µg/m^3. The highest 24-hour average ground-level concentration of PM_{10} is predicted to occur at Dingo Beach. Note that none of the observation stations are residential locations and Dingo Beach is not a publicly accessible beach.

At nearest residences, compliance with the EPP (Air) objective of 50 µg/m^3 will be achieved.

Table 4-45 Predicted maximum 24-hour average ground-level concentrations of PM_{10} due to site activities

Receptor	Predicted ground-level concentrations of maximum 24-hour average PM_{10} (µg/m^3)	
	Coal terminal in isolation	Coal terminal with background
Dingo Beach	42.0	81.1
Mt Luce	12.3	51.4
Proposed Industrial Development	11.0	50.1
Proposed Multi Cargo Facility	21.9	61.0
GBRMP Boundary	16.6	55.7
Caley Valley Wetlands	23.2	62.3
Air quality objective	150	



Note: Source CALPUFF, units µg / m³

Figure 4-60 Predicted maximum 24-hour average ground-level concentrations of PM_{10} due to site operations including a background level of 39.1 µg/m^3

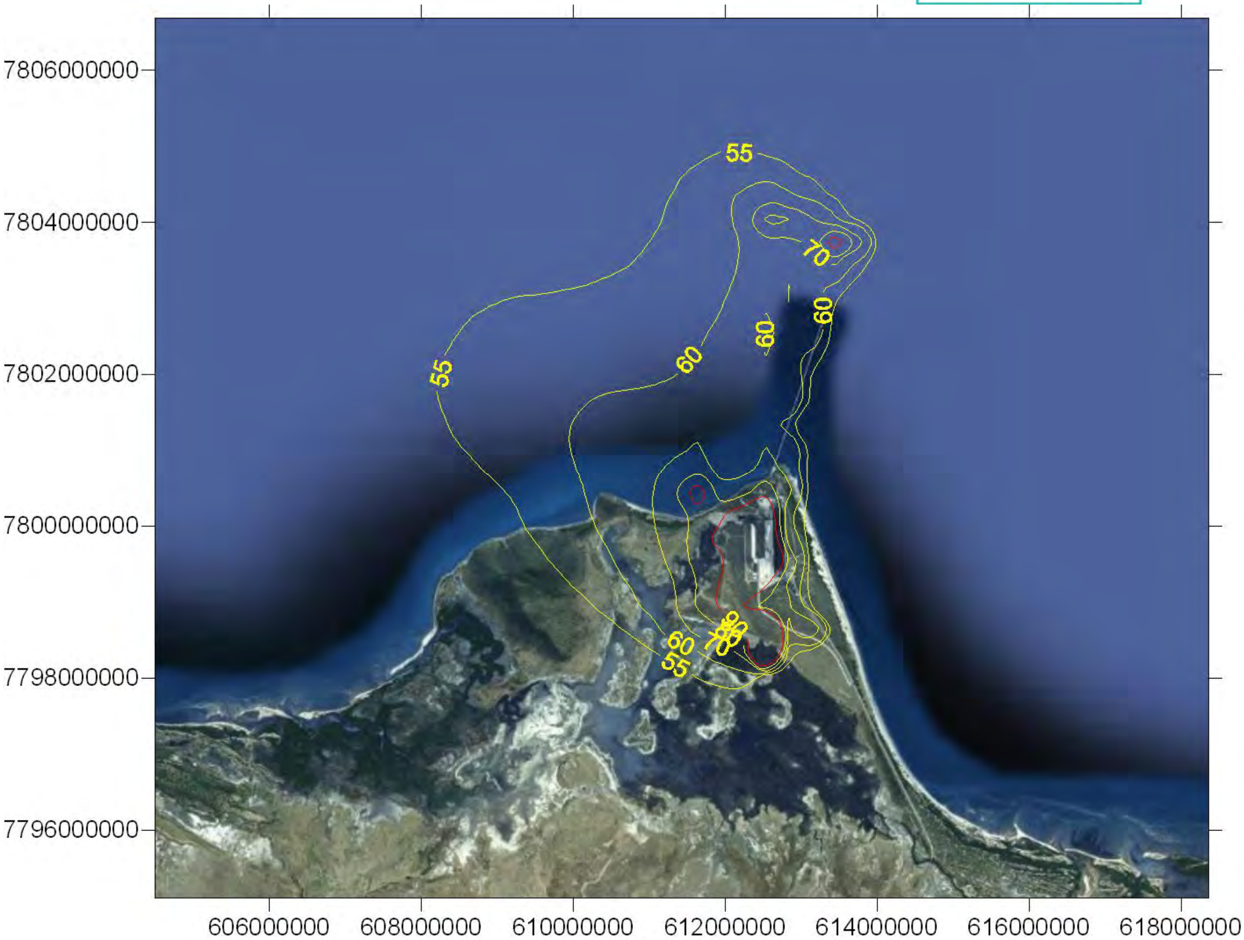
Particulate Matter as TSP

The ground-level concentrations of TSP predicted at the location of the sensitive receptors are presented in Table 4-46. The results show compliance with the annual average EPP (Air) objective of 90 μg/m^3 for TSP at all observation stations. The highest annual average ground-level concentration of TSP predicted at a sensitive receptor is 63.8 μg/m^3 including a background level of 49.2 μg/m^3, at the proposed multi cargo facility.

Table 4-46 Predicted annual average ground-level concentrations of TSP due to site activities

Receptor	Predicted ground-level concentrations of annual average TSP (μg/m^3)	
	Coal terminal in isolation	Coal terminal with background
Dingo Beach	13.3	62.5
Mt Luce	0.6	49.8
Proposed Industrial Development	0.6	49.8
Proposed Multi Cargo Facility	14.6	63.8
GBRMP Boundary	3.0	52.2
Caley Valley Wetlands	5.6	54.8
Air quality objective	90.0	

The annual average ground-level concentrations of TSP resulting from the operation of the coal terminal, including a background level of 49.2 μg/m^3, are presented in Figure 4-61.



Note: Source CALPUFF, units µg/m³

Figure 4-61 Predicted annual average ground-level concentrations of TSP due to site operations including a background level of 49.2 µg/m^3

Dust Deposition

The annual average dust deposition rate predicted due to site activities is presented in Figure 4-62, including a background level of 40 mg/m^2/day and summarised in Table 4-47. Results show the dust deposition rates due to the coal terminal expansion in conjunction with the existing background levels are well below DERM's recommended guideline at the observation stations identified above.

Table 4-47 Predicted annual average dust deposition rates due to site activities

Receptor	Predicted annual average dust deposition rate (mg/m^2/day)	
	Coal terminal in isolation	Coal terminal with background
Dingo Beach	33.1	73.1
Mt Luce	0.6	40.6
Proposed Industrial Development	0.6	40.6
Proposed Multi Cargo Facility	19.5	59.5
GBRMP Boundary	7.5	47.5
Caley Valley Wetlands	11.8	51.8
Recommended air quality guideline	120.0	

Note: Source CALPUFF, units mg/m²/day

Figure 4-62 Predicted annual average dust deposition rate due to site operations including a background level of 40 mg/m^2/day

Dust from Rail Activities

Railway operations can give rise to localised impacts on dust levels, mainly caused by wheel action on the rails, wagon-induced turbulence acting on dust-supporting ground surfaces, windblown dust from loads and emissions from diesel locomotives. There are few studies available to quantify emissions from coal train operations. Katestone Environmental has undertaken several studies involving both ambient air quality monitoring and modelling of emissions from coal trains (Katestone Environmental, 2008a; Katestone Environmental, 2008b). These studies found that the impact of coal trains on ambient dust levels is very localised. Monitoring and modelling at distances of 50 to 100 m of railway lines failed to find evidence of large dust levels. Dust measurements found the increase in dust levels from passing trains was short-lived and dependent on the type of train and meteorological conditions. Considering these results and the substantial separation between residences and the rail line and balloon loop, the rail facilities for the coal terminal are unlikely to adversely affect residential amenity.

It is noted that an assessment of the environmental impacts of increased rail operations is being undertaken as a separate study by Queensland Rail, the authority responsible for the proposed X110 rail loop development.

4.12.4.3 Summary

The modelling indicated that wind erosion of exposed areas such as stockpiles and bare ground are a source of dust. For the 24-hour average ground-level concentration of dust, impacts are highest at Dingo Beach, however, this is not a residential or publicly accessible location. Impacts are due to the proximity to the proposed X110 expansion and the winds predominantly being from the east to east-southeast, transporting dust towards this location. The annual average concentrations are low, indicating that the potential for dust impacts at these receptors only occurs for a short period of time.

Overall, the modelling demonstrates that the coal terminal, with the proposed dust control measures described in Section 3.7 and Section 4.12.3.4, is unlikely to cause adverse impacts at the nearest sensitive receptors. A key element of the dust suppression approach is the installation of automated dust sprayers within the X110 stockyards. Compliance with the relevant air quality objectives is achieved at all sensitive receptors. Considering the conservative nature of the emission rates and ability to manage dust generating activities, the impact on local air quality due to the coal terminal expansion is likely to be low.