APPENDIX E
ECOLOGICAL ASSESSMENTS

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Dr Chris Doyle
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20 May 2003

Examination of Port Kembla Harbour Video for Presence of Seagrasses

Dear Dr Doyle

In response to your request to view the video taken by Southern Commercial Divers at the proposed dredging and spoil sites within Port Kembla Harbour we have undertaken the following:

- reviewed literature provided
- reviewed the video of the proposed dredging and spoil sites
- provided comment on the likely presence or absence of seagrass and attached marine and estuarine macro algae.

No aquatic survey or site inspection was carried out by the author of this letter.

Literature Reviewed

1. Allan Lugg, NSW Fisheries. Email dated 7/11/03. Clarification of Requirements

   Need to know aquatic biota at both the dredge site and the spoil disposal site. The recent survey data may be useful in this regard.

   Reference is made to s205 of the *Fisheries Management Act, 1994* and to identify presence or absence of seagrass or attached marine and estuarine macroalgae. It is suggested that the current survey effort is likely to be either inappropriately located or not intensive enough and their needed to be a visual survey undertaken by a diver.

2. SKM, November 2003 – Draft *Proposed extension of Multi Purpose Berth, Inner Harbour*

   Chapters 1, 2 and 3 of the Draft Review of Environmental Factors. It describes the proposal, outcomes of agency consultation as well as an outline of the assessment and determination process.

3. AWT, November 1999 – *Aquatic Studies for the Port Kembla Outer harbour Development Project*

   A study undertaken to assess the impact of the proposed reclamation of 23 hectares of the Outer Harbour bed. They reported that the soft substrate, including the sediment of the harbour bed and adjoining sandy beach, supported fauna only and no seagrass or other macro algae were recorded. Surveys across the sediment incorporate the entire proposed spoil site but not the dredged area.

4. Neil Charters Pty Ltd. November 2003. Hydrographical Survey, Outer Harbour. Disposal Site. Dwg No. 10229

   Marks up the proposed disposal site and disposal contours. The current levels are between RL -4m to -10m.

5. Southern Commercial Divers. Correspondence dated 17/11/03. Divers Report on Videoing of Seabed at Multipurpose Berth, Port Kembla

   Report attached (Attachment 1). Reported poor visibility and only found fine sediment followed by mud.

6. Southern Commercial Divers. Correspondence dated 18/11/03.

   Letter attached (Attachment 2). Stated that he has only found silt and mud on the seabed floor and no 'marine growth' during his career involving numerous dives in the Port. It is assumed he is referring to no seagrass presence.

Review of Video

Southern Commercial Divers carried out video transects at both the proposed dredge area and disposal site. The video had 10min and 55sec of footage. As stated in their report (Attachment 1) the visibility was so poor during the inspection they turned the video off and continued by feel.

Visibility was very poor due to the high turbidity of the water. The diver stirred up sediments from the bed of the harbour during the course of the dive, further reducing visibility to only a few inches. It was evident that the area inspected supported habitat not suited to seagrass or macroalgae as is consistent with the AWT (1999) findings of benthic sediments at the disposal location.

No seagrass or macroalgae was observed

Discussion

- No seagrass or macroalgae were reported in 1999 at the disposal site (AWT, 1999). No seagrass or macroalgae were evident in the underwater video taken at the dredge and disposal site on the 17 November 2003 (Southern Commercial Divers).

- The main determinants of habitat suitability for seagrass include the water quality, wave environment and the amount of available light (photic depth). Determinants for macroalgae include appropriate substrate type, water quality and light availability.

- It is unlikely that either seagrass or macroalgae would be present at either the dredge or disposal site due to the fine substrate and limited photic depth.

- The fine sediment on the bed of the harbour was evident at both sites and is not considered suitable substrate for either seagrass or macroalgae.

- The other limiting factor for seagrass or macroalgae growth is the lack of light at the depths proposed for the dredging and disposal. The depth at the dredging site is between RL -11.0m, sloping down to -14.0 or -15.0m with the depth of the disposal site between RL -4m to -10m. Without restrictions afforded by the substrate conditions, the shallower areas have the highest probability of supporting seagrass and macroalgae however with the high turbidity evident in the subject sites it is unlikely that there would be sufficient consistent light reaching these depths.

- The conditions of the wave environment are unknown from this review process however it is considered unlikely that wave conditions would be a limiting factor at either the dredging or disposal site.

It is therefore concluded that a Permit under Section 205 of the *Fisheries Management Act, 1994* is not required.

Should you have any questions or need clarification on any matter raised here then please do not hesitate to contact me on 8536 8602 or 0416 093 353.

Yours sincerely.

Andrew Morison
Director

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Ecological Assessment for Proposed Berth - EB4

(Project No. 48-02)

Report prepared for:
Port Kembla Port Corporation

July 2004

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The study team would like to thank Chris Doyle, (Port Kembla Port Corporation).

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1. Introduction

1.1 Description of Project

Port Kembla Port Corporation (PKPC) propose capital dredging to create a two new berths in the Inner Harbour of Port Kembla, to be known as Western Basin No.1 (WB1) and Eastern Basin No. 4 (EB4). The location of these two sites is shown in Figure 1. This report applies only to the proposal for EB4, as WB1 is considered in a separate report.

Approximately 215 000 m^3 will be dredged from the Eastern Basin to create EB4. Approximately 50 000 m^3 of the dredged material will be disposed of in the Inner Harbour, with the remaining material (approximately 165 000 m^3) to be disposed of at an off-shore Spoil Ground.

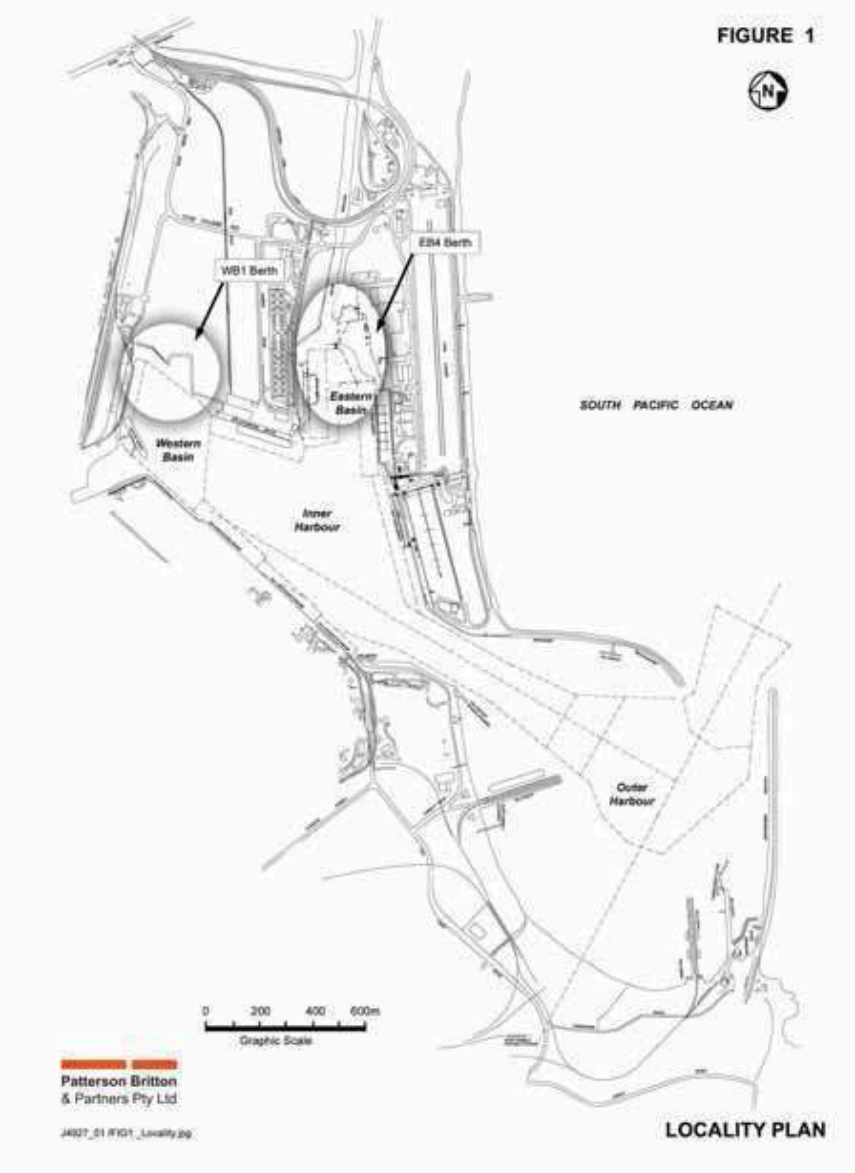

Figure 1. Location of proposed berths (Figure prepared by Patterson Britton & Partners Pty Ltd and used with permission of Port Kembla Port Corporation).

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Sinclair Knight Mertz (SKM) consulted government agencies on their requirements for impact assessment. The requirements relevant to this report are listed below:

- NSW Environment Protection Authority (EPA):
  "Any likely impacts on the surrounding aquatic environment, including impacts to flora and fauna associated with the dredging of the site. (Note: Appropriate buffer distances around any sensitive areas must be maintained)."

- Waterways;
  "Locations of marine and terrestrial vegetation, aquatic and animal habitats etc. likely to be affected (directly or indirectly) by the proposed works during construction and operation."

- NSW Fisheries:
  "The nature, quality and value of aquatic habitats within and adjacent to the area to be dredged including information relating to marine vegetation (seagrasses and marine macro-algae) in the area which may be impacted, fish communities and any threatened fish species (as listed by the Fisheries management Act)."

It was further noted by NSW Fisheries that if any marine vegetation occurred within the impacted areas that a Marine Vegetation Permit under S205 of the NSW *Fisheries Management Act 1994* would be required. This report considers these requirements.

Subsequent correspondence from NSW Fisheries (dated 19 April 2004) referred to the need to assess the risk of spreading marine pests resulting from the disposal of soil. Discussions were had with NSW Fisheries (pers. comm., Allan Lugg, 19 July 2004) to seek comment and recommendations on the environmental assessment methods adopted for this study.

1.2 Study Area and Proposal

The study area for this report is the region proposed for dredging within the Eastern Basin (Figure 2), and the proposed disposal site is adjacent to the multipurpose berth in the Inner Harbour of Port Kembla (Figure 3). Off shore disposal and impacts are not considered in this assessment.

The Port of Port Kembla was created over 100 years ago to support local industry and shipping, and is now ranked as Australia's ninth largest port, with an average of 23 million tonnes moving annually through the port (CRIMP 2001). The Inner Harbour was formed by the dredging of Tom Thumb Lagoon from 1956 - 1960 (PBP 2004a), and is connected to the Outer Harbour by a channel named 'The Cut".

Landuse surrounding the study site is industrial to the north, east and west, with the Inner Harbour of Port Kembla to the south. The Eastern Basin is south of Tom Thumbs Road, and east of Teal Road. Town Drain (or Western Drain) flows into the northwest region of the dredge area. The catchment for this watercourse covers a region to

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the north of the study site, including industrial lands, an area of rehabilitated estuary, JJ Kelly Park, a golf course, and part of the residential suburbs of Coniston and Wollongong.

Whilst Town Drain will not be dredged, the southeast part of this watercourse will be dredged, including a small overland area on the eastern side of the outlet (Figure 2). The level of sediment inflow is not accurately known, but it is expected that the Town Drain carries in the order of several thousand tonnes of sediments, which may be polluted due to both historical and current landuse (PBP 2001).

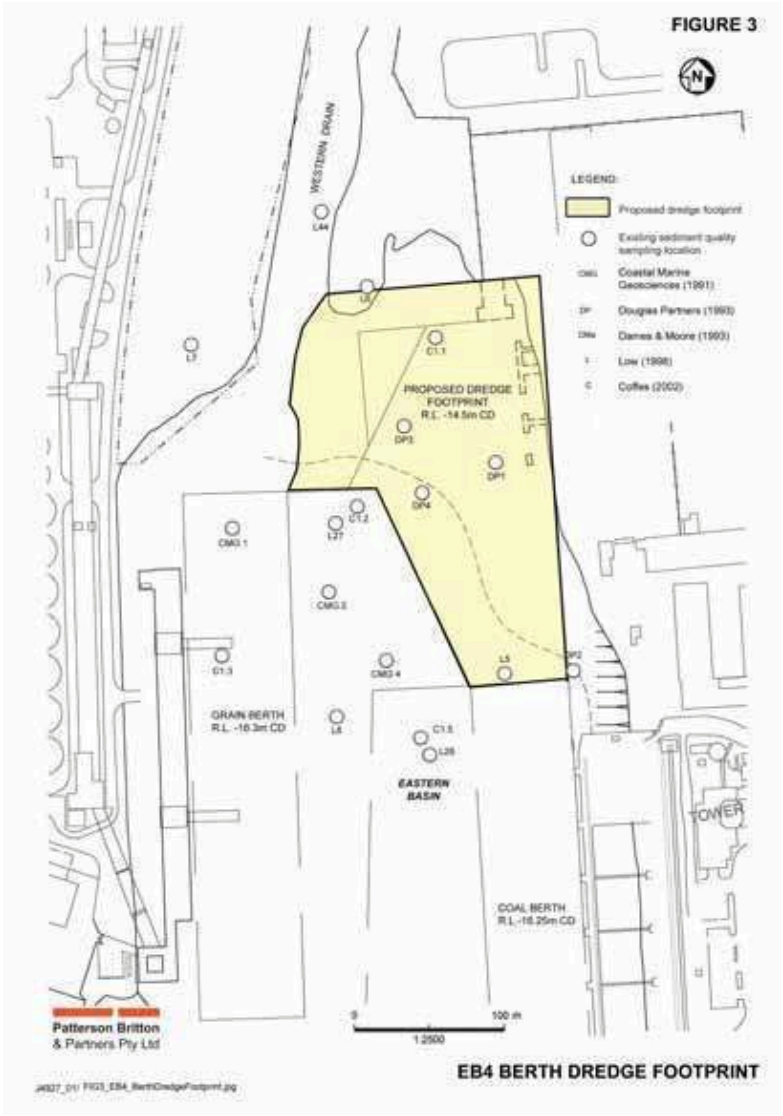

Figure 2. Proposed dredge area for EB4 (Figure prepared by Patterson Britton & Partners Pty Ltd and used with permission of Port Kembla Port Corporation).

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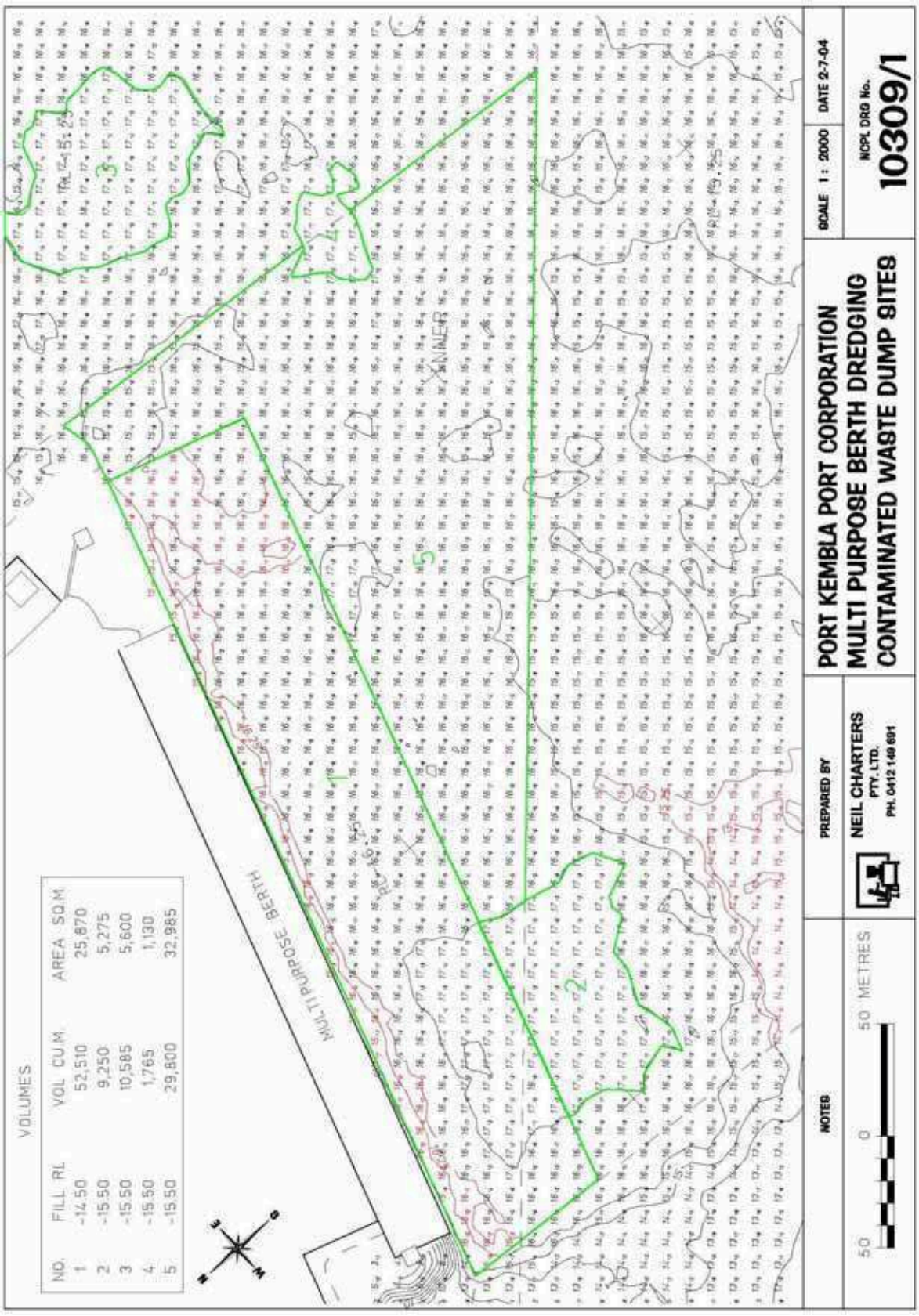

Figure 3. Proposed area for disposal of dredged material within Inner Harbour. (Figure prepared by Neil Charters Pty Ltd and used with permission of Port Kembla Port Corporation).

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The harbour bed in the area for EB4 averages 9m below Chart Datum, sloping to the dredge depth of 14.5m along the southern boundary. Whilst the depth of the harbour bed is generally greater than 5m, the minimum depths of the harbour bed just south of the Ro-Ro berth is 2.1m (immediately adjacent to the rock revetment, and quickly increasing in depth) (unpub. bathymetry data from Port Kembla Port Corporation, 9/7/2004). Depths at the outlet of the Town Drain are also variable, and are very shallow close to the outlet (0.1m depth). The area to be dredged for EB4 includes an 'on-land' area, which is approximately 5m above Chart Datum (PBP 2004a).

There has been sediment testing in the overwater portion of EB4. The initial testing found elevated levels of contaminants within the top 1m of sediments (soft clays). An estimate of the volume of contaminants was calculated, assuming all the top 1.5m layer of soft silty clays to be contaminated, at 50 000 m^3. All contaminated material will be disposed of in the area adjacent to the Multi Purpose Berth (Figure 3). Consideration of the impact of these contaminants due to disturbance is outside of the scope of this report, but the presence of the contaminants does reduce the quality of habitat for flora and fauna in the study area.

Points of note for water quality within the Port Kembla Inner Harbour is that turbidity is high, with an average of 2.51 NTU (minimum of 1.31 NTU, maximum of 8.9 NTU from 10 sampling dates), and with secchi depths averaging 2.97m (minimum of 1.2m, maximum of 8.9m from 48 sampling dates), (Port Kembla Harbour Environment Group 2003). Also, some metals occur at high levels compared to the reference site, with mean levels from 5 sampling dates within the Inner Harbour being: Aluminium 7.3 µg/L, Manganese 11.6 µg/L, Copper 2.0 µg/L, Zinc 19.7 µg/L, Cadmium 3.6 µg/L, and Selenium 2.0 µg/L (Port Kembla Harbour Environment Group 2003).

1.3 Legislative Requirements

1.3.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development proposals. Various legislation and instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), are integrated with EP&A Act and have been reviewed separately.

1.3.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act 1974) or an activity (Part 5 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

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1.3.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. Division 4 of Part 7 covers the protection of marine vegetation (macroalgae, seagrasses or mangroves). Any potential harm to marine vegetation requires a permit from NSW Fisheries.

1.3.4 Rivers and Foreshores Improvement Act 1948

The NSW *Rivers and Foreshores Improvement Act 1948* (RFI Act) aims to provide effective controls on activities that could harm sensitive waterway and foreshore environments. The Act has provisions that require a permit for excavations, fill and other works within 40 m of the top of the bank for rivers, estuaries and lakes as it is recognised that they can have significant detrimental environmental impacts on habitat, water quality, flooding and erosion. This Act is likely to apply to those areas within 40m of the port and Town Drain. However, the RFI Act exempts 'public authorities' from the need to obtain a permit.

The RFI Act is soon to be repealed and replaced by the *Water Management Act* but the provisions under this new Act are likely to be similar to the RFI Act. A notable exception, however, is that 'public authorities' will no longer be exempt from the need to obtain a permit.

1.3.5 Noxious Weeds Act 1993

The objectives of the NSW *Noxious Weeds Act 1993* are to identify which noxious weeds require control measures, identify control measures suitable to those species and to specify the responsibilities of both public and private landholders for noxious weed control. Six noxious weed species were observed on the study site.

1.4 Objectives

The objectives of this report are to:

- Review existing literature on aquatic habitats within Port Kembla harbour, particularly in relation to marine vegetation and aquatic habitats
- Survey the region within, and adjacent to, the area proposed for dredging for marine vegetation (seagrasses and marine macro-algae)
- Document the nature, quality and value of aquatic habitats within, and adjacent to, the area proposed for dredging
- Identify likely fish communities and any potential threatened fish species (as listed under the *Fisheries Management Act 1994* and *Environment Protection and Biodiversity Conservation Act 1999*) within, and adjacent to, the area proposed for dredging
- Identify whether a S205 permit would be required through discussions with NSW Fisheries
- Assess impacts on marine vegetation, fish communities and any potential threatened fish species

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1.5 Limitations

This report is limited in its nature and scope, and these limitations are identified below:

- Issues relating to release of contaminants are not covered in this report (except how contaminants relate to current on-site habitat)
- Impacts of off-shore disposal of sediments is not considered
- Survey was limited to opportunistic observations during the site inspection (see section 2.2 for further details)
- Information for various issues such as fish and pest species present in Port Kembla and water quality information was obtained from literature reviewed

1.6 Issue Scoping

There are a number of potential issues relating to the objectives of this report, for both aquatic and terrestrial flora and fauna, associated with the proposed capital dredging and disposal within Port Kembla to create EB4. They are discussed in section 4 of this report. These issues are:

- Loss or damage to seagrass beds (if present)
- Loss of macroalgae
- Loss of aquatic substrate for macroalgae
- Disturbance of contaminated sediments, and the transport and disposal of these sediments
- Disturbance of dinoflagellate cysts and a resultant 'toxic bloom'
- Impacts on water quality as a result of the dredging and excavation process
- Impacts on aquatic communities in the sediment disposal areas due to smothering and water quality
- Impacts on aquatic communities from ship wave wash
- Impacts on fish and their habitat
- The spread of marine pest species
- Loss of riparian habitat at Town Drain outlet and in northeast corner of proposed dredge area

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2. Methods

To complete this report a variety of literature was reviewed in light of the requirements of EPA, NSW Fisheries and Waterways (see section 1.1). The potential likelihood of occurrence of species and communities of interest was assessed based the current industrialised site conditions environment (section 1.2) and observations made during a site visit.

The literature reviewed and field survey methods are provided below (sections 2.1 and 2.2), with results on likelihood of occurrence in section 0.

2.1 Literature Reviewed

The following literature was considered during the preparation of this report:

- CRIMP (2001). *Report on Port Kembla Introduced Marine Pest Species Survey.*
- Eco Logical Australia Pty Ltd (2003). *Examination of Port Kembla Harbour Video for Presence of Seagrasses.*
- MSE & CEC (1991). *Port Kembla Harbour Study 1991.*
- PBP (2004a). *Draft WB1 & EB4 Capital Dredging Sampling & Analysis Plan.*
- PBP (2004b). *Maps of the area proposed for dredging.*
- Phillips (2002). *Monitoring and Assessing the Water and Sediment Quality of Port Kembla harbour According to the ANZECC & ARMCANZ (2000) Guidelines.*
- Port Kembla Harbour Environment Group (2003). *Summary of Port Kembla Harbour Water Quality Results 2003.*
- Port Kembla Harbour Environmental Group (2004). *Draft Port Kembla Harbour Catchment Atlas.*
- Smith & Caccese (2003). *A Biological Study on the Effects of Water Quality on the Development of Sessile Marine Invertebrate Assemblages: Port Kembla Harbour, NSW.*
- Woodroffe (1998). *Environmental Monitoring in a Port.*

2.2 Site Inspection

Mr Andrew Morison and Dr Steven Ward inspected the northern and eastern boundaries of the proposed dredge area on 14 May 2004. The land based inspection occurred during a sunny day at low tide to facilitate the observation of intertidal habitat and possible presence of any seagrass and macroalgae. Water quality and visibility in the water column was poor, due to rain within the catchment of the site on the night of 12 May and ship movements (Chris Doyle pers. comm., 14/5/2004). A sediment plume was also visible at the outlet of Town Drain extending approximately 40m into the Eastern Basin, but was only apparent at the Town Drain outlet. Whilst water quality was poor, this visibility was considered to be within normal conditions experienced at the site, and adequate for the level of survey required.

The aquatic survey conducted consisted of a walked inspection along the rock revetments and jettys looking for evidence of seagrasses and macroalgae. This consisted of looking for seagrass beds and macroalgae attached to any visible

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substrate, and inspecting visible wrack and other debris on the water surface and deposited on the shoreline for seagrass or macroalgae fronds. The pylons of the jettys were inspected from a distance of approximately 10m.

Given the highly industrialised nature of the site no terrestrial fauna survey was carried out, and terrestrial flora survey consisted of opportunistic observations.

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3. Results

3.1 Terrestrial Flora

The vegetation on the rock revetments and adjacent land in the east and northeast of the dredge area was observed to consist mainly of weeds such as bitou bush (*Chrysanthemoides monilifera*), but with Sydney golden wattle (*Acacia longifolia*) also observed. Vegetation was sparse on the rock revetments near the water, but thick at the top of the revetments (Plate 1, Plate 2, Plate 5, Plate 6, Plate 8, Plate 11), and sparse on the adjacent land that was within 25m of the rock revetments.

The northern shoreline and outlet of Town Drain (also known as Garungaly Waterway) was observed to have sparse vegetation, consisting mainly of weeds such as bitou bush (*Chrysanthemoides monilifera*) and cobbler's pegs (*Bidens pilosa*).

Given its artificial nature and few native species (Table 1), none of the terrestrial vegetation on site meets the definition of any native vegetation communities.

Table 1. Terrestrial flora species observed at the EB4 site.

Scientific name	Common name	Category *
Acacia longifolia	Sydney golden wattle	
Bidens pilosa	Cobbler's pegs	Weed
Blechnum nudum	Fishbone water fern	
Chrysanthemoides monilifera	Bitou bush	W3
Gleichenia dicarpa	Coral fern	
Setaria sp.		Weed
Sporobolus virginicus	Saltwater couch	

* Weed = Environmental weed.
W3 = Listed under the Noxious Weeds Act 1993: The weed must be prevented from spreading and its numbers and distribution reduced

3.2 Terrestrial Fauna

Although no fauna survey was carried out as part of this project, it is considered that suitable habitat for threatened species does not occur on the study site. This assessment is based on the habits of threatened species, the low amount of vegetation, the dominance of weeds, the surrounding industrial landuse and associated current and historical disturbance.

There are a number of records for the green and golden bell frog (*Litoria aurea*) approximately 2km to the south, and additional records approximately 4km to the north, of the study site (Figure 4). However, there is no suitable habitat for this species present at the study site, as the outlet of the Town Drain contains no suitable ponds that could be utilised by the green and golden bell frog.

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Figure 4. Map of green and golden bell frog (Litoria aurea) records in the Port Kembla Harbour region. Data and mapping is from the Atlas of NSW Wildlife (NPWS 2004).

3.3 Aquatic Flora

A total of 15 macroalgae species have previously been found in the Inner Harbour (Table 2, CRIMP 2001), although this study focussed on locating introduced, rather than native, species. For the study site, a total of 4 species came from pile scrapings adjacent to the dredge area for EB4, and one species from the proposed disposal area within the Inner Harbour (Table 2).

The jettys in the east and northeast of the dredge area also had a number of pylons, which are a potential substrate for macroalgae (Plate 1, Plate 3, Plate 4, Plate 5, Plate 9, Plate 10). No macroalgae were observed on these pylons, although these were inspected at a distance. Clumps of barnacles and filamentous green macroalgae were observed, however, on a rope anchored at a jetty and the shore, and trailing in the water (Plate 7).

Evidence of the industrial nature of the site was apparent from crystallised gypsum which was observed along the rock revetment and northern shoreline (Plate 14).

No seagrass has been observed in the Inner Harbour, either during inspections carried out in this study, or in the CRIMP (2001) study which investigated 13 sites within the Inner Harbour of Port Kembla. Eco Logical Australia Pty Ltd (2003) also reviewed diver video footage for transects carried out for a proposed dredge disposal site in the Outer Harbour, and found that no seagrass or macroalgae were observed, and that the habitat was not suited to seagrass or macroalgae due to the high turbidity (low photic depths).

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Table 2. Macroalgae collected from the Inner Harbour of Port Kembla (data from CRIMP 2001). The relevant site location from CRIMP (2001) for EB4 is ANL Roll-on Roll-off Berth (eastern) (ERR), for Town Drain is Tom Thumb Road Bridge (B1I), and for the Inner Harbour Disposal Area is Multi-Purpose Berth (MPB).

Species Name	Site			
	All of Inner Harbour	EB4	Town Drain	Inner Harbour Disposal Area
Amphiroa anceps	Y		Y	
Antithamnion amphigeneum	Y			Y
Apoglossum unguiculescens	Y		Y	
Ceramium macilentum	Y	Y		
Ceramium rubrum	Y		Y	
Codium harveyi	Y		Y	
Dictyota alternifida	Y			
Ecklonia radiata	Y		Y	
Haliptilon roseum	Y		Y	
Halopteris paniculata	Y		Y	
Halopteris sp.	Y			
Laurencia obtusa	Y			
Lobophora variegata	Y		Y	
Polysiphonia scopulorum	Y			
Sargassum sp.	Y		Y	

Seagrass was entered in Table 4.2.2 of CRIMP (2001) as being found in a pile scraping sample from the Outer Harbour at N° 6 Jetty (J6O). This result would appear questionable, however, as seagrass is not known to grow on pile substrates.

Habitat at both the proposed dredge site and disposal area were compared seagrass requirements to assess habitat suitability (Table 3). The photic depths are considered to be insufficient to allow light penetration to the current harbour bed, thus habitat in both the EB4 and dredge disposal site are considered to be not suitable for seagrasses.

No cryptogenic or introduced macroalgae have been found in Port Kembla Harbour. Low levels of *Alexandrium `catenella* type' cysts (a dinoflagellate from the kingdom Protista) have been found in all sediments at low levels (CRIMP 2001). Cysts from the species *A. catenella* can become toxic blooms when disturbed, and blooms are usually less than 4 weeks in length, normally occurring between the months of December and April in southern Australia (CRIMP 2001). These toxic blooms can accumulate in shellfish and cause Paralytic Shellfish Poisoning (PSP) in humans. It was not clear, however, whether or not the cysts observed were from a species that can cause toxic blooms (ie. *A. catenella*) (CRIMP 2001). There is no evidence of a toxic bloom occurring in Port Kembla harbour to date (CRIMP 2001).

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Table 3. Comparison of seagrass habitat requirements and conditions at EB4 and proposed dredge disposal area.

Variable	Seagrass Requirements	Proposed Dredge Site (WB1)	Proposed Inner Harbour Disposal Area
Substrate	Soft sediments eg. sand or mud	Top sediments are very soft silty clays	Very soft silty clays
Depths	Suitable depths are dependent on light availability	Harbour depths generally greater than 5m, but minimum just south of the Ro-Ro berth is 2.1m and at Town Drain outlet is 0.1m, and a mean secchi depth of 2.97m at EB4 (maximum of 8.9m)	Shallowest depth 15.0m
Water Quality	Generally low nutrient waters with low levels of sediment	Levels of total phosphorus and nitrogen are low in the Inner Harbour (0.29 and 0.02 mg/L respectively), compared to 1km off South Wollongong Beach (1.25 and 0.26 mg/L respectively). Fine sediments are stirred up by ship movements (propeller wash)	Levels of total phosphorus and nitrogen are low in the Inner Harbour (0.29 and 0.02 mg/L respectively), compared to 1km off South Wollongong Beach (1.25 and 0.26 mg/L respectively). Fine sediments are stirred up by ship movements (propeller wash)

Table 4. Cryptogenic and introduced algae species (pests) from CRIMP (2001) at, or near, WB1 site within Port Kembla Harbour.

Group	Cryptogenic and Introduced Species	Notes
Macroalage	None	• No cryptogenic or introduced macroalgae found in Port Kembla
Dinoflagellates	*Alexandrium* `*catenella* type' cysts	• Cysts found in all sediments at low levels • Can become toxic blooms when sedentary cysts in sediments disturbed

3.4 Aquatic Fauna

There are 87 species of fish known to occur in both the Inner and Outer Harbours of Port Kembla (MSE & CEC 1991, appendix 2). The fish in the Inner Harbour are noted as being basically estuarine in nature, with some species with tropical affinities also occurring (MSE & CEC 1991). The list of fish species from MSE & CEC (1991) was reviewed as part of the preparation of this report, and none of these species are listed under the FM Act.

The black cod (*Epinephelus daemelii*) is known to occur along the coast of New South Wales, and coastal rock pools and rocky shores in estuaries, are important habitat for small and large juveniles respectively (NSW Fisheries 2002). It is considered unlikely that the study site would be important habitat for the black cod because the

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species has not been observed within Port Kembla Harbour (MSE & CEC 1991), and habitat in the study area is considered unsuitable. Whilst rock revetments do occur on the study site, juveniles of the black cod are not known to utilise this habitat, instead they appear to prefer crevices under a large overhanging rock lip. Juveniles are considered to possibly use the entrance breakwaters. (pers. comm. Allan Lugg, 19/7/04).

There are no known records of species listed under the FM Act within Port Kembla Inner Harbour.

A variety of pest species were documented in CRIMP (2001) (see Table 5 for relevant groups and species). Of these species, the species or groups which occur at, or close to, the WB1 site and have not been recorded at the Inner Harbour disposal site, are 1 Hydrozoan, 1 Polychaete, 6 hull-fouling barnacle (Crustacean), 1 Malacostracan, 1 Ascidian, 3 fish, and up to 16 Bryzoan species (Table 5). The Hydrozoan, barnacle, Bryzoan, and Ascidian species all generally live on hard substrates, and as such are unlikely to survive at the Inner Harbour disposal site or the offshore disposal site where hard surfaces will not occur. The fish pest species are mobile animals, and hence even if they should be transported during dredging works and survive, this is unlikely to spread these animals to regions that they could not reach by normal movements.

The Polychaete worm, *Boccardia chilensis*, can occur in benthos as well as hard surfaces. However, the habitat at the disposal site (soft silty clays) is unlikely to be favourable for this species, and similarly the offshore disposal site would also be unfavourable habitat. The Malacostracan species, *Corophium acutum*, was located on a pile scraping. The Inner Harbour and offshore disposal sites are thus also likely to be unfavourable habitat for this species.

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Table 5. Cryptogenic and introduced species (pests) from CRIMP (2001) at, or near, EB4 site within Port Kembla Harbour.

Group	Cryptogenic and Introduced Species	Notes
Poriferans, Anthozoans, and Echinoderms	None noted	• No cryptogenic or introduced species from these groups found in Port Kembla
Macroalage	None found to occur in Port kembla	• No cryptogenic or introduced macroalgae found in Port Kembla
Dinoflagellates	*Alexandrium `catenella* type' cysts	• Cysts found in all sediments at low levels • Variable toxicity • Can become toxic blooms when sedentary cysts in sediments disturbed
Hydrozoans	*Halecium vasiforme*	• Found at close to EB4 site (BCB & OCB) • Unknown source • High abundance in some pile scrapings
	4 other species	• 4 other hydrozoan pest species occur at other sites in Port Kembla, but not found at EB4 site (*Clytia sp. 1, Halecium vasiforme, Clytia hemisphaerica, Bougainvillia macloviana, Sarsia eximia*)
Polychaetes	*Boccardia chilensis*	• Found close to EB4 site (BCB) • Occurs in various habitats, including on oysters In various habitats, including on oysters & other
	2 species	• Found at Inner Harbour disposal site (MPB) (*Boccardia proboscidea, Hydroides ezoensis*)
	Hydroides dirampha	• Found close to EB4 site (BCB) and at Inner Harbour disposal site (MPB) • Most common introduced species sampled
Other worms	*Enatiid sp. 1*	• Found close to EB4 site (GBI) • Was a new record for Australia, cryptogenic in origin
Crustaceans	6 known hull-fouling barnacle species	• These species were found at various sites within the Inner Harbour, though not all occurred at the Inner harbour disposal site (*Balanus amphritrite, Balanus trigonus, Balanus variegatus, Megabalanus rosa, Megabalanus tintinnabulum and Megabalanus zebra*) • May occurs on rocks & other hard surfaces (eg. piles)
	4 Malacostracan species	• 4 other malacostracan pest species occur at other sites in Port Kembla, but not found at EB4 site (*Cirolana hardfordii, Paracerceis sculpta, Caprella equilibra, Stenothoe validae*)
	3 Malacostracan species	• Found at both EB4 site and at Inner Harbour disposal site (*Sphaeroma walkeri, Liljeborgia c.f. dellavallei, Elasmopus rapax*)
	Corophium acutum	• Found close to EB4 site (GBI) • Malacostracan species
Molluscs	*Mytilus galloprovincialis*	• Widespread in harbour including both EB4 site and Inner Harbour disposal site
Bryozoans	16 species	• Occur in various locations including EB4 site • Sessile animals which mostly occur on hard substrates in marine environments
Chordates	2 Ascidian species	• Found at both EB4 site and at Inner Harbour disposal site (*Ciona intestinalis, Styela plicata*)
	Botryllus schlosseri	• Found close to EB4 site (BCB) • Ascidian species • Hull-fouling. Encrusts seagrasses, oysters & rocky breakwaters
	3 Fish species	• Likely to occur in all areas of Inner Harbour at some time • 2 pest fish species observed in CRIMP (*Tridentiger trigonocephalus, Acentrogobius pflaumi*) and a further species observed in a previous study (*Acanthogobius flavimanus*)

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4. Impact Assessment

Impacts are considered for each of the key issues.

- Loss or damage to seagrass beds (if present)

The habitat at the dredge and disposal site are not considered to be suitable seagrass habitat as light penetration is poor due to the depth of the site and water is turbid as indicated by low secchi values, the rock revetments do not allow seagrass roots to attach, and soft silty clays are too soft. No seagrass beds or evidence of their leaves were observed during the site inspection. There are no records of seagrass within the Inner Harbour, and only one isolated record from the Outer Harbour. Therefore, no impacts are expected upon seagrass.

- Loss of macroalgae

If macroalage are present on the rock revetments, jettys, dredge area, or disposal area, it is expected that these would be lost. Whilst some macroalgae species have been detected (CRIMP 2001), they are not significant species. Therefore, no significant impact upon macroalgae is anticipated.

- Loss of aquatic substrate for macroalgae

Some potential substrate for macroalgae in the rock revetments and jettys will be lost. This will be replaced by some new substrate on the berth pylons and new rock revetments. This habitat will however be reduced as the proposed structures will prevent light access. Given that there are currently no known significant macroalgae present, this loss is not considered to be significant.

- Disturbance of contaminated sediments, and the transport and disposal of these sediments

The dredging process will disturb sediments and reduce water quality. These impacts will be minimised through the development of appropriate controls. These techniques will minimise the sediment plume created during dredging, construction, and disposal of sediments. Some fine sediments are likely to not be captured by these techniques, however. There will be a temporary reduction in water quality, particularly light penetration (through increased turbidity). As no seagrasses and no significant macroalgae are known to be present in the dredge site and the disposal area, or the immediate vicinity of both these sites, the impacts upon marine vegetation will not be significant.

The disturbed sediment may also impact upon fish, macroinvertebrates and other fauna (eg. filter feeders).

- Disturbance of dinoflagellate cysts and a resultant 'toxic bloom'

There is a risk that dredging could disturb dinoflagellate cysts and result in a toxic bloom and Paralytic Shellfish Poisoning in humans. It is currently unknown, however, if cysts from Port Kembla Harbour include species that can cause toxic blooms (CRIMP 2001). These blooms also usually occur between December and April in southern Australia (CRIMP 2001).

It is not known what mitigation measures could be adopted to reduce the risk of any potential blooms. Two possible options include:

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a) Sediment samples from the proposed dredging area be taken and dinoflagellate cysts present be germinated to allow proper identification. Should *A. catenella* or other species that can cause toxic blooms be identified further risk management actions being developed, or
b) Dredging not occur between the months of December and April.

- Impacts on water quality as a result of the dredging and excavation process

Water quality will be reduced during dredging, construction and disposal of sediments through introduction of fine sediments into the water column, and the potential release of contaminants contained within the sediments. The surface sediments are currently disturbed within Port Kembla Harbour by water flows and ship movements. A medium to high impact on water quality is expected in the short term, due to disturbance of fine sediments and contaminants which are not subsequently captured during dredging. Impacts in the long term, however, will be low, as fine sediments in Port Kembla are already disturbed regularly by ship movements and water flow. It is thus not anticipated that this proposal will result in any significant impacts in the long term over current levels of disturbance.

- Impacts on aquatic communities in the sediment disposal areas due to smothering and water quality

It is anticipated that the aquatic communities in both the proposed dredge and disposal areas will be lost, either through removal by dredging or smothered by sediment disposal. No significant marine vegetation or aquatic communities, are known to be present, hence these impacts are not expected to be significant. Recolonisation of species is likely to occur over the long term.

- Impacts on aquatic communities from ship wave wash

Ship wave wash is likely to increase from current levels due to increased ship movements to access EB4. However, as there are no significant seagrass or macroalgae communities these impacts will not be significant.

- Impacts on fish and their habitat

Fish are generally mobile, and thus many individuals are likely to disperse during construction. No threatened fish species are known to occur, and the aquatic habitats which will be affected, sediment substrates with 2 to 3m of soft clay overlying sand and gravel at average depths of 9m, jetties and rock revetments, are common in Port Kembla. No fish breeding areas or nursery areas are known to be present. Impacts of fish and their habitats is therefore considered to be not significant.

- The spread of marine pest species

It is difficult to ascertain the risk associated with the spread of marine pests as there is a limited understanding of their distribution across the Port and capacity to adapt to various habitats.

The marine pest species found in Port Kembla are generally assumed to have located and established within their preferred habitats already. The risk of additional pest species establishing at either the Inner Harbour or offshore

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disposal sites is low. The habitat at these disposal areas is unlikely to be favourable for the pest species detected (see section 3.4).

The rock revetments, piles, and upper sediments are those that are most likely to contain pest species. The top 1.5m of soft silty clays are assumed to be contaminated and will be disposed of at the Inner Harbour disposal site. The rock revetments are likely to be reused in the proposal and piles will be disposed of appropriately.

The deeper sediments to be disposed at the offshore site have a low risk of containing pest species. However, should they contain pest species, the offshore disposal site is unlikely to be of suitable habitat for their establishment (see Section 3.4). The more mobile species that may seek more suitable habitats at coastal sites are likely to have already been able to seek these outside of Port Kembla Harbour. This is considered to be a low risk as any captured organisms are likely to be smothered by the sediments during disposal.

- Loss of terrestrial habitat at Town Drain outlet and in northeast corner of proposed dredge area

Some terrestrial habitat will be lost by Town Drain outlet and in the northeast corner of proposed dredge area. This habitat is not considered to meet the definition of any native vegetation communities.

No significant terrestrial fauna are known to be present, and thus impacts due to the loss of terrestrial vegetation in Tom Thumb Drain will not be significant.

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5. Conclusion and Recommendations

The proposal for the dredging and disposal of sediments associated with construction of the proposed new berth at EB4 is not considered likely to have a significant impact upon aquatic or terrestrial flora or fauna.

The proposal will not result in the loss of any seagrass. Some macroalgae and terrestrial habitat will be lost, however. The terrestrial habitat is dominated by weeds, with some opportunistic natives. Few macroalgae will be lost, and their habitat will be replaced. However, a s205 permit under the *Fisheries Management Act 1994* will be required for the removal of these individuals.

It is recommended that suitable environmental management measures be developed and adopted to minimise the risk of short term impacts to water quality and sediment dispersal during dredging and disposal.

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Appendix 1. Photograph Plates.

Plate 1. Current berth in eastern portion of EB4 dredge area.

Plate 2. View of rock revetments to the south of berths in eastern portion of EB4 dredge area.

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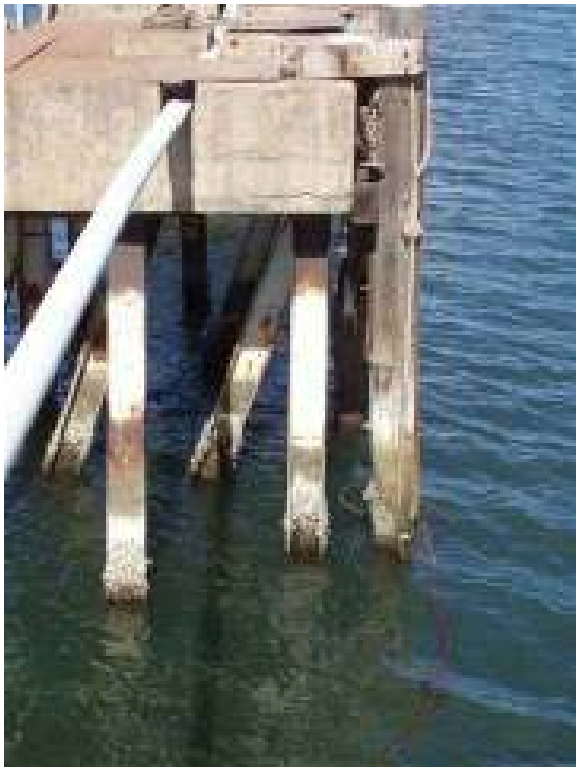
Plate 3. Southern part of current berth (isolated from land).

A



B

Plate 4. Southern jetty: photograph A shows the jetty, and photograph B is a close up of the jetty piles.

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Plate 5. View of rock revetments adjacent to the berths in eastern portion of EB4 dredge area (photograph taken facing north from southern jetty).

Plate 6. View of rock revetments adjacent to the southern jetty in eastern portion of EB4 dredge area (photograph taken facing east from southern jetty).

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Plate 7. Rope between eastern jetty and rock revetments (anchored at the top of the rock revetment). Clumps of barnacles and filamentous green algae are attached in to the rope.

Plate 8. View of water and rock revetments in eastern portion of EB4 dredge area. Photograph taken facing directly down from walkway on the most northern of the eastern jettys. The rock revetment is included within the EB4 overland dredge area.

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Plate 9. Current berth in northeastern portion of EB4 dredge area.

Plate 10. Close up of pylons of current berth in northeastern portion of EB4 dredge area.

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Plate 11. Rock revetment and vegetation in northern portion of EB4 dredge area.

Plate 12. Northern shoreline adjacent to the EB4 dredge area (outside of the proposed dredge footprint). In the background of the photograph are the grain silos on the western side of the basin, with the Town Drain outlet visible below the highest grain silo structure.

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Plate 13. Wrack and debris along the northern shoreline.

Plate 14. Debris and crystallised gypsum along the northern shoreline (white lines visible on the rocks).

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Plate 15. Spit of land in northwestern portion of EB4 overland dredge area (eastern part of Town Drain outlet).

Plate 16. Looking northwest from the proposal site of EB4 (this is where the Eastern Basin meets the Town Drain).

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