Appendix E

Ecology

Appendix E – 1
EPBC Protected Matters Search Tool

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

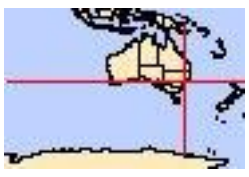
Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 08/03/12 13:00:55

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 5.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	2
Threatened Species:	53
Migratory Species:	70

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	10
Commonwealth Heritage Places:	5
Listed Marine Species:	89
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	26
State and Territory Reserves:	7
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	2

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Historic		
Kurnell Peninsula Headland	NSW	Listed place
Kamay Botany Bay	NSW	Nominated place

Wetlands of International Significance (RAMSAR)	[Resource Information]
Name	Proximity
Towra point nature reserve	Within Ramsar site

Threatened Ecological Communities	[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Eastern Suburbs Banksia Scrub of the Sydney Region	Endangered	Community known to occur within area
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Foraging, feeding or related behaviour may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat likely to occur within area
Sternula nereis nereis Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche bulleri Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
FISH		
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
FROGS		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
MAMMALS		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot [68050]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
PLANTS		
Acacia terminalis subsp. terminalis Sunshine Wattle [64829]	Endangered	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area
Pterostylis sp. Botany Bay (A.Bishop J221/1-13) Botany Bay Bearded Greenhood [64965]	Endangered	Species or species habitat likely to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
REPTILES		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
SHARKS		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Congregation or aggregation known to occur within area

Name	Status	Type of Presence
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable*	Species or species habitat may occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni		
Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera		
Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Puffinus leucomelas		
Streaked Shearwater [66541]		Species or species habitat may occur within area
Sterna albifrons		
Little Tern [813]		Breeding likely to occur within area

Name	Threatened	Type of Presence
Thalassarche bulleri Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Breeding may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Breeding likely to occur within area
Neophema chrysogaster		
Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Breeding may occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Roosting known to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Airservices Australia
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Defence Housing Authority

Name
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - BANKSMEADOW DEPOT (Sydney Workshop Company)

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Malabar Headland	NSW	Listed place
Historic		
Sydney (Kingsford Smith) Airport Group	NSW	Indicative Place
Botany Post Office	NSW	Listed place
Cape Baily Lighthouse	NSW	Listed place
Sydney Airport Air Traffic Control Tower	NSW	Nominated place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Roosting known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]		Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata		
Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus		
Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris		
Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus		
Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis		
Bigbelly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei		
White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii		
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa		
Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata		
Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber		
Red Pipefish [66265]		Species or species habitat may occur within area
Phyllopteryx taeniolatus		
Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus		
Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus		
Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius		
Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus		
Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus		
Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Stigmatopora nigra		
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus		
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus		
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris		
Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer		
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri		
New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus		
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Dugong dugon		
Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus		
Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Kurnell Sand Dune	NSW	Indicative Place
Cape Banks	NSW	Registered
Jennifer Street Bushland	NSW	Registered
Kurnell Peninsula Towra Point Area	NSW	Registered
Little Bay Geological Site	NSW	Registered
Long Bay Area	NSW	Registered
Malabar Headland	NSW	Registered
Towra Point Aquatic Reserve	NSW	Registered
Historic		
Botany Bay Entrance	NSW	Indicative Place
Botany Fire Station	NSW	Indicative Place
Botany Swamps	NSW	Indicative Place
Ramsgate Baths	NSW	Indicative Place
Botany Water Supply Scheme Remains	NSW	Interim List
Sewage Pumping Station 38, Substation and Inspection Hall	NSW	Interim List
Southern & Western Suburbs Ocean Outfall Sewers	NSW	Interim List
Sydney (Kingsford Smith) Airport Group	NSW	Interim List
Bare Island Fort	NSW	Registered

Name	State	Status
Botany Post Office	NSW	Registered
Cape Baily Lighthouse	NSW	Registered
Captain Cooks Landing Place Historic Site	NSW	Registered
La Perouse Memorial Group	NSW	Registered
La Perouse Monuments Historic Site	NSW	Registered
Prince Henry Hospital Conservation Area	NSW	Registered
Sir Joseph Banks Hotel (former)	NSW	Registered
St Matthews Anglican Church	NSW	Registered
The Watch Tower	NSW	Registered

State and Territory Reserves [Resource Information]

Name	State
Boat Harbour	NSW
Botany Bay	NSW
Cape Banks	NSW
Towra Point	NSW
Towra Point - Stink Pot Bay	NSW
Towra Point - Weeny/Quibray Bays	NSW

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red		Species or species habitat likely to occur

Name	Status	Type of Presence
Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Pinus radiata		
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Botany Wetlands	NSW
Towra Point Estuarine Wetlands	NSW

Coordinates

-34.0016 151.22791,-33.99901 151.22228,-34.00343 151.21604,-34.00526 151.21375,-34.00617 151.19624,-34.00511 151.18817,-33.98455 151.20142,-33.98744 151.21345,-33.9815 151.22121,-33.98622 151.22807,-33.99064 151.22746,-33.99201 151.22929,-33.99414 151.2305,-33.99292 151.23431,-33.99841 151.2366,-34.0016 151.24162,-34.00313 151.24984,-34.01531 151.23675,-34.00145 151.22791,-34.0016 151.22791

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix E – 2
OEH Species List

Scientific Name	Common Name	NSW status
Crinia tinnula	Wallum Froglet	V
Litoria aurea	Green and Golden Bell Frog	E1
Chelonia mydas	Green Turtle	V
Oxyura australis	Blue-billed Duck	V
Diomedea exulans	Wandering Albatross	E1
Thalassarche cauta	Shy Albatross	V
Thalassarche melanophris	Black-browed Albatross	V
Ardenna carneipes	Flesh-footed Shearwater	V
Macronectes giganteus	Southern Giant Petrel	E1
Macronectes halli	Northern Giant-Petrel	V
Pterodroma leucoptera leucoptera	Gould's Petrel	V
Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	V
Pterodroma nigripennis	Black-winged Petrel	V
Pterodroma solandri	Providence Petrel	V
Puffinus assimilis	Little Shearwater	V
Botaurus poiciloptilus	Australasian Bittern	E1
Pandion cristatus	Eastern Osprey	V
Haematopus fuliginosus	Sooty Oystercatcher	V
Haematopus longirostris	Pied Oystercatcher	E1
Charadrius leschenaultii	Greater Sand-plover	V
Charadrius mongolus	Lesser Sand-plover	V
Calidris alba	Sanderling	V
Calidris ferruginea	Curlew Sandpiper	E1
Calidris tenuirostris	Great Knot	V
Limicola falcinellus	Broad-billed Sandpiper	V
Limosa limosa	Black-tailed Godwit	V
Xenus cinereus	Terek Sandpiper	V
Gygis alba	White Tern	V
Onychoprion fuscata	Sooty Tern	V
Procelsterna cerulea	Grey Ternlet	V
Sternula albifrons	Little Tern	E1
^Calyptorhynchus lathami	Glossy Black-Cockatoo	V
^^Lathamus discolor	Swift Parrot	E1
^^Neophema chrysogaster	Orange-bellied Parrot	E4A
^^Pezoporus wallicus wallicus	Eastern Ground Parrot	V
^^Polytelis swainsonii	Superb Parrot	V
^^Ninox strenua	Powerful Owl	V
Tyto longimembris	Eastern Grass Owl	V
Dasyornis brachypterus	Eastern Bristlebird	E1
Anthochaera phrygia	Regent Honeyeater	E4A
Epthianura albifrons	White-fronted Chat Epthianura albifrons (Jardine & Selby, 1828) in the Sydney Metropolitan Catchment Management Authority area	E2
Epthianura albifrons	White-fronted Chat	V
Daphoenositta chrysoptera	Varied Sittella	V

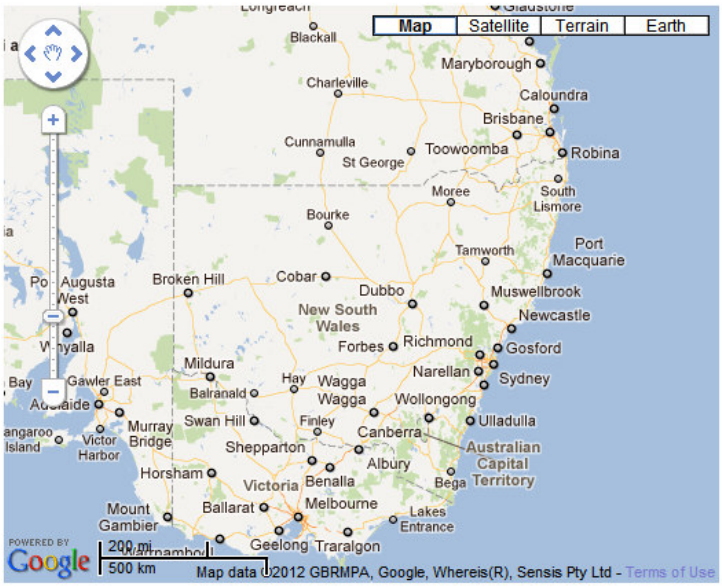
Petroica boodang	Scarlet Robin	V
Neochmia ruficauda	Star Finch	E4
Stagonopleura guttata	Diamond Firetail	V
Pteropus poliocephalus	Grey-headed Flying-fox	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V
Myotis macropus	Southern Myotis	V
Dugong dugon	Dugong	E1
Arctocephalus forsteri	New Zealand Fur-seal	V
Arctocephalus pusillus doriferus	Australian Fur-seal	V
Eubalaena australis	Southern Right Whale	V
Megaptera novaeangliae	Humpback Whale	V
Senecio spathulatus	Coast Groundsel	E1
Epacris purpurascens var. purpurascens		V
Acacia terminalis subsp. terminalis	Sunshine Wattle	E1
^^Callistemon linearifolius	Netted Bottle Brush	V
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V
Syzygium paniculatum	Magenta Lilly Pilly	E1
^Pterostylis sp. Botany Bay	Botany Bay Bearded Orchid	E1
^Thelymitra atronitida	Black-hooded Sun Orchid	E4A

Appendix E – 3
Species Distribution

Records viewer

Records for this map are from I&I NSW research surveys, they do not indicate the entire distribution of the species and there may be errors and omissions.

To view the records using Google Earth you must download and install the Google Earth Plugin.



Records search

Step 1

Select an area type to search by:

- Statewide
- Catchment Management Authority
- Local Government Area

CMA: Sydney Metro

Step 2

Select a species:

There are no records

Step 3

Select a time period:

- pre 1980
- post 1980
- all records

Search

Appendix E – 4
Threatened Species

Search results for listings by region

The provisions of the *Fisheries Management Act 1994* cover all fish (freshwater, estuarine and marine), aquatic invertebrates and marine plants. The definition of fish includes any marine, estuarine or freshwater fish or other aquatic animal (e.g., oysters, prawns, sharks, rays, starfish, insects and worms), at any stage of their life history. It does not include whales, mammals, birds, reptiles and amphibians.

Listings found in the Sydney Metro CMA

ScientificName	CommonName	Status	Profile
Carcharius taurus	Grey nurse shark	Critically endangered	profile
Pristis zijsron	Green sawfish	Presumed extinct	profile
Austrocordulia leonardi	Sydney hawk dragonfly	Endangered	profile
Archaeophya adamsi	Adam's emerald dragonfly	Endangered	profile
Carcharadon carcharias	Great white shark	Vulnerable	profile
Epinephelus daemelii	Black cod	Vulnerable	profile

Appendix E – 5
CMA Subregion Profiles and Report

CMA Sub Region & Profiles Report

29/06/2012

CMA Sub-Region Profile ID	Scientific Name	Common Name	Occurrence
Hawkesbury/Nepean - Sydney Cataract			
10005	Acacia baueri subsp. aspera	Acacia baueri subsp. aspera	Known
10006	Acacia bynoeana	Bynoe's Wattle	Known
10013	Acacia flocktoniae	Flockton Wattle	Known
10140	Calyptorhynchus lathami	Glossy Black-Cockatoo	Known
10155	Cercartetus nanus	Eastern Pygmy-possum	Known
10157	Chalinolobus dwyeri	Large-eared Pied Bat	Known
10207	Dasyurus maculatus	Spotted-tailed Quoll	Known
10273	Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	Known
10331	Falsistrellus tasmaniensis	Eastern False Pipistrelle	Known
10398	Heleioporus australiacus	Giant Burrowing Frog	Known
10413	Hoplocephalus bungaroides	Broad-headed Snake	Known
10444	Kerivoula papuensis	Golden-tipped Bat	Known
10473	Leucopogon exolasius	Woronora Beard-heath	Known
10483	Litoria aurea	Green and Golden Bell Frog	Known
10488	Litoria littlejohni	Littlejohn's Tree Frog	Known
10515	Melaleuca deanei	Deane's Paperbark	Known
10533	Miniopterus australis	Little Bentwing-bat	Known
10534	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Known
10536	Mixophyes balbus	Stuttering Frog	Predicted
10544	Mormopterus norfolkensis	Eastern Freetail-bat	Known
10549	Myotis macropus	Southern Myotis	Known
10555	Neophema pulchella	Turquoise Parrot	Known
10562	Ninox strenua	Powerful Owl	Known
10569	O'Hares Creek Shale Forest	O'Hares Creek Shale Forest	Known
10592	Persoonia bargoensis	Bargo Geebung	Known
10595	Persoonia hirsuta	Hairy Geebung	Known
10608	Pezoporus wallicus wallicus	Eastern Ground Parrot	Predicted
10616	Phascolarctos cinereus	Koala	Known
10646	Pomaderris adnata	Sublime Point Pomaderris	Known
10647	Pomaderris brunnea	Brown Pomaderris	Known
10692	Pseudophryne australis	Red-crowned Toadlet	Known
10697	Pteropus poliocephalus	Grey-headed Flying-fox	Known
10710	Pultenaea aristata	Prickly Bush-pea	Known
10748	Scoteanax rueppellii	Greater Broad-nosed Bat	Known
10755	Shale/Sandstone Transition Forest	Shale/Sandstone Transition Forest	Known

CMA Sub-Region			
Profile ID	Scientific Name	Common Name	Occurrence
10787	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Known
10820	Tyto novaehollandiae	Masked Owl	Known
10821	Tyto tenebricosa	Sooty Owl	Known
10834	Western Sydney Dry Rainforest in the Sydney Basin Bioregion	Western Sydney Dry Rainforest in the Sydney Basin Bioregion	Predicted
10945	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Known
10975	Callocephalon fimbriatum	Gang-gang Cockatoo	Known
20001	Alteration of habitat following subsidence due to longwall mining	Alteration of habitat following subsidence due to longwall mining	Predicted
20002	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Predicted
20003	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	Predicted
20004	Competition from feral honey bees, Apis mellifera L.	Competition from feral honey bees, Apis mellifera L.	Predicted
20005	Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Predicted
20006	Bushrock removal	Bushrock removal	Predicted
20007	Loss or degradation (or both) of sites used for hill-topping by butterflies	Loss or degradation (or both) of sites used for hill-topping by butterflies	Predicted
20008	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	Predicted
20009	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Predicted
20010	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Predicted
20011	Removal of dead wood and dead trees	Removal of dead wood and dead trees	Predicted
20012	Herbivory and environmental degradation caused by feral deer	Herbivory and environmental degradation caused by feral deer	Predicted
20014	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Predicted
20015	Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	Predicted
20016	Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	Predicted
20017	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Predicted
20018	Invasion of native plant communities by exotic perennial grasses	Invasion of native plant communities by exotic perennial grasses	Predicted
20020	Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Predicted
20021	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Predicted
20023	Clearing of native vegetation	Clearing of native vegetation	Predicted
20024	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Predicted
20025	Anthropogenic Climate Change	Anthropogenic Climate Change	Predicted
20026	Infection of native plants by Phytophthora cinnamomi	Infection of native plants by Phytophthora cinnamomi	Predicted
20027	Invasion of native plant communities by Chrysanthemoides monilifera	Invasion of native plant communities by Chrysanthemoides monilifera	Predicted
20043	Invasion and establishment of the Cane Toad (Bufo marinus)	Invasion and establishment of the Cane Toad (Bufo marinus)	Predicted
20044	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Predicted

CMA Sub-Region			
Profile ID	Scientific Name	Common Name	Occurrence
20052	Invasion and establishment of exotic vines and scramblers	Invasion and establishment of exotic vines and scramblers	Predicted
20065	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Predicted
20069	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Known
20079	Loss of Hollow-bearing Trees	Loss of Hollow-bearing Trees	Predicted
20108	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Predicted
20111	Glossopsitta pusilla	Little Lorikeet	Known
20116	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predicted
20129	Petroica phoenicea	Flame Robin	Known
20131	Hieraaetus morphnoides	Little Eagle	Known
20133	Petroica boodang	Scarlet Robin	Known
20134	Circus assimilis	Spotted Harrier	Predicted
20135	Daphoenositta chrysoptera	Varied Sittella	Known
20153	Invasion of Native Plant Communities by African Olive Olea europaea L. subsp. cuspidata (Wall ex G.Don Ciferri)	Invasion of Native Plant Communities by African Olive Olea europaea L. subsp. cuspidata (Wall ex G.Don Ciferri)	Predicted

Appendix E – 6
Field Survey Species List

Field Survey Results

Flora Scientific name	Common name	TSC Act, 1995	EPBC Act, 1999	Survey 1	Survey 2	Survey 3	Survey 4
Algae							
Polysiphonia sp.	Red Algae			x	x		
Ecklonia radiata	Brown Kelp			x	x	x	
Sargassum spp.	Brown Algae						
Padina fraseri	Brown Algae						
Seagrasses							
Caulerpa filiformis	Caulerpa				x		
Halophila ovalis	Paddleweed				x		
Posidonia australis	Strapweed					x	
Zostera capricorni	Eelgrass				x		
Fauna							
Anthozoans							
Carybdea rastoni	Southern Box Jellyfish (Jimble)						x
Cerianthus sp.	Cerianthid tube anemone (white form)						x
Pelagica noctiluca	Planktonic tube-anemone						x
Plesiastrea versipora	Stony coral						
Sarcoptilus grandis	Sea Pen				x		
Aves							
Phalacrocorax varius	Pied Cormorant				x		
Phalacrocorax carbo	Great Cormorant				x	x	
Sterna bergii	Crested Tern				x		
Morus serrator	Australasian Gannet				x	x	
Larus novaehollandiae	Silver Gull			x	x	x	
Haliaeetus leucogaster	White-bellied Sea Eagle		Migratory	x			
Hirundo neoxena	Welcome Swallow						x
Macronectes giganteus	Southern Giant-Petrel (J)	Endangered	Endangered; Migratory			x	
Fish							

Field Survey Results

		TSC Act, 1995	EPBC Act, 1999	Survey 1	Survey 2	Survey 3	Survey 4
Acanthopagrus sp.	Bream sp. (Yellowfin or Black)				x		
Girella tricuspidata	Luderick; Blackfish						
Gymnothorax sp.	Moray Eel			x			
Heterodontus portusjacksoni	Port Jackson Shark				x		x
Scorpaena papillosa	Southern Red Scorpionfish; Common Red Rock Cod (J)				x		
Trygonoptera testacea	Common Stingaree			x	x	x	
Invertebrates							
Pachycerianthus longistriatis	Tubeworm Anemone			x	x	x	
Centrostephanus rodgersii	Black Sea Urchin				x		
Cunjevoi	Sea Squirt						x
Diopatra ornata	Plumed Tubeworm				x	x	
Octopus aegina	Baby Octopus						x
Sepia plangon	Mourning Cuttlefish						x
Thais obrita	-						x
Mammalia							
Tursiops truncatus	Common Bottlenose Dolphin					x	x

Appendix E – 7
Habitat Assessment

Flora

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Acacia terminalis subsp. terminalis	Sunshine Wattle	Endangered	Not listed	Endangered	The Sunshine Wattle has a limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay, with most records from the Port Jackson area and the eastern suburbs of Sydney. Coastal scrub and dry sclerophyll woodland on sandy soils . Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated. Most sites are highly modified or disturbed due to surrounding urban development. Flowers in autumn (OEH Bionet, 2012). Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Caladenia tessellata	Thick-lipped Spider-orchid	Endangered	Not listed	Vulnerable	The Thick-lipped Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. The species generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations) (OEH Bionet, 2012). The species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist within the Project site - given the marine nature of the proposal.	Unlikely
Callistemon linearifolius	Netted Bottle Brush	Vulnerable	Not listed	Not listed	Netted Bottle Brush has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers spring – summer (OEH Bionet, 2012). Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely

Flora

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Cryptostylis hunteriana	Leafless Tongue-orchid	Vulnerable	Not listed	Vulnerable	The Leafless Tongue-orchid has no leaf. Producing an upright flower-stem that bears 5-10 flowers between November and February. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieber*i), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). This species has not been previously recorded within 5 km of the Project site, nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Epacris purpurascens var. purpurascens	-	Vulnerable	Not listed	Not listed	An erect shrub with white to pinkish flowers. Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. Killed by fire and re-establishes from soil-stored seed (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Vulnerable	Not listed	Vulnerable	Narrow-leaved Black Peppermint is a medium-sized tree 15 - 20 m tall with rough, thick, grey-brown bark which extends to the larger branches. This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield, largely on private property. The species grows in dry grassy woodland, on shallow and infertile soils, mainly on granite (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site, nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely

Flora

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Melaleuca biconvexa	Biconvex Paperbark	Vulnerable	Not listed	Vulnerable	Biconvex Paperbark is a shrub or small tree, usually up to 10 m tall, though occasionally as high as 20 m. The species is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.The species generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October. Resprouts following fire (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site, nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Pimelea curviflora var. curviflora	-	Vulnerable	Not listed	Vulnerable	A much-branched subshrub or shrub 20 to 120cm high with hairy stems. Confined to the coastal area of the Sydney and Illawarra regions. Populations are known between northern Sydney and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowalnd Grassy Woodland habitat at Albion Park on the Illawaraa coastal plain. Flowers October to May. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site, nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Pterostylis sp. Botany Bay	Botany Bay Bearded Orchid	Endangered	Not listed	Endangered	Botany Bay Bearded Orchid is a terrestrial orchid with a slender flowering stem to 20 cm. Restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. The species was first collected at Maroubra in 1908, although it has not been recorded at Maroubra since that time. Occupies moist level sites on skeletal sandy soils derived from sandstone. Associated vegetation is coastal heath dominated by Melaleuca nodosa and Baeckea imbricata. Occurs in small localised populations, usually in areas within the heath where the canopy allows filtered light to reach the ground. All species of Pterostylis are deciduous and die back to fleshy, rounded tuberoids in dry or hot conditions. Produces its basal rosette of leaves from mid-winter, followed by the flowering stem. Flowering occurs from August to September (OEH Bionet, 2012). Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely

Flora

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Senecio spathulatus	Coast Groundsel	Endangered	Not listed	Not listed	Coast Groundsel is a low-growing smooth-stemmed daisy, often forming hummocks to 30 cm tall. The species occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). The species grows primarily on dunes (OEH Bionet, 2012). Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Syzygium paniculatum	Magenta Lilly Pilly	Endangered	Not listed	Vulnerable	The Magenta Lilly Pilly is a small to medium sized rainforest tree that grows to 8 m tall. The species is found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (OEH Bionet, 2012). Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Thelymitra atronitida	Black-hooded Sun Orchid	Critically Endangered	Not listed	Not listed	The Black-hooded Sun Orchid is a terrestrial orchid, with a solitary basal grass-like or lance-like leaf, 15 to 35 cm long . In New South Wales, the species is known from two localities, Cape Solander in Botany Bay National Park in southern Sydney, and Bago State Forest south of Tumut. At Cape Solander this species is recorded from shallow black peaty soil in coastal heath on sandstone. It is possible that the two coastal populations of Cape Solander and north-eastern Victoria may be distinct from the ecologically different Bago population. In the Bago area it is recorded as occurring in open forest with a heathy understorey on well-drained sand or clay-loam soils. Although the species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Thesium australe	Austral Toadflax	Vulnerable	Not listed	Vulnerable	Austral Toadflax is a small, straggling herb to 40 cm tall. The species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Amphibia						
Crinia tinnula	Wallum Froglet	Vulnerable	Not listed	Not listed	The Wallum Froglet is found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. In NSW the species extends from north of the Queensland border south to Kurnell. Wallum Froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. The species is a late winter breeder. Males call in choruses from within sedge tussocks or at the water edge (OEH Bionet, 2012). Although this species has been previously recorded in close proximity to the Project site, in Botany Bay National Park (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Heleioporus australiacus	Giant Burrowing Frog	Vulnerable	Vulnerable	Not listed	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on avariety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site, nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Litoria aurea	Green and Golden Bell Frog	Endangered	Vulnerable	Not listed	Formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extends into east Gippsland. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Although this species has been previously recorded in close proximity to the Project site, on Kurnell Peninsular (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Aves						
Actitis hypoleucos	Common Sandpiper	Not listed	Migratory	Not listed	The Common Sandpiper is found along all coastlines of Australia and in many areas inland, the species is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. Utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. Mainly forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. The species eats molluscs such as bivalves, crustaceans such as amphipods, crabs and insects. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks. Birds sometimes venture into grassy areas adjoining wetlands.This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for this species within the Project site.	Potential
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	(Migratory)	Not listed	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Range has contracted dramatically to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Although this species has been previously recorded in close proximity to the Project site, in Botany Bay National Park (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Apus pacificus	Fork-tailed Swift	Not listed	Migratory	Not listed	The Fork-tailed Swift is an insectivorous, non-breeding visitor to all states and territories of Australia. In NSW, the species is recorded in all regions. Many records occur east of the Great Divide. They mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over more urban areas. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. Sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines. They forage aerially, up to hundreds of metres above ground, but also less then 1 m above open areas or over water. Although potential foraging habitat may exist in the vicinity of the proposed works, this species has not been previously recorded within 5km of the Project site (OEH Bionet, 2012).	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Ardea alba	Great (White) Egret	Not listed	Migratory	Not listed	The Great Egret is a widespread species of southern and eastern Asia and Australasia, and may potentially occur in a large number of conservation reserves. range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). The Eastern Great Egret has a diverse diet that includes fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals. Pairs construct a shallow platform-like nest of loosely woven sticks in the upper strata of trees or shrubs standing in or near water or sometimes in inundated reed beds.	Potential
Ardea ibis	Cattle Egret	Not listed	Migratory	Not listed	Two major distributions have been located; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. The species occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. Often forages away from water on low lying grasslands, improved pastures and croplands. Roosts in trees, or amongst ground vegetation in or near lakes and swamps.Feeds mostly on grasshoppers during the breeding season. Consumes other insects including cicadas, centipedes, spiders, cattle ticks, frogs (including cane toads), lizards (particularly skinks) and small mammals.	Potential
Ardenna carneipes	Flesh-footed Shearwater	Vulnerable	Migratory	Not listed	The Flesh-footed Shearwater is a marine species that ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand; the other along the coast of Western Australia. Nests on Lord Howe Island in forests on sandy soils from Ned's Beach to Clear Place, with smaller colonies below Transit Hill and at Old Settlement Beach (OEH Bionet, 2012). Potential foraging habitat may exist in the vicinity of the proposed works.	Potential
Arenaria interpres	Ruddy Turnstone	Not listed	Migratory	Not listed	The species is widespread within Australia during its non-breeding period of the year, including from Tasmania in the south to Darwin in the north and many coastal areas in between. Usually seen singly or, more usually, in loose groups of 20–100, along coasts and occasionally inland. It is found in most coastal regions, with occasional records of inland populations. Strongly prefers rocky shores or beaches where there are large deposits of rotting seaweed. Lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats. The species is carnivorous, feeding on insects, worms, crustaceans, molluscs, and spiders.	Potential
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered	Not listed	The species is widespread, but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.). Hides durig the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds. Although this species has been previously recorded within 5 km of the Project site, near Towra Point Nature Reserve (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Calconectris leucomelas	Streaked Shearwater	Not listed	Migratory	Not listed	This species is pelagic, but also occurs in inshore waters. It occurs in the Pacific Ocean, nesting in Japan and many of its offshore islands. After breeding, the Streaked Shearwater will migrate toward southern Australia. Feeds mainly on fish and squid. It does follow fishing boats, attracted to anchovy crawls off Japan. The species prefers to roost in forested hills where they use burrows to nest in.	Potential
Calidris acuminata	Sharp-tailed Sandpiper	Not listed	Migratory	Not listed	The Sharp-tailed Sandpiper is a summer migrant from Arctic Siberia, being found on wetlands throughout Australia. Strongly migratory, arriving in Australia in August, returning to Siberia in March, with greatest numbers in south-eastern Australia. The species prefers the grassy edges of shallow inland freshwater wetlands. Also found around sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. It is often found in large flocks, often with other waders, foraging in shallow waters. The species feeds on aquatic insects and their larvae, as well as worms, molluscs, crustaceans and sometimes, seeds. The nest is a well-hidden shallow hollow on the ground, lined with grass and leaves.	Potential
Calidris alba	Sanderling	Vulnerable	Migratory	Not listed	The Sanderling is a regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Generally occurs in small flocks, however may associate freely with other waders. Individuals run behind receding waves, darting after insects, larvae and other small invertebrates in the sand, then dart back up the beach as each wave breaks (OEH Bionet, 2012).	Potential
Calidris canutus	Red Knot	Not listed	Migratory	Not listed	Internationally the Red Knot is a non-breeding visitor to most continents. Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. Occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps. Usually forage in soft substrate near the edge of water on intertidal mudflats or sandflats exposed by low tide. An omnivorous species, preying mostly worms, bivalves, gastropods, crustaceans and echinoderms.	Potential
Calidris ferruginea	Curlew Sandpiper	Not listed	Migratory	Not listed	In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. Occur in both fresh and brackish waters. Occasionally recorded around floodwaters. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Calidris ruficollis	Red-necked Stint	Not listed	Migratory	Not listed	The species breeds in north-eastern Siberia and northern and western Alaska. It follows the the East Asian-Australasian Flyway to spend the southern summer months in Australia. It is found on the coast, in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores. May also be seen in saltworks, sewage farms, saltmarsh, shallow wetlands including lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats, flooded paddocks or damp grasslands. They are often in dense flocks, feeding or roosting. are omnivorous, taking seeds, insects, small vertebrates, plants in saltmarshes, molluscs, gastopods and crustaceans.	Potential
Calidris tenuirostris	Great Knot	Vulnerable	Migratory	Not listed	In NSW, the species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	Potential
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Not listed	Not listed	The Glossy Black-cockatoo is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of She-oak species, particularly Black She-oak (Allocasuarina littoralis), Forest She-oak (A. torulosa) or Drooping She-oak (A. verticillata) occur. Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill (OEH Bionet, 2012). Although this species has been previously recorded within 5 km of the Project site, near Towra Point Nature Reserve (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site.	Unlikely
Charadrius bicinctus	Double-banded Plover	Not listed	Migratory	Not listed	In Australia, the Double-banded Plover is found mainly on the east coast and Tasmania and is a regular visitor to Norfolk and Lord Howe Islands. The species is found on coastal beaches, mudflats, sewage farms, river banks, fields, dunes, upland tussock grasses and shingle. They eat molluscs, crustaceans, insects, and occasionally seeds and fruit. The nest site is a scrape in the ground lined with stones, particulalry on braided river beds (having small channels separated by gravel bars).	Potential
Charadrius leschenaultii	Greater Sand Plover	Vulnerable	Migratory	Not listed	The Greater Sand Plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, being found usually singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Charadrius mongolus	Lesser Sand Plover	Vulnerable	Migratory	Not listed	The Lesser Sand Plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	Potential
Charadrius veredus	Oriental Plover	Not listed	Migratory	Not listed	The Oriental Plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia, and there are records at a few scattered sites elsewhere, mainly along the northern coast, such as in the Top End, the Gulf of Carpentaria and on Cape York Peninsula. Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland.	Potential
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	Not listed	Not listed	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Although this species has been previously recorded within 5 km of the Project site, near Bonna Point Nature Reserve (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Dasyornis brachypterus	Eastern Bristlebird	Endangered	Endangered	Not listed	The Eastern Bristlebird is endemic to Australia and occurs in three geographically-separate regional populations in south-eastern Australia. The central population, occurs on the central coast of NSW, and consists of extant local populations at Budderoo National Park and adjoining Barren Grounds Nature Reserve, in the Morton National Park-Red Rocks Nature Reserve area, and at Jervis Bay. The species inhabits low dense vegetation in a broad range of habitat types including sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest (DSEWPaC, 2012). Although this species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Diomedea exulans amsterdamensis	Amsterdam Albatross	Endangered	Endangered (Migratory)	Not listed	The Amsterdam Albatross is a marine, pelagic seabird. It nests in open patchy vegetation (among tussocks, ferns or shrubs) near exposed ridges or hillocks. It sleeps and rests on ocean waters when not breeding. The species is a non-resident visitor to Australia, and may occur in south-west and south Australian waters, and breeding on Amsterdam Island in summer. It has been estimated that the total global population of Amsterdam Albatross is approximately 130 individuals, of which 80 are adults. Potential foraging habitat may exist for this species in the vicinity of the proposed works, however this species has not been previously recorded within 5km of the Project site, so it is considered unlikely.	Unlikely
Diomedea exulans antipodensis	Antipodean Albatross	Vulnerable	Vulnerable (Migratory)	Not listed	A large Albatross species, with breeding confined to New Zealand. The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. The majority of birds breed on Antipodes Island, with a small number of pairs breeding on Campbell Island. This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish. Although representing a small proportion on its total foraging area, potential forage in NSW waters is nonetheless considered significant for the species. Potential foraging habitat may exist for this species in the vicinity of the proposed works, however this species has not been previously recorded within 5km of the Project site, so it is considered unlikely.	Unlikely
Diomedea exulans exulans	Tristan Albatross	Not listed	Endangered (Migratory)	Not listed	The Tristan Albatross is a large albatross, with a length of 110 cm and a wingspan of approximately 3.5 m. They are very similar in plumage to the Wandering Albatross. The Tristan Albatross is a marine, pelagic seabird. It forages in open water in the Atlantic Ocean near the Cape of Good Hope, South Africa where it feeds on squid, fish and crustaceans. It sleeps and rests on ocean waters when not breeding. The species breeds on Inaccessible Island and Gough Island in the Atlantic Ocean. It breeds among grass tussocks on coastal plains, swampy valley floors, and crests of broad ridges or gentle slopes. It prefers to nest on open patchy vegetation (tussock, fern or shrubs), near exposed ridges or hillocks. Potential foraging habitat may exist for this species in the vicinity of the proposed works, however this species has not been previously recorded within 5km of the Project site, so it is considered unlikely.	Unlikely
Diomedea exulans gibsoni	Gibson's Albatross	Vulnerable	Vulnerable (Migratory)	Not listed	A large Albatross species, with breeding confined to New Zealand. Essentially endemic to the Auckland Islands of New Zealand. The non-breeding range is poorly known however the species probably disperses across the southern Pacific. The species is regularly encountered on trans-Tasman shippping routes and at seas off Sydney, and regularly occurs off the NSW coast usually between Green Cape and Newcastle. This species is known only to breed on the Adams, Disappointment and Auckland Islands in the subantarctic Auckland Island group. This species regularly occurs off the NSW coast from Green Cape to Newcastle. Although representing a small proportion on its total foraging area, potential forage in NSW waters during the winter is nonetheless considered significant for the species. Potential foraging habitat may exist for this species in the vicinity of the proposed works, however this species has not been previously recorded within 5km of the Project site, so it is considered unlikely.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Diomedea exulans (sensu lato)	Wandering Albatross	Endangered	Vulnerable (Migratory)	Not listed	The Wandering Albatross is the largest of albatrosses with the greatest wingspan of living birds (up to 3.5m). The species visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and Spetember. It has been recorded along the length of the NSW coast. Wandering albatross spend the majority of their time in flight, soaring over the southern oceans. They feed in pelagic, offshore and inshore waters, often at night, taking fish and cephalopods such as squid, crustaceans and carrion, and will often follow ships feeding on the refuse they trail. They breed on a number of islands just north of the Antarctic Circle. This species has been previously recorded within 5 km of the Project site, within Botany Bay (refer to **Figure A1**), and potential suitable foraging habitat exists for this species within the Project site.	Potential
Epthianura albifrons	White-fronted Chat	Vulnerable	Not listed	Not listed	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Although this species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Fregetta grallaria grallaria	White-bellied Storm-Petrel	Vulnerable	Vulnerable	Not listed	The White-bellied Storm-Petrel (Tasman Sea) breeds on small offshore islets and rocks in the Lord Howe Island group, including Roach Island and Balls Pyramid. The species occurs across sub-tropical and tropical waters in the Tasman Sea, Coral Sea and, possibly, the central Pacific Ocean. In the non-breeding season, it reaches and forages over near-shore waters along the continental shelf of mainland Australia, breeding on offshore islets and rocks in the Lord Howe Island group. Potential foraging habitat may exist for this species in the vicinity of the proposed works, however this species has not been previously recorded within 5km of the Project site, so it is considered unlikely.	Unlikely
Gallinago hardwickii	Latham's Japanese Snipe	Not listed	Migratory	Not listed	Latham's Snipe is a non-breeding visitor to south-eastern Australia, and migrant through northern Australia. The species breeds in Japan and far eastern Russia, and migrate south after the breeding season, travelling across Papua New Guinea to winter in eastern Australia. In Australia, the species occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). Can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. An omnivorous species that feeds on invertebrates, seeds and other plant material. They use their bills to jab and probe into mud that may be exposed or covered by very shallow water.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Gygis alba	White Tern	Vulnerable	Not listed	Not listed	The White Tern is a marine species that occurs widely in tropical and subtropical seas and islands. A recent arrival to Lord Howe Island, only breeding there since the 1960s. This species nests in the high branches of trees. On Lord Howe Island it nests in the introduced Norfolk Island Pine as well as native Sallywood, Blackbutt, Greybark, Banyan and Pandanus. White Terns do not build a nest but select a depression or damaged area on the branch of a tree on which to balance their egg.	Potential
Haematopus fulignosus	Sooty Oystercatcher	Vulnerable	Not listed	Not listed	Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories.	Potential
Haematopus longirostris	Australian Pied Oystercatcher	Endangered	Not listed	Not listed	The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. 'Pied' Oystercatchers are occasionally recorded on Lord Howe island but it is uncertain which species is involved. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.	Potential
Haliaeetus leucogaster	White-bellied Sea-Eagle	Not listed	Migratory	Not listed	The species is distributed along the coastline of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia where it is mostly recorded in coastal lowlands. Breeding records are patchily distributed, mainly along the coastline, and especially the eastern coast, extending from Queensland to Victoria, and to Tasmania. The species is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitat is characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats. feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal. Potential foraging habitat may exist for this species in the vicinity of the proposed works, and although this species has not been previously recorded within 5km of the Project site - the species was observed during field surveys conducted in Botany Bay (URS, 2012).	Potential
Tringa brevipes	Grey-tailed Tattler	Not listed	Migratory	Not listed	Within Australia, the species has a primarily northern coastal distribution and is found in most coastal regions. Often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. The species usually roosts in the branches of mangroves or, rarely, in dense stands of other shrubs, or on snags or driftwood. Where mangroves are not present, it roosts on rocks that are sometimes partly submerged. It is also known to roost on beaches and reefs. Diet consists primarily of; Polychaetes, molluscs, crustaceans, insects and, occasionally, fish.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Hirundapus caudacutus	White-throated Needletail	Not listed	Migratory	Not listed	The White-throated Needletail is widespread in eastern and south-eastern Australia where they spend the non-breeding season. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. The species almost always forage aerially for insects, at heights up to 'cloud level', above a wide variety of habitats ranging from heavily treed forests to open habitats, such as farmland, heathland or mudflats. The species breeds in wooded lowlands and sparsely vegetated hills, as well as mountains covered with coniferous forests.	Potential
Lathamus discolor	Swift Parrot	Endangered	Endangered	Not listed	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW, mostly occurs on the coast and south west slopes. Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta,* Spotted Gum *Corymbia maculata,* Red Bloodwood *C. gummifera,* Mugga Ironbark *E. sideroxylon,* and White Box *E. albens.* Commonly used lerp infested trees include Inland Grey Box *E. microcarpa,* Grey Box *E. moluccana* and Blackbutt *E. pilularis* . Following winter they return to Tasmania where they breed. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable foraging habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Limicola falcinellus	Broad-billed Sandpiper	Vulnerable	Migratory	Not listed	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW. The species favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Feeds by jabbing its bill into soft wet mud. The species roost on banks on sheltered sand, shell or shingle beaches.	Potential
Limosa lapponica	Bar-tailed Godwit	Not listed	Migratory	Not listed	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states, where it occurs during the non-breeding season. The species is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas. The species is mainly carnivorous with a diet consisting of worms, molluscs, crustaceans, insects and some plant material. It has also been recorded eating fruits, fish and tadpoles.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Limosa limosa	Black-tailed Godwit	Vulnerable	Migratory	Not listed	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, the it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. Primarily a coastal species, and is usually found in sheltered bays, estuaries, lagoons with large intertidal mudflats and/ or sandflats. Further inland, it can also be found on mudflats and in water less than 10cm deep, around muddy lakes and swamps.	Potential
Macronectes giganteus	Southern Giant-Petrel	Endangered	Endangered (Migratory)	Not listed	A large seabird up to 100cm in length with a wingspan between 150 and 210cm. The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. It is an opportunistic scavenger and predator, and scavenges from fishing vessels and animal carcasses on land. Potential foraging habitat may exist for this species in the vicinity of the proposed works, this species has been previously recorded within 5km of the Project site (refer to **Figure A1**), and the species was observed during field surveys conducted in Botany Bay (URS, 2012).	Potential
Macronectes halli	Northern Giant-Petrel	Vulnerable	Vulnerable (Migratory)	Not listed	A large seabird up to 95cm in length with a wingspan of 150-210cm. The Northern Giant-petrel has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Although this species has not been previously recorded within 5 km of the Project site, potential foraging habitat may exist for this species in the vicinity of the proposed works.	Potential
Merops ornatus	Rainbow Bee-eater	Not listed	Migratory	Not listed	The species is distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches. The nest is located in an enlarged chamber at the end of long burrow or tunnel that is excavated in the ground. The species feeds on a variety of insects and items inclulding earthworms, spiders and tadpoles.	Potential
Monarcha melanopsis	Black-faced Monarch	Not listed	Migratory	Not listed	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The species is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. Forages for insects among foliage, or catches flying insects on the wing. Builds a deep cup nest of casuarina needles, bark, roots, moss and spider web in the fork of a tree, about 3 m to 6 m above the ground. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable foraging habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Myiagra cyanoleuca	Satin Flycatcher	Not listed	Migratory	Not listed	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. The species is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. Takes insects on the wing, foraging actively from perches in the mid to upper canopy. After the breeding season, it may forage in loose groups, usually of adults and their newly-fledged young, in drier, more open forests. It builds a broad-based, cup-shaped nest of shredded bark and grass, coated with spider webs and decorated with lichen. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable foraging habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Neochmia ruficauda	Star Finch	Extinct	Endangered	Not listed	The Star Finch's (eastern) occurs only in central Queensland, although the species distribution is very poorly known. Based on the small number of accepted records, the distribution of the Star Finch (eastern) is believed to extend north to Bowen, west to beyond Winton and, based on recent records, south to near Wowan. The species occurs mainly in grasslands and grassy woodlands that are located close to bodies of fresh water. It also occurs in cleared or suburban areas such as along roadsides and in towns. Although this species has been previously recorded within 5 km of the Project site (OEH Bionet, 2012), the species' known distribution does not align with this record - and for this reason it is considered to be an error.	Unlikely
Neophema chrysogaster	Orange-bellied Parrot	Critically Endangered	(Migratory)	Not listed	The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. On the mainland, the species spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland. Diet mainly comprises seeds and fruits of sedges and salt-tolerant coastal and saltmarsh plants. Occasionally, flowers and stems are eaten. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable foraging habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Ninox strenua	Powerful Owl	Vulnerable	Not listed	Not listed	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. Now uncommon throughout its range where it occurs at low densities. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation. Although this species has been previously recorded within 5 km of the Project site, (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Numenius madagascariensis	Eastern Curlew	Not listed	Migratory	Not listed	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species breeds in Russia and north-eastern China but its distribution is poorly known. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms. Mainly forages on soft sheltered intertidal areas. Roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves.The species is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects.	Potential
Numenius minutus	Little Curlew	Not listed	Migratory	Not listed	Little Curlews breed in Siberia, moving south to the non-breeding areas in northern Australia and southern New Guinea. The species is widespread in the north of Australia and scattered elsewhere Little Curlews may gather in large flocks on coastal and inland grasslands and black soil plains in northern Australia, near swamps and flooded areas. They also feed on playing fields, paddocks and urban lawns. Feeds mainly on insects, as well as seeds and berries, walking along slowly, picking and probing at the ground.	Potential
Numenius phaeopus	Whimbrel	Not listed	Migratory	Not listed	Whimbrels are common across northern Australia and uncommon to rare further south. They breed in central Siberia to Iceland. The species are found mainly on the coast, on tidal and estaurine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores. The species feed on intertidal mudflats by day and night, on worms, crustaceans and occasionally fish and nestling birds. They run nimbly and take prey by probing with their long curved bills in the mud or pecking briskly at the surface.	Potential
Onychoprion fuscata	Sooty Tern	Vulnerable	Not listed	Not listed	The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Potential
Oxyura australis	Blue-billed Duck	Vulnerable	Not listed	Not listed	The Blue-billed Duck is one of only two Australian species of stiff-tailed ducks - diving ducks with spine-like tail-feathers. The species is endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The species prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Nest solitarily in Cumbungi over deep water between September and February (OEH Bionet, 2012). Although this species has been previously recorded within 5 km of the Project site (refer to **Figure 1A**), no potential suitable foraging habitat exist for the species within the Project site.	Unlikely
Pandion cristatus	Eastern Osprey	Vulnerable	Not listed	Not listed	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. Feeds on fish over clear, open water. Breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea (OEH Bionet, 2012).	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Petroica boodang	Scarlet Robin	Vulnerable	Not listed	Not listed	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. The species lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Habitat usually contains abundant logs and fallen timber: these are important components of its habitat (OEH Bionet, 2012).	Potential
Pezoporus wallicus wallicus	Eastern Ground Parrot	Vulnerable	Not listed	Not listed	The eastern subspecies (wallicus) inhabits south-eastern Australia from southern Queensland through NSW to western Victoria. It formerly occurred in South Australia, but was last recorded in 1945. In NSW populations have declined and contracted to islands of coastal or subcoastal heathland and sedgeland habitats. The species is found in small numbers on the north coast (Broadwater, Bundjalung, Yuraygir NPs) and Myall Lakes on the central coast. The species occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting opportunities for the Ground Parrot, which spends most of its time on or near the ground. When flushed, birds fly strongly and rapidly for up to several hundred metres, at a metre or less above the ground. Ground Parrots feed mostly on seeds from a large range of plant species, which varies seasonally (OEH Bionet, 2012). Although this species has been previously recorded within 5 km of the Project site (refer to **Figure 1A**), no potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Pluvialis fulva	Pacific Golden Plover	Not listed	Migratory	Not listed	The Pacific Golden Plover breeds on the Arctic tundra in western Alaska. It winters in South America and islands of the Pacific Ocean to India, Indonesia and Australia. In Australia it is widespread along the coastline. The species is found on muddy, rocky and sandy wetlands, shores, paddocks, saltmarsh, coastal golf courses, estuaries and lagoons. Feeds on molluscs, insects, worms, crustaceans, lizards and is known to eat birds' eggs and small fish.	Potential
Pluvialis squatarola	Grey Plover	Not listed	Migratory	Not listed	The Grey Plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia. The species is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts. The species feed on molluscs, insects, crustaceans, polychaete worms, and occasionally vegetation and seeds.	Potential
Polytelis swainsonii	Superb Parrot	Vulnerable	Vulnerable	Not listed	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. The speices inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nests in small colonies, often with more than one nest in a single tree (OEH Bionet, 2012). Although this species has been previously recorded within 5 km of the Project site (refer to **Figure 1A**), no potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Procelsterna cerulea	Grey Ternlet	Vulnerable	Not listed	Not listed	The Grey Terntlet is a marine species that is widely distributed in the southern Pacific Ocean, breeding on oceanic islands including Lord Howe Island. Breeds on Lord Howe Island on seacliffs of northern hills and southern mountains, and also on offshore islands including Admiralty Islets, Muttonbird Island and Ball's Pyramid. This species makes a rough nest of seaweed and grass in pockets and hollows along cliff faces.	Potential
Pterodroma leucoptera leucoptera	Gould's Petrel	Vulnerable	Endangered (Migratory)	Not listed	Species has a body length of 30 cm and a wingspan of 75 cm. Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding Petrels are unknown.	Potential
Pterodroma nigripennis	Black-winged Petrel	Vulnerable	Not listed	Not listed	The Black-winged Petrel is a marine species that ranges throughout the Tasman Sea and Central Pacific Ocean, breeding at various island groups including Lord Howe Island. In recent years they have expanded their range. Nests in numerous sites in Lord Hose Island, nesting in a burrow, up to a metre long in sandy soil but shorter in stony volcanic soil. The burrow is located on higher ground, and the entrance is usually hidden amongst bushes.	Potential
Pterodroma neglecta neglecta	Kermadec Petrel	Vulnerable	Vulnerable	Not listed	Marine species, ranging over subtropical and tropical waters of the South Pacific. Balls Pyramid, near Lord Howe Island, is the only known breeding site in Australian waters. Feeds on squid and crustaceans, and nests in crevices amongst rocks. Vagrant birds occur in coastal NSW waters, particularly after storm events.	Potential
Pterodroma solandri	Providence Petrel	Vulnerable	Not listed	Not listed	Marine species, ranging across the eastern Pacific. Only known breeding sites are at Lord Howe Island and Philip Island, offshore from Norfolk Island. Nest on the tops of Mount Gower and Mount Lidgbird and to a less extent, on the lower slopes of the mountains. The nest is a grass lined chamber at the end of a burrow, 1 - 2 metres in length.	Potential
Puffinus assimilis	Little Shearwater	Vulnerable	Not listed	Not listed	The Little Shearwater is a widespread marine species in the subtropical Atlantic, Pacific and Indian Oceans. Lord Howe Island has one of the larger breeding colonies in the Australian region. Breeding sites at Lord Howe Island include Roach Island, Muttonbird Island, Blackburn Island and on the main Island at Muttonbird Point and Transit Hill.	Potential
Calonectris leucomelas	Streaked Shearwater	Not listed	Migratory	Not listed	The Streaked Shearwater is a marine species that can be found over both pelagic and inshore waters. It feeds mainly on fish and squid which it catches by surface-seizing and shallow plunges. It often associates with other seabirds and will follow fishing boats. Breeding begins in March in colonies on offshore islands, occupying burrows on forested hills. It undergoes transequatorial migration.	Potential
Rostratula australis (benghalensis s	Australian Painted Snipe	Endangered	Vulnerable (Migratory)	Not listed	The Australian Painted Snipe has been recorded at wetlands in all states of Australia. It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. The species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds and sometimes utilised areas that are lined with trees, or than have some scattered fallen or washed up timber. Breeding habitat is quite specific - shallow wetlands with areas of bare mud and both upper and canopy cover nearby. No records from within 5km of the Project site (NSW OEH 2011, Wildlife Atlas 2011).	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Rhipidura rufifrons	Rufous Fantail	Not listed	Migratory	Not listed	The Rufous Fantail is found in northern and eastern coastal Australia, being more common in the north. Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas. Strongly migratory in the south of its range, it moves northwards in winter, and virtually disappears from Victoria and New South Wales. Feeds on insects, which it gleans from the middle and lower levels of the canopy. A very active feeder, constantly fans tail and flicks wings and body while foraging. Builds a small compact cup nest, of fine grasses bound with spider webs, that is suspended from a tree fork about 5 m from the ground. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for this species within the Project site - given the marine nature of the proposal.	Unlikely
Stagonopleura guttata	Diamond Firetail	Vulnerable	Not listed	Not listed	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Cental and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. Usually encountered in flocks of between five and 40 birds, occasionally more. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. Although this species has been previously recorded within 5 km of the Project site, (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Sterna albifrons	Little Tern	Endangered	Migratory	Not listed	Migrating from eastern Asia, the species is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. This species has been historically recorded in and around the Project site (refer to **Figure 1A**), and potential suitable foraging habitat may exist for this species within the Project site.	Potential
Sternula nereis nereis	Fairy Tern	Not listed	Vulnerable	Not listed	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. The species nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Thalassarche bulleri	Buller's Albatross	Not listed	Vulnerable (Migratory)	Not listed	Species breeds in New Zealand, on Snares and Solander Islands, but are regular visitors to Australian waters. The species are marine and pelagic, inhabiting subtropical and subantarctic waters of the southern Pacific Ocean. Breeding habitat of Buller's Albatross occurs on subtropical and subantarctic islands and rock stacks in the New Zealand region. Probably takes food by surface-siezing - feeding mostly on squid, supplemented by fish, krill and tunicates.	Potential
Thalassarche cauta cauta	Shy Albatross	Vulnerable	Vulnerable (Migratory)	Not listed	The species has a predominantly white body with dark grey wings and back. This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. Occasionally the species occurs in continental shelf waters, in bays and harbours.	Potential
Thalassarche cauta salvini	Salvin's Albatross	Not listed	Vulnerable (Migratory)	Not listed	A large seabrid that ranges across the Southern Ocean. Breeds mainly on small rocky islands with little vegetation. A colonial, annual-breeding species that breeds on the Bounty Islands, Western islets, Pyramid Islands and Forty Fours. Nests are made of a pedestal of mud, feathers and bird bones. Although potential suitable foraging habitat exists for the species within the Project site, based on the lack of previous records of the species in the area (OEH Bionet, 2012), it is considered unlikely that the species would be affected by the proposal.	Unlikely
Thalassarche cauta steadi	White-capped Albatross	Not listed	Vulnerable (Migratory)	Not listed	The species is probably common off the coast of south-east Australia throughout the year. This species is similar to the Shy Albatross and can be difficult to identify, especially at sea and as a juvenile. Breeding colonies occur on a number of separate islands, the largest occuring on Disappointment Island. The White-capped Albatross is a marine species and occurs in subantarctic and subtropical waters. It reaches tropical areas associated with the cool Humboldt Current off South America. Diet consists of inshore cephalopods (squid) and fish. Although potential suitable foraging habitat exists for the species within the Project site, based on the lack of previous records of the species in the area (OEH Bionet, 2012), it is considered unlikely that the species would be affected by the proposal.	Potential
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Vulnerable (Migratory)	Not listed	This species is a large seadbird with a wingspan of up to 2.4m. It has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. This species migrates to waters off the continenta	Potential
Thalassarche melanophris impavida	Campbell Albatross	Not listed	Vulnerable (Migratory)	Not listed	The species range is confined to southern Australian waters, the Tasman Sea and the south Pacific Ocean. Feeds mainly on fish, also on squid, crustaceans, gelatinous organisms and carrion. Breeding adults forage from South Island, New Zealand and Chatham Rise southwards to the Ross Sea. Breeding is restricted to the northern and western coastline of Campbell Island and the tiny offshore islet Jeanette Marie in New Zealand. Nests on ledges and steep slopes covered in low native grasses, tussocks and mud. Although potential suitable foraging habitat exists for the species within the Project site, based on the lack of previous records of the species in the area (OEH Bionet, 2012), it is considered unlikely that the species would be affected by the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Tyto longimembris	Eastern Grass Owl	Vulnerable	Not listed	Not listed	Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues. The species are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. Always breeds on the ground. Nests are found in trodden grass, and often accessed by tunnels through vegetation. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable foraging habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Xenus cinereus	Terek Sandpiper	Vulnerable	Migratory	Not listed	A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Generally roosts communally amongst mangroves of dead trees, often with related wader species. The diet includes worms, crabs and other crustaceans, small shellfish and the adults and larvae of various flies, beetles and water-bugs.	Potential
Fish						
Epinephelus daemelii	Black cod	Not listed	Vulnerable	Vulnerable	The Black cod, are a large, reef-dwelling, carnivorous grouper species. They are found in warm temperate and subtropical parts of the south-western Pacific. Adults are found in caves, gutters and beneath bommies on rocky reefs. They are teritorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries (NSW DPI, 2007). Although there is no potential suitable habitat for this species within the Project site, there may be in the immediate surrounding area - which has the potential to be impacted by the proposed works.	Potential
Prototroctes maraena	Australian Grayling	Not listed	Vulnerable	Protected	Historically, the Australian Grayling occurred in coastal streams from the Grose R., W of Sydney, southwards through NSW, Vic. and Tas. This species spends only part of its lifecycle in freshwater, where specimens have been captured. The Tambo R. population inhabits a clear, gravel-bottomed stream with alternating pools and riffles, and granite outcrops. Graylings migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species (DSEWPaC, 2012). Due to the lack of previous records, and species' diadromous behaviour, it is considered unlikely that the species will be affected by the proposal.	Unlikely
Invertebrates						

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Archaeophya adamsi	Adam's emerald dragonfly	Not listed	Not listed	Endangered	Adam's Emerald Dragonfly is only known from a few sites in the greater Sydney region. The species is a moderately large, robust dragonfly. Larvae grow to about 23 mm in length and have a large two-lobed frontal plate on the head (see diagram), which distinguishes them from any other species found in NSW. The adults have a brown-black body with yellow markings, and a slight green or bluish metallic reflection on some parts. The abdomen length is around 46 mm and wingspan around 75mm. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Austrocordulia leonardi	Sydney hawk dragonfly	Not listed	Not listed	Endangered	The Sydney Hawk dragonfly has a distribution that includes three locations in a small area south of Sydney, from Audley to Picton. The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages. The Sydney Hawk dragonfly is a black and yellow dragonfly with clear wings spanning 60-70mm, and with an adult abdomen length of 35-40mm. The aquatic larvae have a body length of 22-24mm and are distinguished from the similar Eastern Hawk dragonfly, Austrocordulia refracta, by a uniformly arched abdomen and distinctive abdominal colour pattern. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Mammals						
Arctocephalus forsteri	New Zealand Fur-seal	Vulnerable	Not listed	Not listed	The New Zealand Fur-seal occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Feeds principally on cephalopods, fish also seabirds and occasionally penguins. Prefers rocky parts of islands with jumbled terrain and boulders. This species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), and potential foraging habitat may exist for this species in the vicinity of the proposed works.	Potential
Arctocephalus pusillus doriferus	Australian Fur-seal	Vulnerable	Not listed	Not listed	The Australian Fur-seal is reported to have bred at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than do New Zealand Fur-Seals where they occur together. This species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), and potential foraging habitat may exist for this species in the vicinity of the proposed works.	Potential
Balaenoptera edeni	Bryde's Whale	Not listed	Migratory	Not listed	The Bryde's Whale is a medium-sized whale averaging between 12-15 m in length. The species prefer tropical and temperate waters over the polar seas that other whales in their family frequent. They are largely coastal rather than pelagic. Feeds on plankton, crustaceans and schooling fish. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site.	Unlikely
Balaenoptera musculus	Blue Whale	Endangered	Endangered (Migratory)	Not listed	The Blue Whale is the largest marine mammal up to 33 m long. Breeds in warm water at low latitudes, preferring open seas rather than coastal waters. Often feeds during spring and summer on krill close to the ice edge. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does the species' known distribution overlap with the study area (Menkhorst, 2004).	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Caperea mnarginata	Pygmy Right Whale	Not listed	Migratory	Not listed	The Pygmy Right Whale is a small baleen whale, generally around 6 m in length. The species is found in the Southern Ocean in the lower reaches of the Southern Hemisphere, and feeds on copepods and euphausiids. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site.	Unlikely
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable	Not listed	The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Dasyurus maculatus maculatus	Spotted-tail Quoll	Vulnerable	Not listed	Endangered	The Spotted-tail Quoll's range has contracted considerably since European settlement. It is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Dugong dugon	Dugong	Endangered	Migratory	Not listed	Extends south from warmer coastal and island waters of the Indo-West Pacific to northern NSW, where its known from incidental records only. Major concentrations of Dugongs occur in wide shallow protected bays, wide shallow mangrove channels and in the lee of large inshore islands. Will also occupy deeper waters if their sea grass food is available. Shallow waters such as tidal sandbanks and estuaries have been reported as sites for calving. The species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), and although the species is uncommon in Sydney waters, the proposal has the potential to impact potential suitable habitat for this species in and around the Prioject site - especially foraging habitat in terms of the surrounding protected seagrass communities.	Potential
Eubalaena australis	Southern Right Whale	Vulnerable	(Migratory)	Not listed	A large marine mammal up to 18 m long. Migrates between summer feeding grounds in Antarctica and winter breeding grounds around the coasts of southern Australia, New Zealand, South Africa and South America. They feed in the open ocean in summer. It appears Southern Right Whales may not feed at all in Australian waters. The species has been previously recorded within 5 km of the Project site (refer to **Figure A1**).	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Isoodon obesulus obesulus	Southern Brown Bandicoot	Endangered	Endangered	Not listed	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. The species are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils.They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees Xanthorrhoea spp., blackberry bushes and other shrubs, or in rabbit burrows (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Lagenorhynchus obscurus	Dusky Dolphin	Not listed	(Migratory)	Not listed	Dusky Dolphins occur throughout the Southern hemisphere, mostly in temperate and sub-Antarctic zones. They occur across southern Australia from Western Australia to Tasmania, occuring mostly in temperate and sub-Antarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times. All sightings of Dusky Dolphins in Australian waters have been correlated with abnormally warm sea surface temperatures. They are generally considered to be surface feeders, often found feeding in aggregations with sea birds. Eat a wide diversity of prey, including schooling fish, especially Southern Anchovy, and midwater and benthic prey such as squid and laternfishes.	Potential
Megaptera novaeangliae	Humpback Whale	Vulnerable	Vulnerable (Migratory)	Not listed	Large marine mammal that can grow to 16 m in length. Oceanic and coastal waters worldwide. The population of Australia's east coast migrates from summer cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef. They are regularly observed in NSW waters in June and July, on northward migration and October and November, on southward migration. The species has been recorded within 5km of the Project site (refer to **Figure A1**).	Potential
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Vulnerable	Not listed	Not listed	The species occurs along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Unlikely
Myotis macropus	Southern Myotis	Vulnerable	Not listed	Not listed	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December. Although this species has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat is considered to exist for the species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Orcinus orca	Killer Whale, Orca	Not listed	Migratory	Not listed	Killer whales are found in all oceans, from the frigid Arctic and Antarctic regions to tropical seas. Killer whales as a species have a diverse diet, although individual populations often specialize in particular types of prey. Some feed exclusively on fish, while others hunt marine mammals such as sea lions, seals, walruses and even large whales. Killer whales are regarded as apex predators, lacking natural predators and preying on even large sharks. The species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor is any potential suitable habitat considered to exist for the species within the Project site.	Unlikely
Petrogale penicillata	Brush-tailed Rock-wallaby	Endangered	Not listed	Vulnerable	The Brush-tailed Rock-wallaby's range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Potorous tridactylus tridactylus	Long-nosed Potoroo	Vulnerable	Not listed	Vulnerable	The Long-nosed Potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature (OEH Bionet, 2012). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely
Pseudomys novaehollandiae	New Holland Mouse	Not listed	Not listed	Vulnerable	The species has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha. The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), nor does any potential suitable habitat exist for the species within the Project site - given the marine nature of the proposal.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable	Not listed	Found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Although this species has been previously recorded within 5 km of the Project site (refer to **Figure 1A**), no potential suitable habitat exists for the species within the Project site - given the marine nature of the proposal.	Unlikely
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	Not listed	Not listed	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. (OEH Bionet, 2012). Although this species has been previously recorded within 5 km of the Project site (refer to **Figure 1A**), no potential suitable habitat exists for the species within the Project site - given the marine nature of the proposal.	Unlikely
Reptiles						
Caretta caretta	Loggerhead Turtle	Endangered	Endangered (Migratory)	Not listed	In Australia, the species occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia. While nesting is concentrated in southern Queensland and from Shark Bay to the North West Cape in Western Australia, foraging areas are more widely distributed. Australia has two genetically distinct populations (eastern Australia and Western Australia). It is currently believed that the eastern Australian population includes turtles that breed in New Caledonia.	Potential
Chelonia mydas	Green Turtle	Vulnerable	Vulnerable (Migratory)	Not listed	The species nest, forage and migrate across tropical northern Australia. They usually occur between the 20°C isotherms, although individuals can stray into temperate waters. In Australia, no key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are found in NSW.	Potential
Dermachelys coriacea	Leatherback Turtle	Vulnerable	Endangered (Migratory)	Not listed	Throughout the world's tropical and temperate seas and in all coastal waters of Australia. Most sightings are in temperate waters. Large numbers of Leathery Turtles feed in coastal waters from southern Queensland to the central coast of NSW. Occurs in inshore and offshore marine waters. Feeds on jellyfish. Species takes 13-14 years to reach maturity, and is known to make long migrations from feeding areas to breeding sites. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional historic breeding records from NSW coast, including between Ballina and Lennox Head in northern NSW. Nesting takes place in eastern Australia, occuring from December to February.	Potential

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Eretmochelys imbricata	Hawksbill Turtle	Not listed	Vulnerable (Migratory)	Not listed	The species typically occur in tidal and sub-tidal coral and rocky reef habitats throughout tropical waters, extending into warm temperate areas as far south as northern New South Wales. In Australia the main feeding area extends along the east coast, including the Great Barrier Reef. Two major breeding areas occur in Australia: Northern Great Barrier Reef, Torres Strait and northeastern Arnhem Land have several significant rookeries. Peak nesting period is between January and April. Sponges make up a major part of the diet of hawksbills, although they also feed on seagrasses, algae, soft corals and shellfish. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), and no potential suitable habitat is considered to exist for the species within the Project site, besides the species' potential use of the Project site as a migratory pathway.	Unlikely
Natator depressus	Flatback Turtle	Not listed	Vulnerable (Migratory)	Not listed	All recorded nesting beaches for Flatback Turtles occur in Australia. The species has the smallest migratory range of any marine turtle species, though they do make long reproductive The species feeds mostly on soft-bodied prey such as sea cucumbers, soft corals, jellyfish, molluscs and prawns. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), and no potential suitable habitat is considered to exist for the species within the Project site, besides the species' potential use of the Project site as a migratory pathway.	Unlikely
Sharks						
Carcharias taurus	Grey Nurse Shark	Not listed	Critically Endangered	Critically Endangered	Grey nurse sharks are native to subtropical to cool temperate waters in the Mediterranean Sea and the Atlantic, Indian and western Pacific Oceans. In Australia there is an east coast and a west coast population. The east coast population is found predominantly in inshore coastal waters along the coast of NSW and southern Queensland. The species diet consists of a range of fish, other sharks, squid, crab and lobsters. Historical records indicate the species was fished by hook and line at "regular nurse grounds" off Dolls Point in Botany Bay (NSW Fisheries, 2002) - indicating that potential suitable habitat exists for the species within the Project site.	Potential
Carcharodon carcharias	Great White Shark	Not listed	Vulnerable (Migratory)	Vulnerable	Found throughout the world in temperate and subtropical oceans, with a preference for cooler waters. This distribution includes the coastal waters of NSW.	Potential
Lamna nasus	Porbeagle, Mackeral Shark	Not listed	Migratory	Not listed	The Porbeagle Shark is a wide-ranging, coastal and oceanic shark, but with apparently little exchange between adjacent populations. In Australia, it occurs from southern Queensland to south-west Australia, typically in oceanic waters on the continental shelf, although it is occasionally found in coastal waters. The species is known to use the water column to depths of at least 1360 metres Low reproductive capacity and high commercial value (in target and incidental fisheries) of mature and immature age classes makes this species highly vulnerable to over-exploitation and population depletion. The species feed mostly on teleost fish, both pelagic and demersal species, and on cephalopods (DSEWPaC 2011). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), and no potential suitable habitat is considered to exist for the species within the Project site, given the species' known habitat requirements.	Unlikely

Fauna

Scientific name	Common name	TSC Act	EPBC Act	FM Act	Habitat requirements	Likelihood of occurrence
Pristis zijsron	Green Sawfish	Not listed	Vulnerable	Presumed extinct	Once widely distributed in the northern Indian Ocean, around South and South-East Asia and around northern Australia. The natural distribution of green sawfish originally extended from the Queensland border to the NSW south coast (Shoalhaven River). Previously in NSW, the species was regularly found in the shallow waters at the mouth of the Tweed, Clarence and Richmond Rivers, however the last recorded museum specimen from NSW was captured in 1972. The last specimen from the Sydney region was captured in 1926. With the Green Sawfish no longer found in NSW waters, or southern Queensland waters, the species appears to have experienced a contraction of range of around 30% in Australian waters (DSEWPaC, 2012). This species has not been previously recorded within 5 km of the Project site (NSW OEH, 2012), and is presumed to be extinct in NSW (NSW DPI, 2012).	Unlikely
Rhincodon typus	Whale Shark	Not listed	Vulnerable (Migratory)	Not listed	The Whale Shark is a large filter-feeding shark characterised by a streamlined body with a flattened, broad head. In Australia, the Whale Shark is known from NSW, Queensland, Northern Territory, Western Australia and occasionally Victoria and South Australia, but it is most commonly seen in waters off northern Western Australia, Northern Territory and Queensland. The Whale Shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore, but also comes close inshore and sometimes enters lagoons of coral atolls. This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), and no potential suitable habitat is considered to exist for the species within the Project site.	Unlikely

Populations

Scientific name	Common name	TSC Act	FM Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Epthianura albifrons	White-fronted Chat in the Sydney Metropolitan Catchment Management Authority	Vulnerable	Not listed	Not listed	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. Although this population is known from Towra Point Nature Reserve, and has been previously recorded within 5 km of the Project site (refer to **Figure A1**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	Unlikely
Posidonia australis	*Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).	Not listed	Endangered	Not listed	*Posidonia australis* is widely distributed, sub-tidally, in temperate and cool-temperate marine waters of southeast, southern and southwest Australia. In NSW, the largest meadows of P*osidonia australis* are found on soft sedimentary environments, within the protected waters of marine embayments and marine dominated coastal lakes. In these environments it is often the dominant plant community. Within the state, the species occurs from Wallis Lake in the north to Twofold Bay in the south. In addition, there are a few isolated populations found at sheltered sites along the open coastline and offshore islands of NSW. The slow development of individual plants, the likely low level of dispersal of fruit and seeds and the slow expansion rate of meadows mean that existing areas of Posidonia australis within the estuaries and embayments of NSW can effectively be considered as isolated populations in respect to their long-term survival. The Fisheries Scientific Committee has found that the specified population has undergone a very large reduction in abundance and a very large reduction in geographic distribution within a time frame appropriate to the life cycle and habitat characteristics of the taxon; this meets the criteria of an Endangered Population. This population is known from the shallow waters adjacent to Kurnell Peninsular - in close proximity to the Project site (refer to **Figure X**), and potential suitable habitat exists for this population in and around the Project site.	Likely

Threatened Ecological Communities

Name	TSC Act	FM Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Eastern Suburbs Banksia Scrub of the Sydney Region	Endangered	Not listed	Endangered	The Eastern Suburbs Banksia Scrub represents the plant communities occurring in Sydney's eastern and south-eastern suburbs that has the structural form of sclerophyllous heath or scrub occasionally with small areas of woodland, forest or wetland vegetation. Predominantly a sclerophyllous heath or scrub community although, depending on site topography and hydrology, some remnants contain small patches of woodland, low forest or limited wetter areas. Common species include *Banksia aemula, B. ericifolia, B. serrata, Eriostemon australasius, Lepidosperma laterale, Leptospermum laevigatum, Monotoca elliptica* and *Xanthorrhoea resinifera* . The plant community grows on nutrient poor sand deposits in the eastern and south eastern suburbs of Sydney. It has a structural form predominately of sclerophyllous heath or scrub occasionally with small areas of woodland or low forest. The community is now restricted to less than 1% of its original area and currently exists only as a number of remnants (DSEWPaC 2012). Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	Unlikely
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Endangered	Not listed	Critically Endangered	The ecological community represents a complex of rainforest and coastal vine thickets, including some that are deciduous, on the east coast of Australia. Typically, the ecological community occurs within two kilometres of the coast or adjacent to a large salt water body, such as an estuary and, thus, is influenced by the sea. It is naturally distributed as a series of disjunct and localised stands occurring on a range of landforms derived from coastal processes that can include dunes and flats, cheniers, berms, cobbles, headlands, scree, seacliffs, marginal bluffs, spits, deltaic deposits, coral rubble and islands. As a result, the ecological community is not associated with a particular soil type and can occur on a variety of geological substrata. The community is very rare and occurs in many small stands. Although this community has been previously recorded on Kurnell headland within Botany Bay National Park and Towra Point Nature Reserve (refer to **Figure X**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	
O'Hares Creek Shale Forest (OHSFC)	Endangered	Not listed	Not listed	The O'Hares Creek Shale Forest Community (OHSFC) is the plant community that occurs on deep, well drained red loam on small outcrops of Hawkesbury shale in the Darkes Forest area on the Woronora Plateau within Campbelltown, Wollondilly and Wollongong Council areas. The community occurs on flat ridgetops and adjacent slopes. Locations on the Darkes Forest Ridge typically have a more mesic understorey than those on smaller shale outcrops further west. At any one time, seeds of some species may only be present in the soil seedbank with no above ground individuals present. Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	

Threatened Ecological Communities

Name	TSC Act	FM Act	EPBC Act	Habitat requirements	Likelihood of occurrence
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	Not listed	Not listed	This EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Eucalyptus tereticornis (forest red gum), E. amplifolia (cabbage gum), Angophora floribunda (rough-barked apple) and A. subvelutina (broad-leaved apple). Eucalyptus baueriana (blue box), E. botryoides (bangalay) and E. elata (river peppermint) may be common south from Sydney, E. ovata (swamp gum) occurs on the far south coast, E. saligna (Sydney blue gum) and E. grandis (flooded gum) may occur north of Sydney, while E. benthamii is restricted to the Hawkesbury floodplain. Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Although this community has been previously recorded in and around X (refer to **Figure X**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal. Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	
Shale Sandstone Transition Forest	Endangered	Not listed	Endangered	Shale Sandstone Transition Forest occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with earthy and sandy soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include Forest Red Gum (Eucalyptus tereticornis), Grey Gum (E. punctata), stringybarks (E. globoidea, E. eugenioides) and ironbarks (E. fibrosa and E. crebra). Areas of low sandstone influence (more clay-loam soil texture) have an understorey that is closer to Cumberland Plain Woodland. Shale Sandstone Transition Forest in the Sydney Basin Bioregion contains many more species than described for the canopy (above) and other references should be consulted to identify these. Well adapted to fire, being often close to sandstone areas. Some species in areas with greater shale influence regenerate from profuse annual seeding and underground tubers. High-sandstone-influence sites have poor rocky soils, and many shrubs which rely on nitrogen-fixing root nodules and soil/root fungi to obtain nutrients. Although this community has been previously recorded in and around X (refer to **Figure X**), no potential suitable habitat exists for this species within the Project site - given the marine nature of the proposal.	

Threatened Ecological Communities

Name	TSC Act	FM Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	Endangered	Not listed	Not listed	Southern Sydney sheltered forest on transitional sandstone soils is an open forest dominated by eucalypts with scattered subcanopy trees, a diverse shrub layer and a well-developed groundcover of ferns, forbs, grasses and graminoids. The dominant trees include *Angophora costata* , *Eucalyptus piperita* and occasionally *Eucalyptus pilularis* , particularly around Helensburgh. *Corymbia gummifera* occurs frequently within the community, although generally at lower abundance than the other eucalypts. The community is found within an estimated total extent of less than 45 000 ha, bounded approximately by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. Within this range, the community is currently estimated to occupy an area of approximately 400 - 4 000 ha. The terrain is primarily gentle, with slopes not often exceeding 10°, and where sandstone outcrops occur infrequently. The community is typically associated with sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates (OEH Bionet, 2012). Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	Not listed	Not listed	Swamp Oak Floodplain Forest is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which Casuarina glauca (swamp oak) is the dominant species northwards from Bermagui. Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees (OEH Bionet, 2012). Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	Unlikely
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	Endangered	Not listed	Not listed	Western Sydney Dry Rainforest is a dry vine scrub community of the Cumberland Plain, western Sydney. Very restricted and occurs most commonly in the far southern section of the Cumberland Plain, in the Razorback Range near Picton. Outlying occurrences have been recorded at Grose Vale and Cattai. There are 338 hectares remaining intact, the majority of these occurring in the Wollondilly local government area. Restricted to hilly country where it occurs on the sheltered lower slopes and in gullies. Generally found at higher elevations, in areas receiving higher rainfall than much of the Cumberland Plain Woodland. Occurs on clay soils derived from Wianamatta shale. Rainforest plants within this vegetation are fire sensitive and dependent on the sheltered aspect and density of vegetation for protection. Vine thickets in Western Sydney Dry Rainforest provide good habitat for birds and mammals. Several species of plants (including *Spartothamnella juncea* and rare and threatened such as *Marsdenia viridiflora*) have their southern distribution limit within areas of Western Sydney Dry Rainforest (OEH Bionet, 2012). Although this TEC may be present within 5 km of the Project site, given the marine nature of the proposal, no suitable habitat occurs within the Project site.	Unlikely

Wetlands

Common name	TSC Act	FM Act	EPBC Act	Habitat requirements	Likelihood of occurrence
Towra Point Nature Reserve (Wetlands of International Significance)	Not listed	Not listed	Ramsar	Towra Point Nature Reserve is only 16 kilometres south of the centre of Sydney, at the mouth of the Georges River in Botany Bay. The reserve includes important remnant terrestrial vegetation and wildlife habitats, and is surrounded by seagrass beds, mangroves and migratory wading bird habitats. Towra Point Nature Reserve and the adjacent Towra Point Aquatic Reserve form the largest and most diverse estuarine wetland complex remaining in the Sydney region. Towra Point Nature Reserve Ramsar site was listed under the Ramsar Convention in 1984 because it meets the following Ramsar nomination criteria: Criterion 2 - Threatened species or ecological communities; Criterion 3 - Populations of plants and/ or animals important for maintaining biodiversity of a particular bioregion; Criterion 4 - Supports species at a critical stage of their life cycle or provides refuge in adverse conditions; and Criterion 8 - Food source, nursery or migration path for fish. The principal threats to the Ramsar site's values are introduced plants and animals, altered hydrology, urban and industrial development, and pollution (NSW OEH, 2012). Towra Nature Reserve occurs in close proximity to the Project site, and therefore has the potential to be indirectly impacted by the proposed works.	Likely

Marine Species

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood	Impacts
Aquatic - marine							
Australian Grayling	*Prototroctes maraena*	Protected	Not listed	Vulnerable	Australian grayling occur in freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas. Once hatched, the larvae swim towards the water surface where they are swept downstream to the sea. The larvae and young juveniles have a marine stage before returning to freshwater rivers during spring when they are about 6 months old. The rest of their life cycle is spent in freshwater. The closest historical records of the species are from over 100km south of the Botany Bay region (NSW DPI Records viewer, 2012).	Unlikely	Unlikely
Seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths (see PMST - 22 spp.)	*Syngnathiformes spp.*	Protected	Not listed	Marine	There are currently up to 31 syngnathids (seahorse, pipefish, pipehorse and seadragon), four solenostomids (ghostpipefish) and two species of pegasids (seamoths) that are known to exist in NSW waters. As of July 2004 all species of the families 'Syngnathidae', 'Solenostomidae' and 'Pegasidae' were listed as "protected" under the NSW Fisheries Management Act 1994. It is now an offence to have in your possession, collect or harvest any species of seahorse, seadragon, pipefish, pipehorse, ghostpipefish or seamoths in NSW without a permit. The Environmental Protection and Biodiversity Conservation Act 1999 protects all syngnathids found in Commonwealth waters, making it is an offence to kill, injure, take, trade, move or export any members of the family without a Commonwealth approval permit (NSW DPI, 2012).	Highly likely	Highly likely
Ballina angelfish	*Chaetodontoplus ballinae*	Protected	Not listed	Not listed	Ballina angelfish occur in northern NSW around Coffs Harvour, Ballina and North Solitary Islands, and around Lord Howe Island. The species generally inhabits coral and rocky reefs at depths of 12 - 125m. The species' distribution indicates it is unlikely to occupy habitat in Botany Bay (NSW DPI 2006).	Unlikely	Unlikely

Marine Species

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood	Impacts
Bluefish	*Girella cyanea*	Protected	Not listed	Not listed	Bluefish are a reef-fish found in the south-west Pacific Ocean and occur along the east coast of Australia from Flinders Reef off Cape Moreton in Queensland to Eden in southern New South Wales. Bluefish are also found at Elizabeth and Middleton Reefs, Lord Howe and Norfolk Islands, the Kermadec Islands and the North Island of New Zealand. The species are ocean dwellers and do not generally enter rivers or estuaries. They can be found in coastal and offshore rocky reef areas in NSW from depths of 5–30 m, however they are not common in NSW waters (NSW DPI 2006).	Unlikely	Unlikely
(Bleeker's) Eastern Blue Devil Fish	*Prototroctes maraena*	Protected	Not listed	Not listed	Eastern blue devil fish are a benthic, inshore reef inhabitant. They occur in shallow waters in estuaries as well as in deep waters offshore ranging from 3 to 30 metres. The species are a benthic, inshore reef inhabitant. They occur in shallow waters in estuaries as well as in deep waters offshore ranging from 3 to 30 metres. The species are solitary creatures that usually live alone in caves, crevices or under ledges during the day (NSW DPI 2006). The species habitat requirements indicates it is unlikely to occupy habitat in the proposed dredge footprint.	Unlikely	Unlikely
Elegant Wrasse	*Anampses elegans*	Protected	Not listed	Not listed	The Elegant wrasse can be found in different habitats depending on life-style stage. Juveniles are found among seaweed in coastal bays and harbours (NSW DPI 2006). The species has been historically recorded in Botany Bay (MPA, 2005).	Potential	Potential
Estuary Cod	*Epinephelus coioides*	Protected	Not listed	Not listed	Estuary Cod juveniles are common in shallow waters of estuaries over sand, seagrasses, mud and gravel among mangroves. The species has been historically recorded from Botany Bay (MPA, 2005).	Potential	Potential
Giant Queensland Groper	*Epinephelus lanceolatus*	Protected	Not listed	Not listed	In Australia they occur along all tropical and warm temperate coasts but are rarely found in cooler waters to the south. The species occupies a variety of habitats depending on their stage of growth. Estuaries, coral reef and associated habitats are all important to their survival. They are commonly seen in caves on coral reefs and around wrecks. Along outer reefs they have been found in large lagoons and on reef slopes to depths of at least 50 m. Both adults and juveniles are also found in estuaries (NSW DPI, 2006). The species has been historically recorded from Botany Bay (MPA, 2005).	Potential	Potential

Marine Species

Common name	Scientific name	FM Act	TSC Act	EPBC Act	Habitat requirements	Likelihood	Impacts
Herbsts Nurse Shark	*Odontaspis ferox*	Protected	Not listed	Not listed	Herbsts nurse sharks are a rarely encountered species that looks very similar to the grey nurse shark. Grey nurse sharks are found in shallower inshore waters, while Herbsts nurse sharks are generally found at depths of 150–600 m off the NSW coast. The species habitat requirements indicates it is unlikely to occupy habitat in the proposed dredge footprint.	Unlikely	Unlikely
Weedy Seadragon	*Phyllopteryx taeniolatus*	Protected	Not listed	Marine	Weedy seadragons are endemic in NSW waters from Port Stephens south. They can be found in a variety of habitats including shallow estuaries and deep offshore reefs. They can occur to depths of fifty metres and are generally found in waters deeper than ten metres. Juveniles of the species are often associated with kelp and seagrass habitats (NSW DPI 2007). The species has been historically recorded from Botany Bay (MPA, 2005).	Highly likely	Highly likely
Black Cod	*Epinephelus daemelii*	Vulnerable	Not listed	Not listed	The Black Cod is found in warm temperate and subtropical parts of the south-western Pacific. Adults are usually found in caves, while small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores and estuaries (NSW DPI 2007). The species has been historically recorded from Botany Bay (MPA, 2005).	Potential	Unlikely
Great White Shark	*Carcharadon carcharias*	Vulnerable	Not listed	Vulnerable	Great white sharks are found throughout the world in temperate and subtropical oceans, with a preference for cooler waters. This distribution includes the coastal waters of NSW. The species has been historically recorded from Botany Bay (MPA, 2005).	Potential	Unlikely
Grey Nurse Shark	*Carcharias taurus*	Endangered	Not listed	Critically Endangered	Grey nurse sharks are found predominantly in inshore coastal waters. They have been recorded at various depths, but are mainly found in waters between 15 and 40 m deep, and spend the majority of the time in waters less than 30 m deep (NSW DPI 2007).	Potential	Unlikely
Green Sawfish	*Pristis zijsron*	Presumed Extinct in NSW	Not listed	Vulnerable	Green sawfish live on muddy or sandy-mud soft bottom habitats in inshore areas. They also enter estuaries, where they have been found in very shallow waters (NSW DPI 2007). In Australian waters, Green Sawfish have historically been recorded in the coastal waters off Broome, Western Australia, around northern Australia and down the east coast as far as Jervis Bay, NSW (DSEWPaC, 2012). The species is presumed to be extinct in NSW, and therefore Botany Bay is considered unlikely to provide potential habitat for the species (NSW DPI 2012).	Unlikely	Unlikely

Appendix E – 8
Assessments of Significance

Seabirds Assessment of Significance

Assessment of Significance	Wandering Albatross (*Diomedea exulans sensu lato*)	Southern Giant Petrel (*Macronectes giganteus*)	Northern Giant Petrel (*Macronectes halli*)	Little Tern (*Sternula albifrons*)	Shy Albatross (*Thalassarche cauta*)
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Wandering Albatross (Endangered, TSC ACt; Vulnerable, EPBC Act) has been previously recorded within 5km of the Project site, within Botany Bay (OEH Bionet, 2012) (refer to Figure 11-2). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Southern Giant Petrel (Endangered, TSC Act; Endangered, EPBC Act) has been previously recorded within 5km of the Project site, within Botany Bay (OEH Bionet, 2012) (refer to Figure 11-2), and a juvenile bird was observed during field surveys conducted within the Project site (URS, 2012). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Northern Giant Petrel (Vulnerable, TSC Act; Vulnerable, EPBC Act) has not been previously recorded within 5km of the Project site, within Botany Bay (OEH Bionet, 2012). This species does occur sympatricaly with the Southern Giant Petrel, and potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Little Tern (Endangered, TSC Act; Migratory, EPBC Act) has been previously recorded within 5km of the Project site, within Botany Bay (OEH Bionet, 2012) (refer to Figure 11-2). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Shy Albatross (Vulnerable, TSC Act; Vulnerable, EPBC Act) has not been previously recorded within 5km of the Project site, within Botany Bay (OEH Bionet, 2012). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.
In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act
In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.
Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	N/A	N/A	N/A	N/A	N/A

Seabirds Assessment of Significance

Assessment of Significance	Wandering Albatross (*Diomedea exulans sensu lato*)	Southern Giant Petrel (*Macronectes giganteus*)	Northern Giant Petrel (*Macronectes halli*)	Little Tern (*Sternula albifrons*)	Shy Albatross (*Thalassarche cauta*)
Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A	N/A	N/A	N/A	N/A
In relation to the habitat of a threatened species, population or ecological community:	The Wandering Albatross has been recorded along the length of the NSW coast. The species visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and Spetember. The species spend most of their time in flight, soaring over the Southern Oceans. They feed in pelagic, offshore and inshore waters, often at night, taking fish and cephalopods such as squid, crustaceans and carrion and will often follow ships feeding on the refuse they trail (OEH Bionet, 2012).	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. It is an opportunistic scavenger and predator, and scavenges from fishing vessels and animal carcasses on land (OEH Bionet, 2012).	The Northern Giant Petrel has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn (OEH Bionet, 2012).	The Little Tern migrates from eastern Asia, and In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria.The species is almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records) (OEH Bionet, 2012).	The Shy Albatross occurs along the east coast of Australia from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. Occasionally the species occurs in continental shelf waters, in bays and harbours (OEH Bionet, 2012).
The extent to which habitat is likely to be removed or modified as a result of the action proposed,	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.

Seabirds Assessment of Significance

Assessment of Significance	Wandering Albatross (*Diomedea exulans sensu lato*)	Southern Giant Petrel (*Macronectes giganteus*)	Northern Giant Petrel (*Macronectes halli*)	Little Tern (*Sternula albifrons*)	Shy Albatross (*Thalassarche cauta*)
Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.
The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	Potential foraging habitat for the Wandering Albatross exists within the entire Project site and this species has been previously recorded in the Bay area. However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the Southern Giant Petrel exists within the entire Project site and this species has been previously recorded in close proximity to the Project site (< 100m). However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the Northern Giant Petrel exists within the entire Project site, although this species has not been previously recorded within the Bay area. However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the Little Tern exists within the entire Project site and this species has been historically recorded in close proximity to the Project site (< 100m). However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the Shy Albatross exists within the entire Project site, although this species has not been previously recorded within the Bay area. However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.

Seabirds Assessment of Significance

Assessment of Significance	Wandering Albatross (*Diomedea exulans sensu lato*)	Southern Giant Petrel (*Macronectes giganteus*)	Northern Giant Petrel (*Macronectes halli*)	Little Tern (*Sternula albifrons*)	Shy Albatross (*Thalassarche cauta*)
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,	The key recovery actions identified in the draft recovery plan for the Wandering Albatross (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Avoid discarding any debris at sea, particularly plastic.	The key recovery actions identified in the draft recovery plan for the Southern Giant Petrel (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Avoid discarding any debris at sea, particularly plastic.	The key recovery actions identified in the draft recovery plan for the Southern Giant Petrel (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Avoid discarding any debris at sea, particularly plastic.	The key recovery actions identified in the draft recovery plan for the Little Tern (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained; and • Protect and maintain known or potential habitats, including implementation of protection zones around known habitat sites and sites of recent records.	The key recovery actions identified in the draft recovery plan for the Shy Albatross (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Avoid throwing rubbish overboard from boats; and • Protect ocean and coastline from pollution; and • Preservation of areas where this species is known to breed and forage.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.
Conclusion	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.

Seabirds Assessment of Significance

Assessment of Significance	Wandering Albatross (*Diomedea exulans sensu lato*)	Southern Giant Petrel (*Macronectes giganteus*)	Northern Giant Petrel (*Macronectes halli*)	Little Tern (*Sternula albifrons*)	Shy Albatross (*Thalassarche cauta*)
References	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Wandering Albatross. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Southern Giant Petrel. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Northern Giant Petrel. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Little Tern. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Shy Albatross. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

Populations Assessment of Significance

Assessment of Significance	*Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	Not applicable, this factor refers only to those species listed on Part 1 and Part 4 of Schedule 1, Part 1 of Schedule 1A and Part 1 of Schedule 2 of the TSC Act, and Part 1 and Part 4 of Schedule 4 and Schedule 5 of the FM Act.
In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	Recent mapping of the extent of Posidonia australis(Endangered, FM Act) populations in Botany Bay shows records of the population within close proximity to the southern portion of the Project site (< 250m) (NSW I&I 2009) (refer to Figure 11-2). This species was not observed during seagrass surveys conducted in the dredge footprint - Halophila ovalis was the only seagrass recorded within the Project site, albeit in < 1% coverage (URS, 2012) (refer to Figure 10.3), and potential suitable habitat is not considered to exist for this species within the Project site. However, taking into consideration the proximity of the Project site to areas of known habitat for the population, and given the proposed dredging works to be undertaken within the Project site; it is considered likely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.
In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.
Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	N/A
Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A
In relation to the habitat of a threatened species, population or ecological community:	*Posidonia australis* is widely distributed, sub-tidally, in temperate and cool-temperate marine waters of southeast, southern and southwest Australia. In NSW, the largest meadows of Posidonia australis are found on soft sedimentary environments, within the protected waters of marine embayments and marine dominated coastal lakes. In these environments it is often the dominant plant community. The slow development of individual plants, the likely low level of dispersal of fruit and seeds and the slow expansion rate of meadows mean that existing areas of *Posidonia australis* within the estuaries and embayments of NSW can effectively be considered as isolated populations in respect to their long-term survival (FSC, 2010).

Populations Assessment of Significance

Assessment of Significance	*Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).
The extent to which habitat is likely to be removed or modified as a result of the action proposed,	The proposed works would require some level of indirect disturbance to surrounding areas known to support the endangered population. Due to the nature of the proposed dredging works - there is high potential for turbid waters to disperse tributylin (TBT) loaded materials, and subsequent expected sedimentation of surrounding areas. Given the distribution of the endangered population, there is the potential for the extent of the habitat that is likely to be modified; to be large enough, and the total spread of the population be small enough to create a real threat to the population.
Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). The proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area, and for this reason a suite of dispersion modelling has been undertaken (Cardno, 2012). However, the dispersion modelling undertaken for sediment and TBT shows that neither would exceed the threshold limits in their imapcts on the *Posidonia* seagrass beds. As can be concluded, the predicted sediments concentration would fall below the threshold limits within a relatively short distance of where the dredging would take place, even accounting for consideration of the 95th percentile. Therefore neither turbidity, light preclusion, TBT nor effects on marine vegetation, benthic communities and epifauna would be a significant impact of the proposed works (refer to **Chapter 9, Water Quality**). As such, it is considered unlikely that an area of habitat would become fragmented or isolated form other areas of habitat as a rsult of the proposed action.
The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	Potential habitat for *Posidonia australis* exists within the shallow embayments within Botany Bay, in close proximity to the Project site. Furthermore, losses equating more than 57% of the population from Botany Bay since the 1940s, have been recorded (FSC, 2010) - indicating the importance of what is left of the available habitat for the population.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	No recovery plan or threat abatement plan has been action for this endangered population to this date.

Populations Assessment of Significance

Assessment of Significance	*Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, as outlined in Section 10.6 of the Ecology Chapter - it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.
Conclusion	The results of the assessment of significance indicate that the Project does not have the potential to result in a significant impact to this population. As such, a Species Impact Statement is not required.
References	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • FSC (2010) Final Determination - The seagrass Posidonia australis as Endangered Populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW). Fisheries Scientific Committee. Accessed online 6/7/2012 - http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/352169/FD44-Posidonia-australis.pdf • NSW I&I (2009) Estuarine habitats map - Botany Bay and Cooks River. Accessed online - http://www.dpi.nsw.gov.au/research/areas/aquatic-ecosystems/estuarine-habitats-maps/IINSW_EstMac_map40.pdf • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Dugong (Endangered, TSC Act; Migratory, EPBC Act) has been previously recorded within 5km of the Project site (OEH Bionet, 2012) (refer to Figure 11-2). Given the proximity of the Project site to the adjacent seagrass beds (Figure X), potential foraging habitat exists for this species in and around the Project site. Albeit, this species is not commonly recorded south of Newcastle. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The New Zealand Fur-seal (Vulnerable, TSC Act) has been previously recorded within 5km of the Project site (OEH Bionet, 2012) (refer to Figure 11-2). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.	The Australian Fur-seal (Vulnerable, TSC Act) has been previously recorded within 5km of the Project site (OEH Bionet, 2012) (refer to Figure 11-2). Potential foraging habitat may exist for this species within the Project site. However, suitable foraging habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.
In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.
Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	N/A	N/A	N/A
Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A	N/A	N/A
In relation to the habitat of a threatened species, population or ecological community:	Dugongs are found south of warmer coastal and island waters of the Indo-West Pacific to northern NSW, where they are known from incidental records only. Major concentrations of Dugongs occur in wide shallow protected bays, wide shallow mangrove channels and in the lee of large inshore islands. Will also occupy deeper waters if their sea grass food is available. Shallow waters such as tidal sandbanks and estuaries have been reported as sites for calving (OEH Bionet, 2012).	The New Zealand Fur-seal occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Feeds principally on cephalopods, fish also seabirds and occasionally penguins. Prefers rocky parts of islands with jumbled terrain and boulders (OEH Bionet, 2012).	The Australian Fur-seal is reported to have bred at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than do New Zealand Fur-Seals where they occur together (OEH Bionet, 2012).

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
The extent to which habitat is likely to be removed or modified as a result of the action proposed,	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.
Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	Potential foraging habitat for the Dugong exists within the seagrass beds to the south of the Project site, and this species has been previously recorded in the Bay area. However, this species is only considered to be an occasional visitor to NSW coastal and estuarine waters, with records as far south as Sydney considered to be vragrants (DSEWPaC, 2012). For this reason and the availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the New Zealand Fur-seal exists within the entire Project site and this species has been previously recorded in close proximity to the Project site. However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.	Potential foraging habitat for the New Zealand Fur-seal exists within the entire Project site and this species has been previously recorded in close proximity to the Project site. However, due to the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Grey Nurse Shark critical habitat and aggregation sites in NSW are identified under the FM Act, 1994; and one site exists in close proximity to the Project site, off Magic Point near Maroubra (NSW DPI, 2012) - which is approximately 3km north-east of the proposed works. Further information relating to this notification is made under section 220T of the FM Act (NSW Government Gazette, 2002).
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,	The key recovery actions identified in the draft recovery plan for the Wandering Albatross (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Boats should not approach within 300 m of any Dugong; and • Protection of preferred sea-grass habitats.	The key recovery actions identified in the draft recovery plan for the New Zealand Fur-seal (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Boats should not approach within 300 m of any seal.	The key recovery actions identified in the draft recovery plan for the Australian Fur-seal (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Boats should not approach within 300 m of any seal.

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.
Conclusion	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.

Mammals Assessment of Significance

Assessment of Significance	Dugong (*Dugong dugon)*	New Zealand Fur-seal (*Arctocephalus forsteri*)	Australian Fur-seal (*Arctocephalus pusillus doriferus*)
References	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • DSEWPaC (2012) Species Profiles, Recovery and Threats database - Dugong. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 6/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=28 • OEH Bionet (2012) Threatened species profiles – Dugong. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – New Zealand Fur-seal. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • OEH Bionet (2012) Threatened species profiles – Australian Fur-seal. Office of Environment and Heritage. • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

Fish and Sharks Assessment of Significance

Assessment of Significance	Black cod (*Epinephelus daemelii*)	Grey Nurse Shark (*Carcharias taurus*)
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The Black Cod (Vulnerable, FM Act; Vulnerable, EPBC Act) is found in warm temperate and subtropical parts of the south-western Pacific. In NSW, the species occurs along the entire coast, with a higher population density documented in northern NSW. The species were once widespread along the NSW coast, with historical evidence suggesting that declines in black cod numbers were already noticed adjacent to Sydney as far back as the early 20th century. Potential suitable habitat may exist for this species in and around Botany Bay, by way of near-shore rocky and offshore coral reefs at depths down to 50 m (MPA, 2010). However due to a lack of any previous records in the area (OEH Bionet, 2012), it is considered unlikely that the proposed action would have an adverse effect on the life cycle of the species such that a viable local population is placed at risk of extinction.	The Grey Nurse Shark (Critically Endangered, FM Act; Critically Endangered, EPBC Act) has not been previously recorded within 5km of the Project site (OEH Bionet, 2012). However historical records indicate the species was fished by hook and line at "regular nurse grounds" off Dolls Point in Botany Bay (NSW Fisheries, 2002) - indicating that potential suitable habitat may exist for the species in and around the Project site. However, suitable habitat exists throughout the Bay, and given the proposed dredging works - only short-term disturbance is anticipated within the Project site. For this reason, it is considered unlikely that the proposed works will have an adverse effect on the species such that a viable local population of the species is likely to be placed at risk of extinction.
In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act	Not applicable, this factor refers to endangered populations listed in Part 2 of Schedule 1 of the TSC Act and Part 2 of Schedule 4 of the FM Act
In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.	Not applicable, this factor relates to endangered ecological communities listed under Part 3 of Schedule 1 of the TSC Act and Part 3 of Schedule 4 of the FM Act and the critically endangered communities listed under Part 2 of Schedule 1A of the TSC Act and Part 2 of Schedule 4A of the FM Act.

Fish and Sharks Assessment of Significance

Assessment of Significance	Black cod (*Epinephelus daemelii*)	Grey Nurse Shark (*Carcharias taurus*)
Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	N/A	N/A
Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A	N/A
In relation to the habitat of a threatened species, population or ecological community:	The Black Cod is found in both inshore and offshore sites, and rocky reefs are known to provide important habitat. The species is most commonly associated with habitat supporting caves and overhangs. Commercial and recreational fishers have reported catching black cod indepths of 100+ metres. Smaller individuals are also often encountered in estuary systems, and recently settled juveniles can be commonly found in coastal rock pools along the NSW coastline. Each adult individual will generally have its own 'hole', to which it retreats to for safety. The black cod is considered to be a territorial species as the same individuals have been encountered in the same locations or caves over long periods of time. (MPA, 2010; MPA, 2011).	Grey nurse sharks are native to subtropical to cool temperate waters in the Mediterranean Sea and the Atlantic, Indian and western Pacific Oceans. In Australia there is an east coast and a west coast population. The east coast population is found predominantly in inshore coastal waters along the coast of NSW and southern Queensland. The species diet consists of a range of fish, other sharks, squid, crab and lobsters
The extent to which habitat is likely to be removed or modified as a result of the action proposed,	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.	The proposed works will result in some changes to the receiving marine environment which have the potential to alter the biotic and abiotic features of the surrounding environnment (refer to **Chapter 9, Water Quality**). However, the impacted area of land would not be large enough and total spread of the population fo this species is not small enough to create a real threat to the population.

Fish and Sharks Assessment of Significance

Assessment of Significance	Black cod (*Epinephelus daemelii*)	Grey Nurse Shark (*Carcharias taurus*)
Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.	The historical nature of Botany Bay is that of a port, and almost all of Sydney's commercial shipping passes through Port Botany (City of Botany Bay Council, 2012), and for this reason the concentration of heavy industry and shipping within the Bay has led to a general decline in water quality and contamination of sediments over time (Colman, 2001). Although the proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area; due to the nature of the Bay, it is considered unlikely that the proposed works will further fragment or isolate areas of potential habitat for the species, due to a lack of potential suitable habitat for thie species in the immediate vicinity.
The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	Although the species is found around the NSW coastline, there is no evidence to indicate the presence of Black Cod populations within Port Botany Harbour. However, the average depth of black cod sightings are considered to around 17.7 m, with the shallowest at just 5 m, suggesting that the potential suitability of the habitat available to the species, within the harbour cannot be ruled out on depth. However, due to the disturbed, congested nature of the harbour in the region of the Project site, it is considered unlikely that the proposed area of impact would consist of important habitat for the species, that could affect the long-term survival of the species.	Potential foraging habitat for the Grey Nurse Shark exists within the entire Project site and an important aggregation site for the species is known in close proximity to the Project site - at Magic Point, near Maroubra. Magic Point consists of an overhang and nearby gutter-like formations that are part of the reef system extending from the headland. These features occur at a depth of around 14 m. Aggregations have been observed here during 55.6 percent of the surveys conducted between 1998 and 2001,especially during winter (NSW Fisheries, 2002). However, due to the proximity of the Project site from this known aggregation site, and the highly mobile nature of the species, and availability of areas of better quality habitat throughout the Bay, it is considered unlikely that the habitat within the Project site is important to the long-term survival of the species.

Fish and Sharks Assessment of Significance

Assessment of Significance	Black cod (*Epinephelus daemelii*)	Grey Nurse Shark (*Carcharias taurus*)
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),	Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or NSW DPI within the Project site.	Grey Nurse Shark critical habitat and aggregation sites in NSW are identified under the FM Act, 1994; and one site exists in close proximity to the Project site, off Magic Point near Maroubra (NSW DPI, 2012) - which is approximately 3km north-east of the proposed works. Further information relating to this notification is made under section 220T of the FM Act (NSW Government Gazette, 2002).
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,	A recovery plan exists for the species. The proposed works have the potential to oppose an objective of the recovery plan for the species, under Objective 8 - Mitigating the impacts of water pollution on Black Cod. The proposed action would therefore be inconsistent with the recovery plan were there to be a recorded population of the species in Port Botany Bay Harbour, in proximity to Project site. However, due to the lack of records of the species in this region, the proposed action is considered to be consistent with the objectives of the recovery plan for the species.	The key recovery actions identified in the draft recovery plan for the Wandering Albatross (OEH Bionet, 2012) are consistent with key threats associated with the decline of the species. Those recovery actions that are relevant to the Project include: • Avoid discarding any debris at sea, particularly plastic.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.	The following KTPs are relevant to the Project: • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and • Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. However, providing mitigation measures are adopted for the Project, it is considered unlikely that the Project would result in the operation of, or increase the impact of these KTPs.
Conclusion	Given the lack of historical records of the species from within Port Botany Bay harbour, the results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.	The results of the assessment of significance indicate that the proposed works will not result in a significant impact to this species. As such, a Species Impact Statement is not required.

Fish and Sharks Assessment of Significance

Assessment of Significance	Black cod (*Epinephelus daemelii*)	Grey Nurse Shark (*Carcharias taurus*)
References	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • MPA (2010) Baseline data on the distribution and abundance of black cod *Epinephelus daemelii* at 20 sites in Northern Rivers marine waters. Marine Park Authority. Accessed online 6/7/2012 - http://www.northern.cma.nsw.gov.au/downloads/publications/marine-and-coastal/pub-black-cod-baseline-data.pdf • MPA (2011) Distribution, relative abundance, habitat use and seasonal variation of Black Cod within the Port Stephens Great Lakes Marine Park. Accessed online 6/7/2012 - http://www.hcr.cma.nsw.gov.au/uploads/res/Black_Cod_report_FINAL.pdf • NSW I&I (2011) Black Cod Recovery Plan. Accessed online 6/7/2012 - http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0017/307232/Black-Cod-Recovery-Plan.pdf • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.	• City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 6/7/2012 -http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay • NSW DPI (2012) Grey Nurse Shark Critical Habitat. Department of Primary Industries. Accessed online 6/7/2012 - http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what/register/grey-nurse-shark • NSW Government Gazette (2002) Other Legislation - Critical Habitat of the Grey Nurse Shark Notification 2002. No. 237. Accessed online 6/7/2012 - http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/381315/Grey-nurse-shark-critical-habitat.pdf • OEH Bionet (2012) NSW Bionet Atlas Search data download. Office of Environment and Heritage. • OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet. • URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

Appendix E – 9
Significant Impact Criteria

Table of Contents

Significant Impact Criteria

1.1 Fauna

1.1.1 Wandering Albatross *(Diomedea exulans sensu lato)* and Shy Albatross (*Thalassarche cauta cauta*)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

a) lead to a long-term decrease in the size of an important population of a species

The Wandering Albatross (Endangered, TSC Act; Vulnerable/ Migratory, EPBC Act) is the largest of albatrosses, with a wingspan of up to 3.5m. The species visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and Spetember. It has been recorded along the length of the NSW coast. The current global population of the species is estimated to be 55 000 individuals. Around 8 500 pairs breed each year. There are approximately 28 000 mature individuals (DSEWPaC, 2012a).

The Shy Albatross (Vulnerable, TSC Act, Vulnerable/ Migratory, EPBC Act) is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. Occasionally the species occurs in continental shelf waters, in bays and harbours (DSEWPaC, 2012b).

The Wandering Albatross has been previously recorded within 5 km of the Project site, in Botany Bay (refer to **Figure 10.2**). Althought the Shy Albatross has not been previously recorded in the study area, potential suitable foraging habitat exists for this species within the Project site. However, due to the small scale of the Project in comparison to the extensive foraging range of the species, it is considered unlikely that the proposed action would have an adverse effect on the size of an important population of the species such that the local population of the specees will be placed at risk of extinction.

b) reduce the area of occupancy of an important population

The area of occupancy for the Wandering Albatross is circumpolar oceans, with a range inhabiting Southern Oceans encirclying Antarctica. The current global population of the the species is estimated to be 55 000 individuals, with around 8 500 pairs breeding each year. The Temperate East Marine Region provides foraging areas which are considered to be biologically important to the species, from between July to November (DSEWPaC, 2012a). The area of occupancy for this species, of both breeding and resident is considered to be 1,900 km² (BirdLife International, 2012).

The Shy Albatross is endemic to Australia, and breeds on Albatross Island, Bass Strait, and Mewstone and Pedra Branca, off southern Tasmania. The total breeding population is currently around 12 200 breeding pairs. The area of occupancy is estimated with high reliability to be 6km² with a stable trend (DSEWPaC, 2012b)

Potential foraging habitat exists for the species' within the inshore marine waters contained within the Project site. However, due to the nature of the proposed works causing only temporary disturbance to the marine environment within the Project site, combined with the

highly mobile nature of these species; it is considered unlikely that the proposed action will reduce the area of occupance of an important population.

c) fragment an existing important population into two or more populations

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). The Wandering Albatross and Shy Albatross are marine migratory species, spending the majority of their time in flight, soaring over the southern oceans. No important population of the species is known to occur within the study area; and due to the highly mobile nature of the species, it is considered unlikely that the works associated with the Project will fragment an existing important population of either species into two or more populations.

d) adversely affect habitat critical to the survival of a species

Critical habitat was declared for this species in 2002, implicating the location and extent of Macquarie Island which is considered to be one of the four major breeding locations under Australian jurisdiction where these albatross species breed. However, no Critical habitat listed on the register of Critical Habitat kept by the Director-General, OEH or DPI occurs within the study area, and therefore this listing of critical habitat is not applicable to the Project.

e) disrupt the breeding cycle of an important population

The Wandering Albatross breeds on subantarctic islands. On breeding islands, the species nests on coastal or inland ridges, slopes, plateaux and plains, often on marshy ground (DSEWPaC, 2012). The Shy Albatross breeds on just three islands off Tasmania, breeding in small colonies (of 6 - 500 nests), usually in association with the Australasian Gannet *Sula serrator.* The species nests on level or gently sloping ledges, summits, slopes and caves of rocky islets and stacks, usually in broken terrain with little soil and vegetation (DSEWPaC, 2012b). No areas of known breeding habitat for either speices will be impacted, and therefore there should be no disruption to the breeding cycle of the species.

f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The construction phase of the Project will involve dredging works, which will require some disturbance to potential foraging habitat for the species in and around the Project site. However, the disturbance will be temporary. For this reason, it is considered unlikely that the proposed works would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that thespecies is likely to decline.

g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.

However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of the Wandering Albatross or Shy Albatross (DSEWPaC 2012a), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

h) introduce disease that may cause the species to decline, or

Introduction of a disease is not cited as a threatening process for this species (DSEWPaC, 2012a).

i) interfere substantially with the recovery of the species.

No formal recovery plan has been developed for either of these species. In lieu of a formal recovery plan, a number of threats have been outlined in the *National Recovery Plan for Threatened Albatrosses and Giant Petrels* 2011-2016 (DSEWPaC, 2011), of which the following are considered relevant to the Project -

- Marine pollution.

However, assuming mitigation measures are adopted, it is not considered likely that the works associated with the Project would in any way exacerbate this threat to the species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact either of these species. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

BirdLife International (2012) Species factsheet: *Diomedea exulans*. Accessed on 11/07/2012 - http://www.birdlife.org/datazone/speciesfactsheet.php?id=3952&m=1

DSEWPaC (2011) National recovery plan for threatened albatrosses and giant petrels 2011-2016. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 10/7/2012 - http://www.environment.gov.au/biodiversity/threatened/publications/recovery/pubs/albatrosses-and-giant-petrels-recovery-plan.pdf

DSEWPaC (2012a) Species Profile and Threats Database – Wandering Albatross. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 10/7/2012 - http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=1073

DSEWPaC (2012b) Species Profile and Threats Database – Shy Albatross. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82345

DSEWPaC (2012b) Schedule 2 – Regional Advice on MNES - EPBC Act Policy Statement. Accessed online 10/7/2012 - www.environment.gov.au/coasts/mbp/...east/.../te-draft-plan-schedule2.doc

OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet.

URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

1.1.2 Southern Giant-Petrel (*Macronectes giganteus*) and Northern Giant Petrel (*Macronectes halli*)

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

a) lead to a long-term decrease in the size of a population

The Southern Giant Petrel (Endangered, TSC Act; Endangered/ Migratory, EPBC Act) is a large seabird up to 100cm in length with a wingspan between 150 and 210cm. The species has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. The species has a world population of approximately 62 000 individuals (31 300 annual breeding pairs), of which around 7090 breeding pairs are believed to breed in Australian territory (DSEWPaC, 2012a). The Southern Giant-Petrel is considered to be a sibling species to the Northern Giant-Petrel. It was not identified as a separate species until the 1960s, when a detailed study of the breeding biology of the giant-petrels uncovered that there were actually two distinct species breeding side by side on Macquarie Island

Th Northern Giant-Petrel (Vulnerable, TSC Act; Vulnerable/ Migratory, EPBC Act) is also a large seabird up to 95cm in length with a wingspan of 150-210cm. The species has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Recent population estimates of the species suggest that there has been an increase of 25% in the global population size of the Northern Giant-Petrel since the last published estimate, to about 8 600 pairs (DSEWPaC, 2012b).

The Southern Giant-Petrel has been previously recorded within 5 km of the Project site, in Botany Bay (refer to **Figure 10.1**), and was observed during field surveys conducted in the study area (URS, 2012). Althought the Northern Giant-Petrel has not been previously recorded within the study area, potential suitable foraging habitat exists for both species within the Project site. However, due to the small scale of the Project in comparison to the extensive foraging range of the species, it is considered unlikely that the proposed action would have an adverse effect on the size of an important population of the species such that the local population of the specees will be placed at risk of extinction.

b) reduce the area of occupancy of the species

The Southern Giant-Petrel breeds on six subantarctic and Antarctic islands in Australian territory. The number of breeding birds is estimated to be 12,000, with 2 sub-populations (Macquarie Island and Heard Island), and its geographic distribution is restricted, with an area of occupancy of 40km^2 (TSSC, 2011a).The Northern Giant Petrel breeds in the sub-Antarctic, and visits areas off the Australian mainland mainly during the winter months (May-October). The species breeds at a single location within Australian territory (Macquarie Island), the area of occupancy is 10km^2, and the total number of mature individuals is limited, with an estimated population size of 2600, all in a single sub-population. The species occurs outside Australian territory, however, because site fidelity is high, immigration rate is likely to be low (TSSC, 2011b). Thus, the area of occupancy for both species does not coincide with the study area.

Potential foraging habitat exists for the species within the inshore marine waters contained within the Project site. However, due to the nature of the proposed works causing only temporary disturbance to the marine environment within the Project site, combined with the highly mobile nature of the species; it is considered unlikely that the proposed action will reduce the area of occupance of an important population.

c) fragment an existing population into two or more populations

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). The Southern and Northern Giant-Petrel are marine and oceanic migratory species', of which the waters off southeastern Australia are considered to be particularly important wintering grounds (DSEWPaC, 2012a). However, no important population of either species is known to occur within the study area; and due to the highly mobile nature of these species, it is considered unlikely that the works associated with the Project will fragment an existing important population of the speices into two or more populations.

d) adversely affect habitat critical to the survival of a species

Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or DPI within the study area. To date, no critical habitat has been declared for this species.

e) disrupt the breeding cycle of a population

The Southern Giant-Petrel breeds on the Antarctic Continent, Peninsula and islands, and on subantarctic islands and South America (DSEWPaC, 2012a). The Northern Giant-Petrel breeds on sub-Antarctic islands. Its breeding range extends into the Antarctic zone at South Georgia. It nests in coastal areas where vegetation or broken terrain offers shelter, on sea-facing slopes, headlands, in the lee of banks, under or against vegetation clumps, below cliffs or overhanging rocks, or in hollows (DSEWPaC, 2012b). No areas of known breeding habitat for the speices will be impacted, and therefore there should be no disruption to the breeding cycle of the species.

f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The construction phase of the Project will involve dredging works, which will require some disturbance to potential foraging habitat for the species in and around the Project site. However, the disturbance will be temporary. For this reason, it is considered unlikely that the proposed works would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that thespecies is likely to decline.

g) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.

However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of the Southern or Northern Giant-Petrel (DSEWPaC 2012a, b), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

h) introduce disease that may cause the species to decline, or

There is no mention in the relevant literature of any potential disease-based threats to either of these species (DSEWPaC 2012a, b).

i) interfere with the recovery of the species

No formal recovery plan has been developed for either species. In lieu of a formal recovery plan for either species, a number of threats have been outlined in the *Agreement on the Conservation of Albatrosses and Petrels* (ACAP, 2010a). Marine threats to the Southern Giant-Petrel, that are considered to be relevant to the Project (ACAP, 2010a), include:

- swallowing of debris; and
- contamination with organochlorine pesticides and heavy metals .

Marine threats to the Southern Giant-Petrel, that are considered to be relevant to the Project (ACAP, 2010b), include:

- Contamination by pollutants through dietary sources is also a potential concern, with relatively high concentrations of hexachlorobenzenes (HCB), mercury and increasing *dichlorodiphenyl-dichloroethylene* (DDE) concentrations in this species.

However, assuming mitigation measures are adopted, it is not considered likely that the works associated with the Project would in any way exacerbate this threat to the species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact either of these species. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

ACAP (2010a) Species Assessments – Southern Giant-Petrel. Agreement on the Conservation of Albatrosses and Petrels. Accessed online 11/7/2012 - http://www.acap.aq/acap-species

ACAP (2010b) Species Assessments – Northern Giant-Petrel. Agreement on the Conservation of Albatrosses and Petrels. Accessed online 11/7/2012 - http://www.acap.aq/acap-species

DSEWPaC (2012a) Species Profile and Threats Database – Southern Giant-Petrel Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=1060

DSEWPaC (2012a) Species Profile and Threats Database – Northern Giant-Petrel Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1061

OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet.

TSSC (2011a) Amendment to the list of threatened species under the EPBC Act - *Macronectes giganteus.* Threatened Species Scientific Committee. Accessed online 11/7/2012 - http://www.environment.gov.au/biodiversity/threatened/species/sg-petrel.html

TSSC (2011b) Amendment to the list of threatened species under the EPBC Act - *Macronectes halli.* Threatened Species Scientific Committee. Accessed online 11/7/2012 - http://www.environment.gov.au/biodiversity/threatened/species/ng-petrel.html

URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

1.1.3 Black Cod (*Epinephelus daemelii*)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

a) lead to a long-term decrease in the size of an important population of a species

The Black Cod's (Vulnerable, TSC Act; Vulnerable, EPBC Act) distribution ranges from southern Queensland through NSW to northern Victoria. The NSW coastline forms the species' main range, both in Australia and internationally. No estimates are available for the total number of mature black cod in NSW (TSSC, 2012a, b). Although, strong localised declines in black cod stocks around Sydney were first noted in the early 1900s due to fishing pressure. In 1916, an Australian fisheries scientist noted that '*at one time the species was fairly plentiful in the vicinity of Port Jackson, but has become very scarce in recent years, owing to the havoc wrought by fishermen, and the increased shipping*' (TSSC, 2012a).

Recent surveys indicate the species now has a patchy distribution and is rare or absent from much of its former range along the New South Wales (NSW) coastline, and has made little discernible recovery (TSSC, 2012b). Although the Black Cod has not been previously recorded within 5 km of the Project site, potential suitable foraging habitat exists for the species within the Project site (OEH Bionet, 2012). It should be noted though, that the Project site does not provide any potential suitable rocky outcrop reefs for territorial occupation by the species. Therefore, due to the lack of suitable habitat for the species within the Project site, it is considered unlikely that the proposed action would have an adverse effect on the size of an important population of the species such that the local population of the specees will be placed at risk of extinction.

b) reduce the area of occupancy of an important population

An estimate of area of occupancy is not possible for black cod due to a lack of comprehensive spatial data on rock reef habitat along the eastern Australian coastline (TSSC, 2012a). Potential suitable foraging habitat exists for the species within the inshore marine waters contained within the Project site. However, due to the nature of the proposed works causing only temporary disturbance to the marine environment within the Project site, and the lack of suitable reef habitat for the species; it is considered unlikely that the proposed action will reduce the area of occupance of an important population.

c) fragment an existing important population into two or more populations

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). The Black Cod is largely an inshore species,and the main range of the species encompasses the heavily-settled and heavily fished NSW coastline. Although an important Black Cod population has been identified at both Elizabeth and Middleton Reefs Marine National Nature Reserves (TSSC, 2012a), no important population of the species is known to occur within the study area; and due to the lack of suitable reef habitat for the species within the Project site, it is considered unlikely that the works associated with

the Project will fragment an existing important population of the speices into two or more populations.

d) adversely affect habitat critical to the survival of a species

Not applicable. No Critical habitat is listed on the register of Critical Habitat kept by the Director-General, OEH or DPI within the study area. To date, no critical habitat has been declared for this species.

e) disrupt the breeding cycle of an important population

Black cod generally inhabit near-shore rocky and offshore coral reefs at depths down to 50 m, but are occasionally recorded from deeper waters. In coastal waters adult black cod are found in rock caves, rock gutters and on rock reefs. The Black cod are an aggressive, territorial species and individuals may occupy one particular cave for most of their adult lives. The species has also been recorded frequently utilising the same near-shore rocky reef habitats as *Carcharias taurus* (Grey Nurse Shark – East-Australian population). Recently settled juvenile black cod (i.e. individuals that have recently completed the pelagic larval stage) are often found in coastal rock pools while slightly older juvenile black cod are often found in estuary systems. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters (TSSC, 2012a). However, no areas of known breeding habitat for the species will be impacted, and therefore there should be no disruption to the breeding cycle of the species.

f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The construction phase of the Project will involve dredging works, which will require some disturbance to potential foraging habitat for the species in and around the Project site. However, the disturbance will be temporary. For this reason, it is considered unlikely that the proposed works would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.

However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of the Black Cod (TSSC, 2012a, b), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

h) introduce disease that may cause the species to decline, or

There is no mention in the relevant literature of any potential disease-based threats to this species (TSSC, 2012a, b).

i) interfere substantially with the recovery of the species.

No formal recovery plan has been developed for this species. In lieu of a formal recovery plan for either species, a number of threats have been outlined in the *Approved Conservation*

Advice for Epinephelus daemelii (DSEWPaC, 2012b). Marine threats to the Black Cod, that are considered to have potential relevance to the Project, include:

- Modification of estuarine habitats; considered to be a potential threat to juvenile Black Cod.

However, assuming mitigation measures are adopted, it is not considered likely that the works associated with the Project would in any way exacerbate this threat to the species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact the Black Cod. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet.

TSSC (2012a) Listing advice to the Minister on Amendment to the list of Threatned species under the EPBC Act – *Epinephelus daemelii.* Accessed online 11/7/2012 - http://www.environment.gov.au/biodiversity/threatened/species/pubs/68449-listing-advice.pdf

TSSC (2012b) Approved Conservation Advice for *Epinephelus daemelii* (Black Cod). Accessed online 11/7/2012 - http://www.environment.gov.au/biodiversity/threatened/species/pubs/68449-conservation-advice.pdf

URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

1.1.4 Grey Nurse Shark (*Carcharias taurus*)

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

a) lead to a long-term decrease in the size of a population

The Grey Nurse Shark (Critically Endangered TSC Act; Critically Endangered EPBC Act) is native to subtropical to cool temperate waters in the Mediterranean Sea and the Atlantic, Indian and western Pacific Oceans. In Australia there is an east coast and a west coast population. The east coast population is found predominantly in inshore coastal waters along the coast of NSW and southern Queensland (DSEWPaC, 2012). This species has not been previously recorded within 5 km of the Project site (OEH Bionet, 2012), however the species can be found in aggregations at reefs off of Sydney (DSEWPaC, 2012), and historical records indicate the species was fished by hook and line at "regular nurse grounds" off Dolls Point in Botany Bay (NSW Fisheries, 2002) - indicating that potential suitable habitat exists for the species within the Project site. It should be noted though, that the Project site does not provide any potential suitable rocky outcrop reef habitats suitable for aggregations. Furthermore, due to the temporary nature and small scale of the Project in comparison to the extensive foraging range of the species, it is considered unlikely that the proposed action would have an adverse effect on the size of an important population of the species such that the local population of the specees will be placed at risk of extinction.

b) reduce the area of occupancy of the species

An estimate of area of occupancy for the Grey Nurse Shark is not available for this speice. However, the population is believed to be low and estimated to be less than 500 individuals, of which less than 250 are believed to be mature. Evidence suggests migrational movement, probably in response to water temperatures, up and down the coast. The species is regularly seen at the same locations, and these observations suggest that the species exhibits some degree of site fidelity. This characteristic makes the species vulnerable to localised pressures in certain areas (DSEWPaC, 2012). However, due to the nature of the proposed works causing only temporary disturbance to the marine environment within the Project site, and the lack of suitable reef habitat for the species; it is considered unlikely that the proposed action will reduce the area of occupance of an important population.

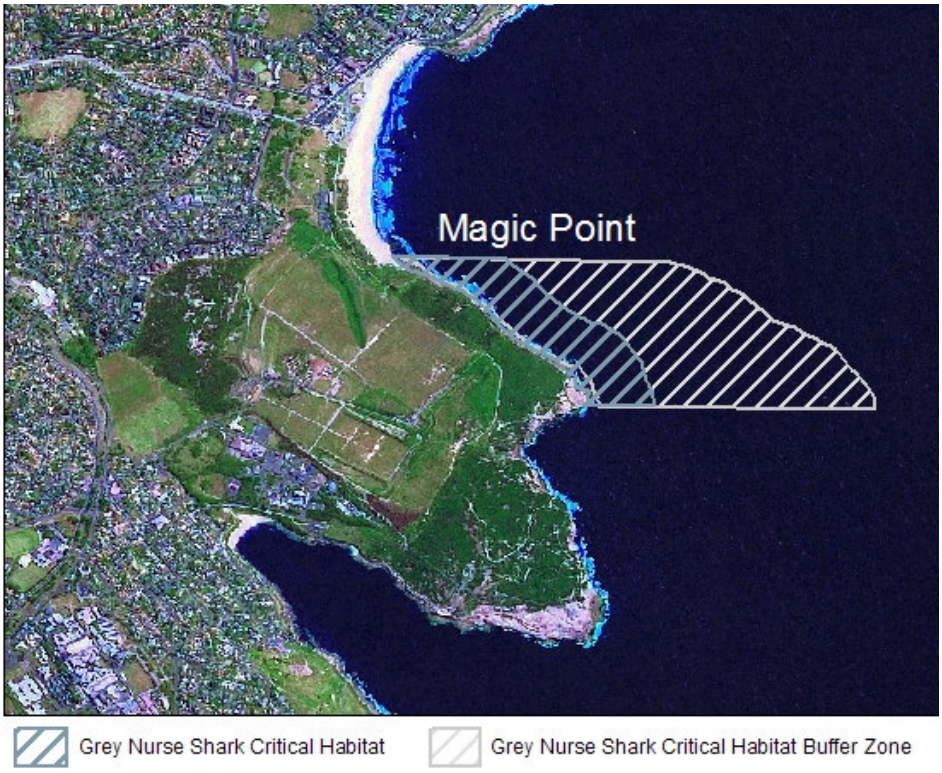
c) fragment an existing population into two or more populations

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). The Grey Nurse Shark is largely found at depths of between 15-40m on the eastern coast. The species has also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf – and are often observed hovering motionless just above the seabed, in or near deep sandy-bottomed gutters or rocky caves, and in the vicinity of inshore rocky reefs and islands (DSEWPaC, 2012). No important population of the species is known to occur within the study area; and due to the lack of suitable reef habitat for the species within the Project site, it is considered unlikely that the works associated with the Project will fragment an existing important population of the speices into two or more populations.

d) adversely affect habitat critical to the survival of a species

Grey Nurse Shark critical habitat and aggregation sites in NSW are identified under the FM Act, 1994. In December 2002, ten Grey Nurse Shark (east coast population) critical habitat areas were declared in NSW waters with associated regulations to control fishing and diving activities. Of the listed critical habitat sites (NSW Fisheries 2003), one location occurs in close proximity to the Project site – Magic Point in Maroubra, Sydney – which is approximately 3 km north-east of the Project site (DSEWPaC, 2012; NSW DPI 2012) (refer to **Plate 2-1**). Further information relating to this notification is made under section 220T of the FM Act (NSW Government Gazette, 2002).

Plate 0-1 – Critical habitat at Magic Point, in Maroubra, Sydney (NSW DPI, 2012)



However, due to the proximity of the Project site from the critical habitat located at Magic Point; it is considered unlikely that the works associated with the Project would have an adverse effect on this declared critical habitat.

e) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The construction phase of the Project will involve dredging works, which will require some disturbance to potential foraging habitat for the species in and around the Project site. However, the disturbance will be temporary. For this reason, it is considered unlikely that the proposed works would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

f) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.

However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of the Black Cod (DSEWPaC, 2012), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

g) introduce disease that may cause the species to decline, or

There is no mention in the relevant literature of any potential disease-based threats to this species (DSEWPaC, 2012).

h) interfere with the recovery of the species.

A recovery plan for this species is in effect - *Recovery Plan for the Grey Nurse Shark Carcharias taurus* (Environment Australia, 2002). Actions and recovery criteria identified in the plan that are relevant to the Project are listed below -

- Develop appropriate mechanisms to protect key sites.

However, assuming mitigation measures are adopted, it is not considered likely that the works associated with the Project would in any way exacerbate this threat to the species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact the Grey Nurse Shark. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

DSEWPaC (2012) Species Profile and Threats Database – Grey Nurse Shark (east coast population). Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68751

Environment Australia (2002) The Recovery Plan for the Grey Nurse Shark *Carcharias Taurus* in Australia. Accessed 11/7/2012 - http://www.environment.gov.au/coasts/publications/grey-nurse-plan/index.html.

NSW DPI (2012) Grey Nurse Shark Critical habitat. Department of Primary Industries. Accessed online 11/7/2012 - http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what/register/grey-nurse-shark

NSW Government Gazette (2002) Other Legislation - Critical Habitat of the Grey Nurse Shark Notification 2002. No. 237. Accessed online 11/7/2012 - http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/381315/Grey-nurse-shark-critical-habitat.pdf

OEH GIS (2012) Wildlife Atlas Spatial Data Programs Data Request for threatened species records - Port Hacking 9129 and Sydney 9130 1:100 000 map sheet.

URS (2012) Caltex Kurnell Dredging Project – Ecological Assessment. URS Pty Ltd, Sydney Office.

Significant Impact Criteria

2.3 Migratory Species

2.3.1 Birds - White Bellied Sea-Eagle (*Haliaeetus leucogaster)* and Little Tern (*Sterna albifrons*)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

a) *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The White Bellied Sea-Eagle (Migratory, EPBC Act) is distributed along the coastline of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia where it is mostly recorded in coastal lowlands. Breeding records are patchily distributed, mainly along the coastline, and especially the eastern coast, extending from Queensland to Victoria, and to Tasmania. The species is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitat is characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats (DSEWPaC, 2012a).

The Little Tern (Endangered, TSC Act; Migratory, EPBC Act) migrates from eastern Asia, the species is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records) (DSEWPaC, 2012b).

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). A number of records exist for both the White Bellied Sea-Eagle, and the Little Tern within 5km of the Project site (refer to **Figure 10.2**), and the White Bellied Sea-Eagle was observed during field surveys conducted in Botany Bay (URS, 2012). However, due to the nature of the proposed works causing only temporary disturbance to the marine environment within the Project site, and the wide-ranging nature of these species; it is considered unlikely that the proposed action will substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for these species.

b) *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or*

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the

water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.
However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of either the White Bellied Sea-Eagle, or the Little Tern (DSEWPaC, 2012a, b), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

c) *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

The White Bellied Sea-Eagle has been recorded breeding on the coast, at inland sites, and on offshore islands. Breeding territories are located close to water, and mainly in tall open forest or woodland, although nests are sometimes located in other habitats such as dense forest (including rainforest), closed scrub or in remnant trees on cleared land (DSEWPaC, 2012a).

In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches. The species nest on sand-spits, banks, ridges or islets in sheltered coastal environments, such as coastal lakes, estuaries and inlets, and also on wide and flat or gently sloping sandy ocean beaches, and also, occasionally, in sand-dunes (DSEWPaC, 2012b).

The Project site may provide suitable foraging habitat for these species, however no potential breeding or resting habitat is considered to exist for the species in this area, and therefore it is considered unlikely that the proposed works would have the potential to seriously disrupt the lifecycle of an ecologically significant proportion of the population of either of these migratory species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact on this species. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

DSEWPaC (2012a) Species Profile and Threats Database – White Bellied Sea-Eagle. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=943

DSEWPaC (2012b) Species Profile and Threats Database – Little Tern. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=813

2.3.2 Mammals – Dugong (*Dugong dugon*)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

a) *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The Dugong (Endangered, TSC Act; Migratory, EPBC Act) is found in north Australian waters from Shark Bay, Western Australia, in the west to Moreton Bay, Queensland, in the east. In NSW, the species inhabits coastal and estuarine waters around Wallis Lake, Port Stephens, Lake Macquarie and Brisbane Waters.These areas are associated with some of the largest seagrass beds in NSW, some of which contain the *Halophila* species preferred by Dugongs. The presence of Dugongs in these areas at this time coincided with warm water temperatures (>18°C). Individuals found as far south as Sydney, are generally considered to be vragrants (DSEWPaC, 2012).

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking place in and around the fixed berths (URS, 2012). Dugongs have been previously recorded within 5km of the Project site (refer to **Figure 10.2**), and potential suitable habitat exists for the species within the seagrass beds in and around Botany Bay Harbour, although not directly within the Project site (URS, 2012). However, seagrass beds can be destroyed or fragmented through the effects of dredging-related disturbances, resulting in increases in sedimentation and turbidity which, in turn, lead to degradation of seagrass beds through smothering and lack of light (DSEWPaC, 2012).

However, due to the nature of the proposed works causing only temporary disturbance to the marine environment in and around the Project site, the vragrant nature of this species within the Sydney region; and assuming mitigation measures are adopted; it is considered unlikely that the proposed action will substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for these species.

b) *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or*

The dredging component of the proposed works will result in temporary disturbance to the seafloor, with an end result to increase the bathymetric depth in the Project site. It is likely that the works will result in subsequent changes in turbidity, sediment load and stratification of the water column in and around the Project site. As a result of these changes, it is considered possible that the altered marine environment within the Project site could create a more favourable environment for some exotic species and thus facilitate the establishment of invasive species in the area.

However, no marine invasive species that are considered relevant to the Project have been listed as a threat to populations of the Dugong (DSEWPaC, 2012), and for this reason it is considered unlikely that the Project would result in the establishment of any invasive species that may result in a threat to this species.

c) *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

Dugongs are considered only occasional visitors to the NSW coastal waters at present, they may have occurred in greater numbers in NSW prior to European settlements. While the species frequent coastal waters, they also use estuarine creeks and streams and have been tracked travelling within creeks upstream for several kilometres. Feeding aggregations tend to occur in wide, shallow protected bays; wide, shallow mangrove channels; and in the lee of large inshore islands. These areas are coincident with sizeable seagrass beds. (DSEWPaC, 2012a).

The seagrass beds in and around Botany Bay may provide suitable foraging habitat for this species, however no potential foraging, breeding or resting habitat is considered to exist for the species within the Project site. Furthermore, the species is particularly uncommon in Sydney waters and therefore it is considered unlikely that the proposed works would have the potential to seriously disrupt the lifecycle of an ecologically significant proportion of the population of either of these migratory species.

Conclusion

The significant impact criteria assessment concludes that the Project is not likely to significantly impact on this species. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this Report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

DSEWPaC (2012) Species Profile and Threats Database – Dugong. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 11/7/2012 - http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=28

Significant Impact Criteria

2.4 Wetlands of International Importance

2.4.1 Towra Point Nature Reserve Ramsar site

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

a) *areas of the wetland being destroyed or substantially modified*

The Towra Point Nautre Reserve Ramsar site consists of 386.5 hectares of wetlands that lie on the mouth of the Georges River on the southern shores of Botany Bay, and located approximately 16 kilometres from the Sydney CBD (DECCW, 2010).

The Project site is located in the entrance to Botany Bay, between the Kurnell Peninsular and Port Botany. Despite Botany Bay being historically subjected to heavy industry and commercial shipping, Towra Point Nature Reserve remains the largest and most diverse estuarine wetland complex remaining in the Sydney region (NSW NPWS, 2001; City of Botany Bay Council, 2012).

The proposal will require some disturbance to the marine environment and seafloor in and around the Project site. The disturbance will be in the form of dredging and associated works within the Project site. The purpose of the dredging is to maintain and increase the navigable depth for vessels approaching or using the wharf facilities at Kurnell. Specifically, the sub-berth and approaches will be maintenance dredged, with capital dredging taking pl.ace in and around the fixed berths (URS, 2012). The most eastern extent of the Ramsar listed portion of the site is 1.75 km south of the Project site (refer to **Figure 10.1**). The Reserve extends in a north-westerly direction, flanked by the Kurnell Headland, Botany Bay, and Dolls Point.

Due to the proximity of Towra Point Nature Reserve from the Project site, and taking into consideration the proposed dredging works, it is considered unlikely that the Project would have a significanct impact on the ecological character of the Towra Point Nature Reserve Ramsar site such that areas of the wetland are destroyed or substantially modified.

b) *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*

The historical nature of Botany Bay is that of a commercial shipping channel, and this concentration of heavy industry and shipping in and around the Bay has led to the catchment being largely cleared (> 75%), and highly industrialised containing about 15% of Australia's industries (Dames and Moore, 1995).

The proposed dredging works would remove sediment at spot locations across the dredge footprint that has accumulated over the past 40 years. The preferred dredge method, would involve mechanical dredging to undertake the works, specifically a Backhoe Dredger (BHD) that works by removing dredged material from the seabed in a closed bucket, lifting it through the water column before slewing it over and releasing it in to an adjacent splitter hopper barge. This method has the added benefit of allowing controlled and more accurate dredging to take place around structures and is therefore appropriate for dredging next to the Kurnell Wharf (URS, 2012).

Due to changes in bathymetry within the Project site, the Project is considered to have the potential to alter hydrological regimes within the study area. For this reason, the following hydrodynamic modelling investigations were carried out to identify the potential impacts of the proposed works, including -

- *Hydrodynamic and Wave Impact Assessment*;

- *Shoreline Impact Assessment;* and
- *Dredge Plume Modelling*.

The proposed works are expected to result in subsequent intermediate abiotic and biotic changes to the area, and for this reason a suite of dispersion modelling has been undertaken (Cardno, 2012). However, the dispersion modelling undertaken for sediment and TBT shows that neither would exceed the threshold limits in their imapcts on the Posidonia seagrass beds. As can be concluded, the predicted sediments concentration would fall below the threshold limits within a relatively short distance of where the dredging would take place, even accounting for consideration of the 95th percentile. As such, neither turbidity, light preclusion, TBT nor effects on marine vegetation, benthic communities and epifauna would be a significant impact of the proposed works (refer to **Chapter 9, Water Quality**). Therefore, due to the scale and extent of the dredging works, and distance of the Project site from the listed Ramsar Weltands, it is considered unlikely that the dredging works will result in a substantial or measurable change in the hydrological regime of the adjacent wetlands – in terms of a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetlands.

c) *the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependant upon the wetland being seriously affected*

The proposed dredging works will have the potential to affect some abiotic features of the Project site, which may include;

- increased turbidity and suspended sediment concentrations through dredging associated works, and the potential to significantly impact surrounding seagrass communities;
- potential release of eco-toxicological and chemical contaminants associated with dredged materials, into water column (eg disturbance of TBT-laiden sediment, absorbed by marine biota); and
- changes to existing hydrological pathways as a result of bathymetric , which have the potential to impact on the quality of nearby wetlands and waterway.

As such, the Project will have the potential to impact the habitat or lifecycle of some native species. However, the results of the modelling and assessments indicate that these impacts are expected to be localised and short-term, and due to the proximity of the Project site rom the Ramsar Wetlands, it is considered unlikely that the habitat or lifeyclye of a native species dependent upon the wetland would be seriously affected.

d) *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health*

A number of studies have been previously conducted in Botany Bay focusing on water quality. As an example, during the construction of Sydney Airport's *Parallel Runway* at Kingsford Smith Airport (1992-1994), there was extensive monitoring of the effects of dredging on water quality and bioavailability of contaminants within Botany Bay (Dames and Moore 1995, 1998, White *et al.* 1994, MPR 1994, 1998). These studies concluded that generally there was little transfer of contaminants into Bay waters or biota as a result of the dredging operations (see also Lawson & Treloar 2003).

Numerous natural and anthropogenic disturbances, causing resuspension of contaminated sediment can, however, act to transfer contaminants from the sediment to the water column, possibly releasing contaminants from the particulate material. In this way, sites with existing sediment contamination still pose a real hazard to organisms in other habitats. While resuspended sediment and remobilized metals from the outer harbour can be flushed through the nearby harbour entrance easily, the highly contaminated material from the inner harbour is retained within the basin for much longer. A study by

(Hedge et al, 2009) found that dredging, and the resultant resuspension of dredged material, substantially affected the accumulation of several trace metals in deployed oysters. This study presents and un-confounded demonstration of the potential for dredging activities to cause large scale increases in water column contamination.

Other studies, such as the EIA for the Sydney Airport third runway, (Kinhill, 1991) took seven cores from locations relevant to dredging undertaken for construction of the third runway and analysed them for contamination of the sediments. Results from these cores identified some contamination in the form of heavy metals and organochlorines. However, the observed concentrations of heavy metals all lay within the accepted range for uncontaminated sediments in the Sydney region; being towards the lower end of this range. It can therefore be concluded that all metal contamination identified in these analyses occurred naturally in the Bay sediments. Organochlorine concentrations for the majority of sea bed sediments in the tested area were below the detection limit. However, some surface samples showed elevated levels, including chlordane, dieldrin and DDT (Dichlorodiphenyltrichloroethane). Of the twelve samples tested, however, only those closest to Penrhyn Estuary and the Mill Stream channel showed any organochlorines (Molino Stewart, 2009).

From this study (Molino Stewart, 2009) ,the sample taken closest to the proposed works of the Caltex Project site was taken near the entrance to Port Botany, and exhibited no elevated organochlorine levels (Molino Stewart, 2009). Based on these results, it is considered unlikely that any elevated organochlorine levels would therefore be identified within the Project site

Due to the scale and extent of the proposed works, and distance from the Ramsar Wetlands, the works associated with the Project required assessment to confirm whether or not they have the potential to result in a substantial or measurable change in the water quality of the wetlands – in terms of salinity levels, pollutants, water nutrients, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health. Hydrodynamic modelling has confirmed that the proposed works will not have an impact on water quality in the Ramsar site.

e) *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland*

The Towra Point Nature Reserve is considered to be an area of important habitat for a number of threatened species, including a range of listed-migratory species. The main aquatic noxious weed found in Botany Bay is considered to be *Caulerpa taxifolia* (Caulerpa). No invasive fauna species are known to exist in the vicinity of the Bay. The proposed works will have the potential to result in fluctuations in abiotic factors, which may create a more favourable environment for some species, and thus facilitate the establishment of invasive species in the area. For this reason, the proposal is considered to have the potential to transport noxious marine weed species in and around the Project site, and into the Bay and nearby Towra Point Nature Reserve.

However*, C. taxifolia* was not identified within the Project site during field surveys undertaken within the study area (URS, 2012). For this reason, it is considered unlikely that the works associated with the Project would result in an invasive species that is harmful to the ecological character of the wetland being established, or an existing invasive species being spread, in the wetland.

Conclusion

The significant impact criteria assessment concludes that it is unlikely that the proposal has the potential to significantly impact Wetlands of International Importance. As such, a referral to the Minister is not required. A number of measures are recommended in **Section 10.6** of this report to mitigate the degree of impact to ensure that biodiversity values within the Project area are maintained or improved.

References

City of Botany Bay Council (2012) A short history of the city of Botany Bay. Accessed online 10/7/2012 - http://www.botanybay.nsw.gov.au/index.php/your-city/a-short-history-of-the-city-of-botany-bay

Hedge LH, Knott NA, Johnston EL (2009) Dredging related metal bioaccumulation in oysters. *Marine Pollution Bulletin* **58**(6): 832-40. Accessed online 10/7/2012 - http://old.bees.unsw.edu.au/school/staff/johnston/Hedge_Knott_Johnston.pdf

Kinhill (1991) Proposed Third Runway Sydney (Kingsford Smith) Airport: supplement to the draft environmental impact statement, Volume two, summary of public submissions. Proposed Third Runway Sydney (Kingsford Smith) Airport: supplement to the draft environmental impact statement, 2. Prepared for: Federal Airports Corporation. Kinhill Engineers Pty Ltd and Federal Airport Corporation, Ultimo, NSW.

Molino Stewart (2009) Botany Bay Cable Project EA – Chapter 7. *prepared* for Ausgrid. Accessed online 10/7/2012 - http://www.ausgrid.com.au/Common/Network-projects/Network-projects-by-area/Sydney-South/Botany-Bay-Cable-Project/~/media/Files/Network/Network%20Projects/Sydney%20South/BBCP_EA_-_Chapter_7.ashx

NSW DECCW (2010) Towra Point Nature Reserve Ramsar site: Ecological character description. Department of Environment, Climate change, and Water. Accessed online 10/7/2012 - http://sydney.cma.nsw.gov.au/bbcci/publications/Final_Towra_Pt_ECD.pdf

NSW NPWS (2001) Towra Point Nature Reserve – Plan of Management. National Parks and Wildlife Services. Accessed online 10/7/2012 - http://www.environment.nsw.gov.au/resources/parks/pomfinaltowra.pdf

URS (2012) Caltex – EIS Proposal for the Kurnell Dredging Project. URS Australia Pty Ltd. Rebruary, 2012

Appendix E – 10
Towra Point Ramsar Information

Ramsar Information Sheet

Text copy-typed from the original document.

1. Date this sheet was completed: January 1998

2. Country: Australia

3. Name of wetland: Towra Point Nature Reserve

4. Geographical co-ordinates: Latitude: 34°00'S Longitude: 151°10'E

5. Altitude: Less than 5 metres above sea level

6. Area: 386.5 hectares

7. Overview
Towra Point Nature Reserve TNPR contains approximately half of the mangrove communities remaining in the Sydney region. These wetland communities are important as they provide habitat for over thirty species of migratory birds listed on the Japan-Australia Migratory Bird Agreement. They are also significant for wading and wetland birds in the Sydney region.

8. Wetland type: E F G H

9. Ramsar Criteria: 1a, 2a, 2b, 3b, 3c, dominant reason 2b

10. Map of site included: The Ramsar site is outlined on the appended map.

11. Name and address of compiler:
NSW National Parks and Wildlife Service
Conservation Assessment and Planning Division
PO Box 1967
Hurstville NSW 2220
Australia
Phone 02 9585 6477; Fax 02 9585 6495

12. Justification of criteria selected under point 9:
Towra Point Nature Reserve is botanically diverse, almost 300 plant species have been identified. The Reserve contains approximately 50% of the remaining mangrove communities and 90% of the remaining saltmarsh communities in Sydney. Consequently, these wetlands are particularly good representative example of this wetland type for this biogeographical region.
Areas of Towra Point provide habitat for almost half of the bird species listed under the Japan-Australia Migratory Bird Agreement. Moreover, several species listed under the *NSW Threatened Species Conservation Act 1995* occur within the Reserve.

13. General location:
Approximately 16 km south of Sydney centre, Towra Point adjoins Kurnell Peninsula forming the southern and eastern boundaries of Botany Bay.

14. Physical features:
Towra Point is located on the northern side of Kurnell Peninsula which forms the southern shore of Botany Bay. It is and estuarine complex bounded by Woolooware, Quibray and Weeney Bays. The Nature Reserve comprises three areas: two small sections along the shores of Quibray Bay and the third which covers the majority of Towra Point and the bed of Weeney Bay.

Towra Point is a low lying promontory of Holocene sandy sediments. TPNR consists of sandspits, bars, mudflats, dunes and beaches.

The tidal range for Botany Bay is approximately 0.1 - 2.0 m. Average annual rainfall for Sydney is 1088.3 mm. The mean maximum temperature at Sydney is 20.0°C whilst the mean minimum temperatures is 12.9°C.

A number of small freshwater ponds once existed (1770) on Towra Point, however, seawater contamination has caused them to become brackish.

The surrounding catchment comprises industrial, residential and recreational areas.

15. Hydrological values:
Towra Point is an estuarine landform comprising a mixture of spits, bars, mudflats, dunes and beaches. The shape of Towra Point has been influenced by changes in the topography of Botany Bay which in turn are sue to the tidal currents, erosive and transporting forces caused by waves from ocean swells entering through the heads, and movements in the mouth and scour channels of the Georges River.

The flat intertidal areas of muddy sand at Towra Point, Towra Spit and Quibray Bay are of particular importance as they provide roosting and feeding habitat for a number of waterfowl and migratory birds. The muddy sand flats at the eastern end of Towra Point and at the western end of Towra Spit are being damaged by coastal erosion. Towra Spit is actively extending in a south-westerly direction and the beaches on the eastern and western faces of Towra Point are eroding and contributing sand to the growth of the spit. Recent erosion has been partly attributed to dredging and port works within Botany Bay.

In 1991, erosion caused the western portion of Towra Spit to separate from the mainland and to form a highly mobile island west of the spit. However, during 1997 the island rejoined the mainland at the eastern end after a large local storm.

Works are proposed to stabilise Towra Spit island, and to protect shorebirds. Measures to mitigate impacts of coastal erosion elsewhere at Towra Point are being investigated.

16. Ecological features:
TPNR consists of a variety of habitats, including:
- seagrass meadows of strapweed (*Posidonia australis*), eelgrass (*Zostera capricorni*) , and paddleweeds (*Halophila ovalis* and *Halophila decipiens*);
- stands of mangroves including the grey mangrove (*Avicennia marina*) and the river mangrove (*Aegericas corniculatum*);
- saltmarshes
- dune woodlands
- Casuarina forest (*Allocasuarina littoralis* and *Casuarina glauca*)
- small occurrences of littoral rainforest, and
- sand dune grasslands

The terrestrial plant communities comprise a number of recognised associations such as swamp she-oak forest, littoral rainforest, littoral strandline and a complex mosaic of dune sclerophyll scrub/forest.

17. Noteworthy flora:
Towra Point Nature Reserve is botanically diverse, almost 300 vascular plant species have been identified (appendix 1).

The vegetation within TPNR is regionally significantly - the reserve contains approximately 50% of the remaining mangrove communities and 90% of the remaining saltmarsh communities in Sydney. Also, most vegetation communities occurring within the Reserve are now regionally uncommon due to urban development and expansion in the area.

Vegetation at Towra Point is also of great scientific importance because it was the site for some of the first botanical collections in Australia, by Joseph Banks and Daniel Solander in 1770. Thus the Reserve is the type locality for some species of indigenous flora.

The Reserve provides habitat for a small population of *Syzygium paniculatum*, which is listed as vulnerable under the *NSW Threatened Species Conservation Act 1995*. The plant *Gahnia filum* reaches its northern limit at Carters Island which is located within the Reserve.

18. Noteworthy fauna:
With the distinction of being one of the few remaining areas of estuarine wetlands in the Sydney region, Towra Point is important for the survival of many species of birds. Approximately 200 bird species have been recorded from the Towra Point area. Of particular significance is the occurrence of 31 of the 66 species presently listed in the Japan-Australia Migratory Birds Agreement (Anon. 1983a).

Anon. (1983a) has shown that Towra Point has a regular occurrence of 2.0% of the Australian population of the Eastern Curlew (*Numenius madagascariensis*), 6.1% of the Lesser Golden Plover (*Pluvialis dominica*) and 1.1% of the Ruddy Turnstone (*Arenaria interpres*) (Anon. 1983a). The sand spit area has also been used for breeding by species such as Little Tern (*Sterna albifrons*) and Pied Oystercatcher (*Haematopus ostralegus*) which are listed as endangered and threatened, respectively, under the *NSW Threatened Species Conservation Act 1995*.

The percentages for the occurrences of species within the area are difficult to assess from existing data due to the limited number of studies. However, the estuarine wetland at Towra point has large populations of migratory waders stopping to feed and rest an route to large summer feeding grounds in the south.

Limited surveys of other fauna (mammals, reptiles, amphibians and invertebrates) have also been undertaken.

Towra Point also supplies rich nutrient grounds for fish nurseries and an array of invertebrate species.

19. Social and cultural values:
The Towra Point area offers a readily accessible variety of wetland plants and animals in close proximity to Australia's largest city, Sydney, for research and teaching. There are no similar wetlands in central coastal New South Wales. In addition, the development of nearby areas for housing and heavy industry offers an interesting example for the study of interactions between the physical, social and biological environments of the area

The Reserve has some historic structures and three known Aboriginal sites.

20. Land tenure/ownership of:
The Ramsar site is a Nature Reserve dedicated under the New South Wales *National Parks and Wildlife Act 1974*. Surrounding lands include an Aquatic Reserve, dedicated under the *NSW Fisheries Management Act 1994*, and freehold lands.

21. Current land use/principal human activities:
The Ramsar site is permanently dedicated as a Nature Reserve and used for nature conservation. Surrounding lands include industrial, sporting and residential areas and Towra point Aquatic Reserve.

22. Factors adversely affecting the site's ecological character, including changes in land use and development projects:
TPNR is primarily surrounded by a highly industrial environment. Oil pollution associated with shipping movements is a moderate threat to the reserve. Also, dredging within Botany Bay and revetment walls construction are possibly altering wave movements within the bay, which may affect the seagrass meadows adjacent to the Reserve.

Shoreline instability and erosion, and invasive weed infestations, are ongoing management problems within the Reserve. Shoreline erosion causes impacts on wader roosting, feeding and nesting habitats. This poses a serious threat to the viability of wading bird populations at Towra Point.

Introduced plant and animals and litter are continuous management problems and are a medium to high threat to the Reserve.

Access to the Reserve by trail bike and horseback riders are a medium to high threat as they facilitate the propagation of weeds. Access by day users from boats are a low threat.

There also may be threats from proposed sandmining, landfill and dredging activities, and from proposed tourist developments in the vicinity of the Reserve.

23. Conservation measures taken:
A Draft Plan of Management for Towra Point Nature Reserve was adopted on 2 May 1989. This Plan addresses numerous conservation and management initiatives to preserve and enhance the area for nature conservation.

Management responsibilities of Towra Point primarily rests with the NPWS and NSW Fisheries. Draft Joint Management Guidelines between the two Departments have been prepared and include management initiatives such as reciprocal law enforcement rights and development of regulative signs.

Approximately 90 to 95% of Blackberry (*Rubus vulgaris*), Pampas Grass (*Cortaderia selloana*) and Prickly Pear (*Opuntia stricta*) has been removed by local volunteers and contractors. 95% of Bitou bush (*Chrysanthemoides monilifera*) has been removed and the removal of Lantana (*Lantana camara*) and Buffalo Grass (*Stenotaphrum secondatum*) has begun.

The NPWS has purchased an “oiled bird rehabilitation facility” which can be used in the event of a major oil spill in the area.

Management of Little Terns and waders continues each breeding season. Activities such as removal of vegetation, sandbagging, signposting, wardening and law enforcement are undertaken.

Access to the majority of the Reserve is by permit only. Regulatory signs have been erected within and surrounding the Reserve to deter inappropriate activities being undertaken.

Removal of pest animal species is undertaken regularly. Fox baiting is undertaken prior to the Little Tern breeding season. Pig eradication was undertaken in 1993 and has not been necessary again.

A sand bag wall has been installed as a temporary measure to control erosion at Towra Lagoon. This is a community initiative which has been funded by the State Government.

Activities, designated under the *NSW Environmental Planning and Assessment Act 1979*, that are undertaken within the Reserve are regulated through By-laws under *the NSW National Parks and Wildlife Act 1974*.

Since dedication of the TPNR, land acquisitions have increased the are of the Reserve by 105 ha

Strategies for controlling or eradicating pest plants and animals within the Reserve are being implemented according to the pest management plan for the Reserve. Management to eliminate inappropriate activities such as camping, and the use of horses and dogs within the Reserve, which may compromise the conservation values of the Reserve, is being carried out in accordance with the plan of management with the Reserve.

24. Conservation measures proposed but not yet implemented:
The NSW National Parks and Wildlife Service is currently revising the Draft Plan of Management for TPNR. The revised Plan of Management will take a holistic approach and consider TPNR in the context of Botany Bay as a whole. Areas that will be addressed within the review include the management of shoreline erosion , management of flora and fauna within the Reserve and visitor access.

A consultancy has been let to review the erosion mitigation measures for the reserve. The review will recommend a preferred option to address the significant erosion threats to the Reserve. Engineering works to protect shorebird habitats are proposed.

Additions to the Reserve of approximately 70 ha are proposed.

The current plan of management for TPNR is being reviewed and updated.

25. Current scientific and research facilities:
A number of universities, government departments and non-government organisations are undertaking research at Towra Point. Areas researched include terrestrial and aquatic flora, intertidal waders and biological control of Bitou Bush

NPWS has undertaken research into the breeding success of Little Terns at Towra Point since 1991.

26. Current conservation education:
A number of schools and universities carry out fields studies within TPNR. A NSW Department of School Education Field Studies Centre is located nearby at Botany Bay National Park (BBNP). The centre conducts educational programs on wetlands. NPWS also operates a visitors centre in BBNP which includes an interpretative exhibition on wetlands.

27. Current recreation and tourism:
Current recreational usage of parts of the reserve is high. In summer months in excess of 500 people and 120 boats have been recorded from the western face of Towra Point. This area is used for picnicking and swimming and access is generally by boat. Bush walking, under permit, usually associated with bird watching, occurs within the Reserve. Access for this activity is usually by land.

Activities such as horse riding, trail-bike riding and camping were once popular in the Reserve, but management practices have virtually eliminated these uses because they are incompatible with the management objectives for the Reserve.

28. Jurisdiction:
Territorial: Government of New South Wales
Functional: NSW National Parks and Wildlife Service

29. Management authority:
New South Wales National Parks and Wildlife Service (Metropolitan Region, Sydney Zone, District)
District Manager, PO Box 44, Sutherland NSW 2232, Australia
Phone 02 9542 0666; Fax 02 9542 1420

30. Bibliographical references:

Anon (1977). *An investigation of Management Options for Towra Point, Botany Bay.* Australian Littoral Society for Australian National Parks and Wildlife Service.

Anon (1983a). *Results from the 1983 Summer National Wader Counts*. Internal Report. National Parks and Wildlife Service.

Anon (1983b). *Wetlands*. Journal of the Coast and Wetland Society. Vol 3, No. 1

National Parks and Wildlife Service (1987). *Towra Point Nature Reserve Draft Plan of Management*. NSW National Parks and Wildlife Service.

Appendix

Appendix 1: Plant and Animal species recorded at Towra Point.

Appendix E – 11
Seagrass Literature Review and Survey Results

Seagrass Literature Review and Survey Findings

Seagrass Habitat

Recent habitat mapping of Botany Bay undertaken by NSW DPI (Fisheries) in 2009 investigated the extent of estuarine habitats in the area.

Densely covered seagrass beds have been identified as being located about 3 km back from the estuary entrance adjacent to Silver Beach. The beds are found in the sub-tidal zone and extend from the Kurnell Peninsula headland in to Woolooware Bay in depths ranging between approximately 0.5 – 3 m below chart datum (CD).

As part of the study, URS undertook surveys of seagrass habitat in closest proximity to the proposed dredging area, focusing on those between the Kurnell Pier and Silver Beach, in order to determine their present composition and extent. The aim of the study was to confirm the current extent of seagrasses in this area, which was achieved by undertaking towed diver and circular diver bottom searches. Seagrass mapping undertaken by (DPI, 2009) was used to inform the survey.

Change in the Last 100 Years

The distribution of seagrass beds in Botany Bay has undergone natural and man-induced changes over the last 100 years. The earliest estimates of the total extent of seagrass beds in Botany Bay are based on aerial photographs from the 1940's. The largest area of seagrass was estimated to be 761 ha, based on aerial photos from 1942. The smallest estimate was a total of 340 ha, based on aerial photos from 1977-1979. Considerable changes in the extent of the seagrass beds along the entire northern shore of the bay (i.e. including the shoreline from the mouth of the Cooks River to La Perouse) can be attributed largely to two expansions of the airport and the development of port facilities and access, although there appears to have been extensive natural variation in the seagrasses from 1930 to 1961 (Ecology Lab, 2003).

Decline since the 1980s

The data collected during the (DPI, 2009) surveys and its predecessor the Comprehensive Coastal Assessment (CCA) were used, in comparison to the original West *et al.* (1985) seagrass surveys in the 1980s, and each estuary was given a score in terms of the relative loss or gain of these habitats (Roper *et al.* 2009). There was estimated to have been a loss of seagrass of over 10% (and up to 40%) in the estuaries of the Sydney Metropolitan CMA region of the NSW coast, resulting in a ranking of 'fair'. (Creese *et al* 2009) (refer to **Table 1-1**).

Table 1-1 Extent of *Posidonia australis* beds in NSW in the 1980s and 2000s[1]

	***Posidonia* area**	
Estuary	**West *et al*, 1985**	**Creese *et al*, 2009**
Botany Bay	2.414 km^2	3.151 km^2

[1] Creese et al (2009)

Aerial photography was also reviewed prior to the field surveys to draw further comparisons (NearMaps, 2012; GoogleMaps, 2012). However, areas interpreted to contain seagrasses, where they had previously been mapped as present (DPI, 2009), were marked with buoys and on hand-held differential GPS equipment with an average accuracy range of +/-7m. For areas where aerial photos appeared to indicate discrepancies with DPI 2009 mapping and could not be resolved, ground-truthing was undertaken in the field using divers and differential GPS. The species compositions and depths of seagrasses at the margins of beds and patches were recorded (URS, 2012, Gray Diving Services,2012).

A towed diver search of the *Halophila ovalis* patch to the south of Fixed Berth (1) was noted to have receded significantly, when compared to DPI, 2009 data. Furthermore, a circular diver search of the *Halophila* community previously mapped to the south-east of the Fixed Berth (2) revealed that this patch no longer was found here. It was pointed out by (Creese et al, 2009) that the mapping technique undertaken for the study was unable to take account of discontinuities within mapped seagrass beds. In addition, there are many instances in NSW where quite substantial bare patches occur within beds, often because of human activities such as the installation of boat moorings as observed in Lake Macquarie. These 'holes' can mean that the real extent of a bed is much less than that mapped (Creese et al, 2009).

However, the extent of the *Posidonia/Halophila* patch to the south-east of the Fixed Berths was observed to align with DPI, 2009 mapping, although it appeared to be largely composed of *Posidonia*. The observed reduction in the extent of *Halophila* communities in these patches may be explained by the species seasonal pattern of low biomass in winter when salinity, temperature and light are limiting, followed by high biomass in summer seasons. A study on *H. ovalis* by (Hillman et al, 1995), showed there to be seasonal differences in biomass, and marked differences in seasonal trends of the species.

Also, it should be noted that *Halophila* spp. require less light than the other seagrass species, and can be found in very deep waters or in very shallow areas with turbid conditions (Green and Short, 2003). This provides anecdotal evidence to support the presence of *H. ovalis* in the deeper, turbid waters found within the turning circle of the proposed dredging area.

In order to protect the Caltex Kurnell Jetty from potential slumping of the dredge batter slope and vessel propeller wash, a rock revetment is proposed for the proposed dredging area The rock revetment would extend approximately 70 – 80 m along the south-western batter and would be approximately 15 to 25 m wide (*pers comm*. Khaled Elomar, Project Manager, Caltex 22/8/2012). Although it is predicted that the construction of a rock revetment in the area will create additional habitat for intertidal marine flora and fauna (TAS EPA, 2010), the potential ecological impacts associated with the rock revetment on seagrass communities in the immediate area is uncertain.

The construction of artificial coastal stabilisation measures such as bulkheads, seawalls, revetments, sandbags and groynes can be damaging to seagrasses (Miththapala, 2008). Dredging for such structures also adversely affects seagrass meadows, for example through changes in turbidity (Spalding et al, 2003 *in* Green and Short, 2003; Miththapala, 2008). Dredging for harbour and channel maintenance and releasing the dredged sediments on the seafloor also increases turbidity and lowered light levels (Green and Short, 2003). Indirect impacts caused by dredging activities include increased turbidity from suspended sediment, increased boat traffic, and changes in hydrological conditions (USGS, 2005).

Seagrasses that have the potential to be adversely impacted by the works associated with the proposed dredging area, include communities of both *Halophila* and *Posidonia* to the south and south-west of the proposed dredging area, between Kurnell Pier and Silver Beach. Due to the potential for seagrasses in this area to be affected by the proposal, pre and post-construction-monitoring of the seagrass beds in this region is proposed to be undertaken. To compensate for any potential loss of seagrasses as a result of works associated with the dredging works, seagrass habitat will be rehabilitated to its former (pre-dredging) extent where necessary.

Comparison of 2009 to 2012

The primary focus of the ecological field survey was the identification of flora, fauna and habitat resources within the study area. Surveys were also conducted outside of the proposed dredging area, in order to identify ecological values associated with the study area and surrounding environs that had been identified through the desktop review.

The key ecological constraints considered for the study area include:

- NSW and Commonwealth-listed threatened species, populations and ecological communities;
- Aquatic habitat resources; including extent of seagrass habitat, macro-algal deposits, artificial reef structures (e.g. wharf pylons and discarded anchors);
- Potential threatened species habitat;
- Presence of aquatic weeds;
- Presence of aquatic invertebrates; and
- Sensitive area identification.

The field survey was undertaken in a manner that referenced the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (DEC, 2004), *Draft Guidelines for Threatened Species Assessment* (DEC & DP&I 2005) and the *Manual for Mapping and Monitoring Seagrass Resources* (McKenzie et al, 2003). Given the condition of the study area, existing levels of disturbance, and overall lack of habitat resources, the survey recommendations of the above listed guidelines were adapted to allow appropriate assessment of a highly modified study area.

Given the disturbed nature of the study area, the surveys were adapted from the guidelines outlined above and modified accordingly, and included the following techniques:

- Recording of any threatened species identified within the study area;
- Opportunistic observations of flora species found within the study area, including the identification of any aquatic plants, vegetation communities and populations present within the study area;
- Recording of any noxious aquatic and marine weeds;
- Opportunistic observations of any fauna species within the study area, including migratory species in and around Botany Bay; and
- An assessment of the habitats and habitat resources present, and their suitability for threatened species or populations predicted to occur within the study area.

The stratification of habitats and vegetation types to determine survey effort as recommended in the guidelines outlined above was not undertaken. This process was considered inappropriate to the survey requirements given the marine nature of the proposed dredging works, and taking into account the homogenous and disturbed nature of the study area. Instead, biogenic habitat categories were recorded for the study area, with categories adopted from (Creese et al, 2009) (refer to **Table 1-2**). Marine benthic random meander surveys (Cropper, 1993) were undertaken to determine the presence (if any) of seagrasses, or potential suitable habitat within the proposed dredging area and surrounding environs.

Seagrass surveys undertaken by URS (supported by Gray Diving Services, 2012) involved Towed Diver Bottom Searches and Circular Diver Bottom Searches (refer to **Figure 11-3**). Seagrass samples were taken, where seagrass was observed within the study area to confirm species identification. All field surveys aimed to ensure adequate sampling of the study area.

Table 1-2 Biogenic habitat categories for coastal sub tidal bay environments[2]

Biogenic Habitat	Description
Macroalgae	Primarily brown seaweeds such as *Ecklonia radiate, Sargassum spp.* or *Phyllospora comosa.* This habitat could also contain small patches of the green alga *Caulerpa filiformis.*
Turfing algae	Small filamentous and foliose red and brown algae of the genera *Zonaria, Corallina, Amphiroa* or *Laurencia* (often with some *Sargassum spp).*
Sessile invertebrates	Sponges, ascidians, tube worms, bryozoans andr corals, typically found on vertical or sloping walls on the deep edges of reefs.
Peat barrens	Peat beds with no obvious plant or animal growth. This habitat could also contain a few scattered macroalgaes.

[2] Adopted from (Creese et al, 2009).

Appendix F

Heritage

Kurnell Port and Berthing Facility Upgrade: Heritage Impact Assessment

Prepared by Australian Museum Business Services
for URS Australia Pty Ltd

December 2012

120950

AMBS
Australian Museum Business Services - 6 College Street, Sydney NSW 2010, Ph (02) 9320 6311, Fax (02) 9320 6428
australianmuseum.net.au/AMBS ambs@austmus.gov.au

Document Information 120950

Citation:	AMBS (2012) *Kurnell Port and Berthing Facility Upgrade: Heritage Impact Assessment*. Report prepared for URS Australia Pty Ltd.
Local Government Area:	Sutherland Shire LGA
Versions:	Version 1: Draft Report issued September 2012 Version 2: Draft Report issued September 2012 Version 3: Report issued October 2012 Version 4: Report issued December 2012
Recipient:	Chris Fay, Associate Environmental Planner, URS Australia Pty Ltd
Approved by:	Jennie Lindbergh, AMBS Senior Project Manager
Primary Authors:	Libby Percival, AMBS Project Manager Ngaire Richards, AMBS Project Officer

Executive Summary

Australian Museum Business Services (AMBS) has been commissioned by URS Australia Pty Ltd (URS) on behalf of Caltex Australia Petroleum Pty Ltd (Caltex) to prepare a Heritage Impact Assessment (HIA) to address Aboriginal, historic and maritime heritage issues associated with the Kurnell Port and Berthing Facility Upgrade. The project will be assessed under the new Part 4 Division 4.1 of the *Environmental Planning and Assessment Act 1979* (NSW EP&A Act) as State Significant Development. The HIA forms a Technical Appendix to the Environmental Impact Statement (EIS) for the proposed works. The HIA is based on a desktop assessment of the Aboriginal, historic and maritime cultural heritage of the study area.

The Kurnell Port and Berthing Facility Upgrade involves dredging and berth upgrade works to improve ship access to the Kurnell Wharf in Botany Bay. The Kurnell Wharf is the sole entry point for the feedstock of crude oil and other petroleum product imports that are processed at the Caltex-operated Kurnell Refinery. It comprises two fixed shipping berths, a submarine (sub) berth, a turning circle and an approach to the wharf from the main Botany Bay shipping channel.

Scope of the Assessment

Based on hydrodynamic modelling prepared by Cardno for the proposed works, the La Perouse shoreline to the west of the site would not be impacted by the works and has not therefore been addressed in this report. The Aboriginal and historic heritage study areas are therefore focused on the shoreline to the south of the site, including Kurnell Wharf, the village of Kurnell, and Kamay Botany Bay National Park. The maritime heritage study area is focused on the project Site, a total area of approximately 128,000 m^2 within Botany Bay.

Existing Environment

Aboriginal Heritage Context

The Kurnell Peninsula was inhabited by the Gweagal people at the time of European contact. Early European accounts of the area indicate that small groups of Aboriginal people camped near the water, sometimes in bark huts. Extensive evidence of fishing and shellfishing activity was observed. Radiocarbon dates have been obtained for a number of Aboriginal occupation sites on the Peninsula, the majority of which date to within the last 3,000 years.

An extensive search of the AHIMS database was undertaken on 28 August 2012 (AHIMS client service number #78255), and 75 registered Aboriginal sites were identified within a 6km x 7km area centred on the project Site. Registered Aboriginal sites identified on the northern foreshore include midden deposits and Aboriginal burials at Captain Cook's Landing Place in Kamay Botany Bay National Park (AHIMS Site 52-3-0219), which contribute to the significance of the Kurnell Peninsula Headland NHL listing, and Potential Archaeological Deposits (PADs) on the Silver Beach foreshore.

Historic Heritage Context

The following table provides a summary of the historic heritage items and places within an area of approximately 100 m of the Kurnell shoreline, facing the project Site:

Name	Other names	Primary Address	Heritage Register	Significance
Kurnell Peninsula Headland*	• Kamay Botany Bay • Botany Bay National Park (Kurnell Historic Site) • Kurnell monuments (in National Park) • Captain Cook's landing place • Captain Cook's landing site • Banks Memorial • Solander monument • Captain Cook monument • Forby Sutherland monument • Landing place wharf abutment • Alpha Farm Site • Captain Cook Watering hole • Captain Cook Watering well • Flagpole • Botany Bay Entrance Landscape Conservation Area • Captain Cooks Landing Place Historic Site	Cape Solander Drive, Kurnell, NSW, Australia	• NHL • OEH Section 170 Register • SEPP Kurnell Peninsula • National Trust Register • RNE	National
Australian Oil Refinery	• Kurnell Oil Refinery • Australian Lubricating Oil Refinery	Cape Solander Drive, Kurnell	• SEPP Kurnell Peninsula	Local
Bonna Point Reserve		Sir Joseph Banks Drive, Kurnell	• SEPP Kurnell Peninsula	Local
Crown Land, boatshed		Prince Charles Parade, Kurnell	• SEPP Kurnell Peninsula	Local
Silver Beach and roadway		Prince Charles Parade, Kurnell	• SEPP Kurnell Peninsula	Local

*Note: Aboriginal cultural heritage values have also been identified for this item.

The Kurnell Peninsula Headland is famous for being the place where British explorer Lieutenant (later Captain) Cook first set foot on the shore of eastern Australia in April 1770. It is also the place where crew of the *Endeavour* first encountered the Indigenous occupants of the land, and naturalists Joseph Banks and Daniel Solander collected the first scientific type-specimens of Australian flora and fauna. It was meant to be the location of the first British penal colony in Australia; however, Captain Arthur Phillip found the land to be unsuitable, and decided to establish Sydney to the north at Port Jackson. Despite this, the site of Captain Cook's landing place quickly became a commemorative landscape, where heroes of science and exploration and the events of 1770 could be memorialized and celebrated. From 1899, it was developed as a park, focused on the landing site and its symbolic importance for a national identity. In 2004, the Kurnell Peninsula Headland was listed on the NHL, recognising its outstanding heritage value to the nation as the site of first recorded contact between British and Indigenous people in eastern Australia.

The local heritage item Australian Oil Refinery refers to the Kurnell Refinery, constructed by Caltex between 1953 and 1956, including storage areas, power plant, yard, and wharf, as well as the 1960s Australian Lubricating Oil Refinery and the 1970s Bass Strait complex. The Refinery was the second oil refinery to be constructed in NSW, and is the only refinery operating in the State today.

Maritime Heritage Context

According to historical records, archival sources, The Australian National Shipwrecks Database (SEWPaC), and the NSW Maritime Heritage Shipwreck Database (OEH), 25 vessels over 10 tons are known to have been wrecked in the vicinity of Botany Bay, including Kurnell, between 1788

and 1990. Of those 25 vessels, nine were wrecked inside Botany Bay and may lie in the vicinity of the Dredge Footprint. These vessels are:

Vessel Name	Year Wrecked
Eileen	1934
George	1877
Magnet	1874
Minnie Wamsley	1903
Prompt	1881
Reclama	1930
Swan	1836
Unidentified Barge	1953
Unknown Shipwreck – possible the ketch Arab	1907

In addition, other maritime activities are likely to have left their mark on the maritime environment:

- Moorings and anchor fields
- Ballast mounds
- Commercial and amateur fishing equipment
- Seaweed harvesting
- Shell grit and lime production

A comparison of the historical chart information from 1803, 1848-1851 and 1935 with a 2012 edition of AUD Chart 198 (Datum WGS84), which shows the waters of Botany Bay, indicates that dredging operations carried out in the Bay in the vicinity of the Kurnell Wharf between 1953 and 1965 removed from the original seabed, between 2 to 4 metres in the eastern section of Area 1 (Sub-berth approach); between 3 and 5 metres in Area 2 (Sub-berth 3), and between 1 and 3 metres in Area 3 (Fixed Berths 1 and 2).

Given the nature of the material used in the construction of the Eileen (1934), George (1877), Magnet (1874), Minnie Wamsley (1903), Prompt (1881), Swan (1836) and the Unknown Shipwreck (1907), the relatively small size of the vessels, the exposed nature of the seabed, and the extensive dredging and other extractive processes which have occurred in Area 2 (Sub-berth) and Area 3 (Fixed Berths 1 and 2), it is predicted that the potential to disturb shipwrecks in these areas is very low. The potential to disturb other items of underwater cultural heritage is also low.

Given the less extensive, and limited, dredging and other extractive processes which have occurred in the western parts of Area 1 (Turning Circle and approaches), it is predicted that the potential to disturb items of underwater cultural heritage is moderate in this area.

It is also predicted, based on historical information, that the Reclama (1930) and the Unidentified Barge (1953) lie outside the study area.

Predicted Impacts

Aboriginal Heritage Impact Assessment

Previous archaeological investigations carried out near the foreshore demonstrate that despite disturbance across the Kurnell Peninsula, in situ archaeological deposits may still be present. However, all of the Aboriginal heritage sites which have been identified on the Silver Beach foreshore and within Kamay Botany Bay National Park on the Kurnell Peninsula Headland are located above the high water mark. Given the results of hydrodynamic and sediment modelling, which suggest there would be some indiscernible changes in wave energy along the length of Silver Beach and minor sediment build up along the Kurnell Headland foreshore (less than 1mm), it is unlikely that Aboriginal heritage sites or values would be affected by the proposed works.

Historic Heritage Impact Assessment

The proposed dredging works, including the location of dredging equipment and changes to water turbidity, would have a minor, temporary impact on important views of Botany Bay from the Meeting Place Precinct, the visual and physical relationship between the site and the bay, and the natural beauty of the place, which all contribute to the national heritage values of the Kurnell Peninsula Headland. Upgrades to the Kurnell Wharf fixed berth infrastructure, including installation of a hydraulic loading arm system to Fixed Berth 1 would not substantially alter views of the wharf from the headland, insofar as there will be little or no change to the bulk or vertical scale of the existing berthing structures. Extension of the wharf structure by the addition of a third mooring island, similar to the existing mooring islands, will not interrupt views to the Meeting Place Precinct from the headlands to the north, and will have little or no impact on the existing approach experience to the site from the bay. Overall, the proposed works would not have any long-term or significant impact on the current view corridors, the orientation of the site to the bay, or the national heritage values of the place.

Any sediment build-up could obscure significant archaeological evidence of early wharves and rock cuttings along the foreshore, including, in particular, important archaeological evidence of Holt's wharf and Birnie's dock, associated with the Kamay Botany Bay National Park Meeting Place Precinct. This build-up would not impact on the physical fabric of the rock cuttings, but there is a possibility it could interfere with the visual appreciation or interpretation of these elements by the general public. Taking into consideration the dynamic nature of the intertidal environment and minimal changes to water movement within the bay, any sediment build up is likely to be temporary and as such would not have a significant impact on the National heritage values of the place. Although the Isaac Smith Memorial is sited off-shore, the predicted sediment build-up is unlikely to have an adverse impact on the stability or setting of the monument.

Hydrodynamic modelling of the proposed works indicates that there would not be any changes to wave energy in the vicinity of the National Park. As such there are unlikely to be any impacts on fabric or significance of the remains of the Isaac Smith Memorial, the Trust wharf, or original elements of the sandstone seawall as a consequence of increased wave energy.

Hydrodynamic and wave impact modelling of the proposed dredging works indicate that there would be indiscernible changes in wave energy along the length of Silver Beach, and that there would be no, or negligible, impacts on beach erosion or the structural integrity of the sandstone groynes. Changes to water turbidity would have a minor, temporary impact on important views of Botany Bay. The works are unlikely to have long term impacts on the amenity or aesthetic significance of the beach and roadway.

The proposed upgrades to the Kurnell Wharf fixed berth infrastructure aim to keep the wharf in operation and as such would support the primary industrial heritage significance of the overall Australian Oil Refinery (AOR) site as a rare, active oil refinery in NSW. However, the installation of a new hydraulic loading arm system, manifold, and quick release hooks on Fixed Berth 1 would involve the permanent removal of the remaining 1960s loading arm technology from the wharf. This change would have a minor adverse impact on the historic and scientific significance of the overall site.

Construction of four, standalone breasting dolphins to allow the berthing of larger ships is unlikely to have adverse impacts on the wharf structure, and would also support the primary heritage significance of the overall site. The proposed works would not have any impact on the main refinery site, and are consistent with the technical significance of the AOR as an operational refinery.

Maritime Heritage Impact Assessment

No shipwrecks or other elements of maritime heritage have been identified within the dredge footprint. However, the motile nature of the maritime environment is such that there is potential for unexpected maritime relics to be exposed during the dredging process. As less extensive dredging and other extractive processes have taken place in the north-western section of the dredge footprint within Area 1 (Turning Circle and its approaches), there is a moderate potential to disturb hitherto undiscovered shipwrecks, articles associated with shipwrecks, or other items of underwater cultural heritage in this area during dredging works.

Conclusions and Recommendations

Aboriginal Heritage

Aboriginal cultural heritage values of the study area are not likely to be affected by the proposed works, and as such no further assessment of the study area is required prior to works.

Recommendation 1

There are no Aboriginal heritage constraints on the proposed works. No further Aboriginal cultural heritage assessment is required prior to works.

Recommendation 2

A copy of this report should be supplied to La Perouse Local Aboriginal Land Council for review and comment. Any feedback provided should be appended to this report.

Historic Heritage

Overall, the effects of the dredging would not permanently damage, destroy, or substantially alter significant historic heritage fabric or views associated with the national heritage values of the Kurnell Peninsula Headland. As such, Caltex is not required to submit a referral to SEWPaC for an assessment and approval by the Minister under the provisions of the C'th EPBC Act.

The proposed wharf upgrades would impact on significant fabric of the wharf structure, which contributes to the overall historic and technical significance of the local heritage item Australian Oil Refinery. Taking into consideration the long-term, cumulative impacts of upgrades to the wharf structure on the heritage significance of the place, it would be appropriate to make an archival recording of the physical fabric and operation of the wharf, which could in future be used to illustrate the history of the place.

Recommendation 3

Consideration should be given to preparing a photographic recording of the existing fabric and operation of Kurnell Wharf prior to the upgrade works, including in particular the existing infrastructure at Fixed Berth 1, which would be replaced as part of the proposed works. This record would become part of the history of the place and should be maintained for the appreciation of present and future generations.

Maritime Heritage

Although no shipwrecks or other elements of maritime heritage have been identified or noted within the study area, there is moderate potential for unexpected maritime relics to be exposed during the dredging works in the northwest part of the dredge footprint within Area 1 (Turning Circle and approaches). Should maritime relics be unexpectedly found during the dredging works, works in the area of the relics should cease and the Heritage Council of NSW should be notified, in accordance with Section 146 of the NSW Heritage Act. Mitigation may include archaeological excavation of the relics.

To mitigate against the potential for an unexpected discovery of shipwrecks or other maritime relics delaying the works program, existing side scan data of the northwest part of the dredge footprint in Area 1 should be reviewed by a maritime archaeologist prior to works. If this data is not available, a remote sensing survey should be undertaken by a maritime archaeologist prior to works. This could be undertaken in conjunction with geotechnical and/or other preconstruction surveys. In addition, works in Areas 2 and 3 should be monitored for maritime cultural heritage to ensure that any relics exposed would be assessed by a maritime archaeologist and an appropriate management strategy put in place.

Recommendation 4

Should maritime heritage relics be unexpectedly found during the dredging works, works in the area of the relics should cease and the Heritage Council of NSW should be notified, in accordance with Section 146 of the NSW Heritage Act.

Recommendation 5

To mitigate against the potential for an unexpected discovery of relics delaying the works program, existing side scan data of the north-western section of the dredge footprint in Area 1 (Turning Circle and its approaches) should be reviewed by a maritime archaeologist prior to works. If this data is not available, a remote sensing survey should be undertaken by a maritime archaeologist prior to works. In addition, works in Areas 2 and 3 should be monitored for maritime cultural heritage to ensure that any relics exposed would be assessed by a maritime archaeologist, and an appropriate management strategy put in place.

Management and Mitigation Measures

Caltex have included the following management and mitigation measures in the EIS for the proposed works to address impacts on the significance of existing and potential heritage items, places and archaeological sites affected by the works:

- A photographic record of the existing fabric and operation of Kurnell Wharf would be prepared prior to the proposed works. This would focus in particular on the existing infrastructure at Fixed Berth 1. This record would become part of the history of the place and would be maintained for the appreciation of present and future generations.

- A management control would be included in the *Dredge and Spoil Disposal Management Plan* (DSDMP) and the *Construction Environmental Management Plan* (CEMP) for the works' contractor to monitor for heritage items or relics during dredging. If relics were to be discovered in the dredging areas, the works would immediately cease at that location and the relics would be reported to NSW Heritage Council (in accordance with Section 146 of the Heritage Act 1977). Further assessment by a maritime archaeologist and development of an appropriate management strategy may also be required.

Contents

Tables

Figures

1 Introduction

1.1 Preamble

Australian Museum Business Services (AMBS) has been commissioned by URS Australia Pty Ltd (URS) on behalf of Caltex Australia Petroleum Pty Ltd (Caltex) to prepare a Heritage Impact Assessment (HIA) to address Aboriginal, historic and maritime heritage issues associated with the Kurnell Port and Berthing Facility Upgrade. The HIA forms a Technical Appendix to the Environmental Impact Statement (EIS) for the Project, which is being assessed as State Significant Development under Part 4 Division 4.1 of the *Environmental and Planning Assessment Act 1979* (NSW EP&A Act).

1.2 The Project Site and Proposal

The Kurnell Port and Berthing Facility Upgrade involves dredging and berth upgrade works to improve ship access to the Kurnell Wharf in Botany Bay. The project Site is located within the south-eastern portion of Botany Bay, north of the Kurnell Peninsula, and approximately 9 km south of Sydney's Central Business District (CBD). The Site is bounded to the north and east by the main Botany Bay shipping channel. To the south are Silver Beach, the village of Kurnell, and the Kurnell Refinery. The Botany Bay headlands, which are to the west and southwest of the site, form part of Kamay Botany Bay National Park.

The Kurnell Wharf is the sole entry point for the feedstock of crude oil and other petroleum product imports that are processed at the Caltex-operated Kurnell Refinery. Caltex is responsible for operating and maintaining the area of Botany Bay around the wharf where the works are proposed. It comprises two fixed shipping berths, a submarine (sub) berth, a turning circle and an approach to the wharf from the main Botany Bay shipping channel.

The wharf and breasting island were constructed in 1953-56 and last upgraded in 2010. Dredging last took place within the sub berth, turning circle and approaches in 1969. The fixed berths have never been dredged. Sediment has subsequently accumulated around the wharf, such that Caltex must now dredge the area to reclaim its full navigable depth and to ensure continued safe access to the Kurnell Wharf by the size of ships required to deliver products to the refinery.

In addition, Caltex proposes to dredge an additional area around the existing berths at the wharf, to accommodate the number and size of ships required to meet increased demand for petroleum products by the NSW economy over the next decade. The additional area has never been previously dredged.

The works also require upgrade to the sub berth, fixed berths, and wharf infrastructure to comply with current design standards and allow future larger ships to berth both safely and efficiently.

The proposed dredge footprint, berths and wharf (the project Site) are shown in Figure 1.1.

Figure 1.1 The project Site, including the proposed dredge footprint, berths and wharf.

Table 1.1 and Figure 1.2 provide a summary of the proposed dredging works, showing the area, depth, volume and over dredging volume of the maintenance and capital works.

Table 1.1 Summary of proposed dredging volumes. Source of current average depth (m below Chart Datam): Maritime Services Board 1983; source of proposed dredging volumes: URS.

Location	Dredging Type	Current average (m below CD)	Design Level (m below CD)	Design Area (m^2)	Design Volume (m^3)	Total Volume, incl. over-dredging (m^3)
Area 1 (approach and turning circle)	Maintenance	12.2	12.8	98,750	30,500	60,250
Area 2 (sub berth)	Maintenance	13.1	14	16,750	7,750	12,750
Area 3 (fixed berths 1 & 2)	Capital + maintenance	11 & 11.6	12.8	61,250	61,250	80,000

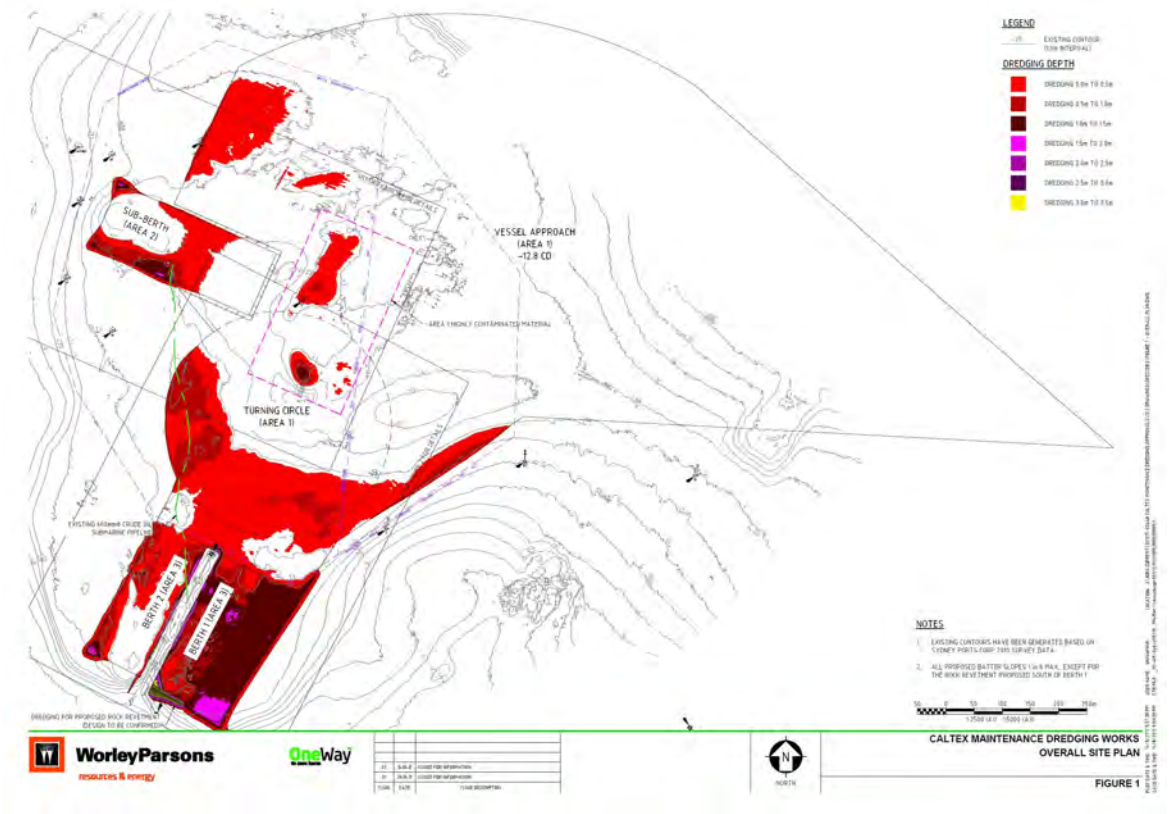


Figure 1.2 Overall site plan, showing proposed dredging works. (Source: WorleyParsons)

The proposal includes provisions to re-use 1,050 m^3 of clean dredged sediment taken either from the area north of the sub berth or the area on the southern side of the turning circle. The remaining 89,200 m^3 of the dredged material would be disposed at the Sydney Offshore Disposal Ground. The disposal ground is located approximately 5 nautical miles (nm) (10 km) east-southeast off Sydney Heads in water depths approximately 100 to 130 m below CD. The offshore disposal grounds cover an area of approximately 23 km^2.

Hydrodynamic and wave impact modelling of the proposed works indicates that there would be indiscernible changes in wave energy along the length of Silver Beach. Dredge plume modelling indicates that suspended sediments generated by the dredging in Area 1 (approach and turning circle) would be dispersed in a localised area, and that there would be some minor sediment build up (less than 1 mm) along the foreshore of the Kurnell Headland (refer to Chapter 8 of the EA). All waste materials would be stored in a controlled manner and disposed of by authorised means onshore.

1.3 Scope of Assessment

Based on hydrodynamic modelling prepared by Cardno for the proposed works, the La Perouse shoreline to the west of the site would not be impacted by the works and has not therefore been addressed in this report (refer to Chapter 8 of the EIS). The Aboriginal and historic heritage study areas are therefore focused on the shoreline to the south of the site, including Kurnell Wharf, the village of Kurnell, and Kamay Botany Bay National Park. The maritime heritage study area is focused on the project Site, a total area of approximately 128,000 m^2 within Botany Bay.

1.4 Methodology

This report is based on a preliminary desktop assessment of the Aboriginal, historic and maritime cultural heritage of the study area. A brief land-based site visit was undertaken by Ngaire Richards and Libby Percival on 11 September 2012 to confirm the locations of known Aboriginal and historic heritage items, places and archaeological sites. The report is consistent with the principles and guidelines of the Burra Charter (*The Australia ICOMOS charter for the conservation of places of cultural significance*).

The Aboriginal cultural heritage impact assessment has been undertaken in accordance with Step 1 of the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (Department of Environment and Conservation [DEC] 2005).

The historic heritage and maritime heritage impact assessment has been prepared in accordance with current best-practice heritage guidelines as identified in the *NSW Heritage Manual* (1996), published by the Heritage Office and Department of Urban Affairs and Planning (now the Heritage Branch, Office of Environment and Heritage [OEH], Department of Premier and Cabinet), and associated supplementary publications including *Archaeological Assessments* (1996), *Assessing Heritage Significance* (2001) and *Assessing Significance For Historical Archaeological Sites and 'Relics'* (2009). The assessment of impacts on items of National heritage significance has been prepared in accordance with *Matters of National Environmental Significance: Significant impact guidelines 1.1* (Department of the Environment, Water, Heritage and the Arts 2009). The maritime archaeology component of the report has also been prepared in accordance with *Underwater Heritage – Principles and Guidelines* (Heritage Office 1994).

The following statutory and non-statutory heritage lists and registers have been reviewed to identify the location and significance of Aboriginal, historic and maritime heritage sites, items and places within the study area:

- National Heritage List (NHL)
- Commonwealth Heritage List (CHL)
- NSW State Heritage Register (SHR)
- NSW State Heritage Inventory (SHI)
- OEH Aboriginal Heritage Information Management System (AHIMS)
- *State Environmental Planning Policy (Kurnell Peninsula) 1989,* Schedules 2 and 3 (SEPP Kurnell Peninsula)
- SEWPaC Australian National Shipwreck Database
- OEH New South Wales Maritime Heritage Shipwreck Database
- National Trust of Australia (NSW) Register
- National Trust of Australia (NSW) Industrial Archaeological Sites List (IAS)
- Register of the National Estate (RNE)

1.5 Limitations

This report does not include full archaeological, underwater, or heritage survey and assessment of the study area, and only includes preliminary consultation with La Perouse Local Aboriginal Land Council and relevant local councils.

1.5.1 Aboriginal Community Consultation

Aboriginal community consultation is an integral part of the assessment of Aboriginal cultural heritage significance. Preliminary consultation was undertaken in order to:

- provide La Perouse Local Aboriginal Land Council, as statutory representatives of the local Aboriginal community, with the opportunity to comment on the Aboriginal cultural heritage values of the study area and be involved in the heritage assessment process;
- identify potential Aboriginal cultural heritage values of the study area;
- integrate potential Aboriginal heritage values and recommendations for management into the assessment report; and,
- provide an opportunity for the local Aboriginal community to comment on the outcomes and recommendations of Heritage Impact Assessment reporting.

Initial consultation was undertaken with La Perouse LALC, who were advised of the proposed dredging and berth upgrade works on 5 September 2012, and invited to identify any spiritual, traditional, historical or contemporary associations and attachments which the project area has for the present-day Aboriginal community, in accordance with Step 1 of the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). No response was received within the notification period.

The Heritage Impact Assessment was provided to La Perouse LALC for review, with a request for feedback by 8 November 2012. La Perouse LALC was contacted again on 26 November 2012 by phone, and asked if they would like to comment on the report; however, no response had been received as at 10 December 2012.

This level of consultation does not comply with OEH requirements as specified in the *Interim Community Consultation Requirements for Applicants* (DEC 2004), and should be regarded as a Preliminary Assessment only. However, as Aboriginal cultural heritage values are not likely to be affected by the proposed port and dredging works, there is no further requirement for community consultation or assessment.

1.5.2 Maritime Heritage

Although the Australian National Maritime Museum (ANMM) conducted a review of the historical records relevant to the maritime heritage of the study area and assessed the area for maritime heritage significance, because of the nature of underwater cultural heritage and the scarcity of historical and field information there is a possibility that items of underwater cultural heritage, protected as relics under the *Heritage Act 1977* may be present within the area covered by this report.

1.6 Authorship and Acknowledgements

This report has been prepared by AMBS Project Officer Ngaire Richards and AMBS Project Manager Libby Percival. Sections 5.6, 6.4, 7.3 and 8.3 were contributed by Kieran Hosty, Curator of Maritime Archaeology at the Australian National Maritime Museum (ANMM) and are based on archival research carried out by Kieran Hosty, Paul Hundley and Dr Nigel Erskine from ANMM. AMBS Senior Project Manager Jennie Lindbergh reviewed the report for quality and consistency, and AMBS

Project Manager Christopher Langeluddecke provided a technical review of the Aboriginal heritage aspects of the report.

2 Statutory Context

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (C'th EPBC Act) provides a legal framework for the protection and management of places of national environmental significance. Several heritage lists are addressed by the EPBC Act, including the National Heritage List (NHL) and the Commonwealth Heritage List (CHL). The NHL protects places that have outstanding value to the nation. The CHL protects items and places owned or managed by Commonwealth agencies. The Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) is responsible for the implementation of national policy, programs and legislation to protect and conserve Australia's environment and heritage and to promote Australian arts and culture. Approval from the Minister is required for controlled actions which would have a significant impact on items and places included on the NHL or CHL.

The following place is listed on the NHL:

Place ID	Name	Primary Address	Significance
105812	Kurnell Peninsula Headland	Cape Solander Dr, Kurnell, NSW, Australia	National

The location of the Kurnell Peninsula Headland is described as:

> *About 400ha, at Kurnell, comprising Botany Bay National Park, Lot 1 DP91704, the road reserve extending from Cape Baily Lighthouse in the east to the Park boundary in the west and the area between the seaward boundaries of the National Park and Lot 1 DP91704 and the Low Water Mark.*

The boundary of the place is illustrated in Figure 2.1.

The following place has been nominated for inclusion on the NHL:

Place ID	Name	Primary Address	Significance
106162	Kamay Botany Bay	Captain Cook Dr, Kurnell, NSW, Australia	National

The nomination seeks to include all the values encompassed in the current NHL Kurnell Peninsula Headland within a broader boundary and recognise additional associative values.

There are no heritage items listed on the CHL within the study area or its near vicinity.

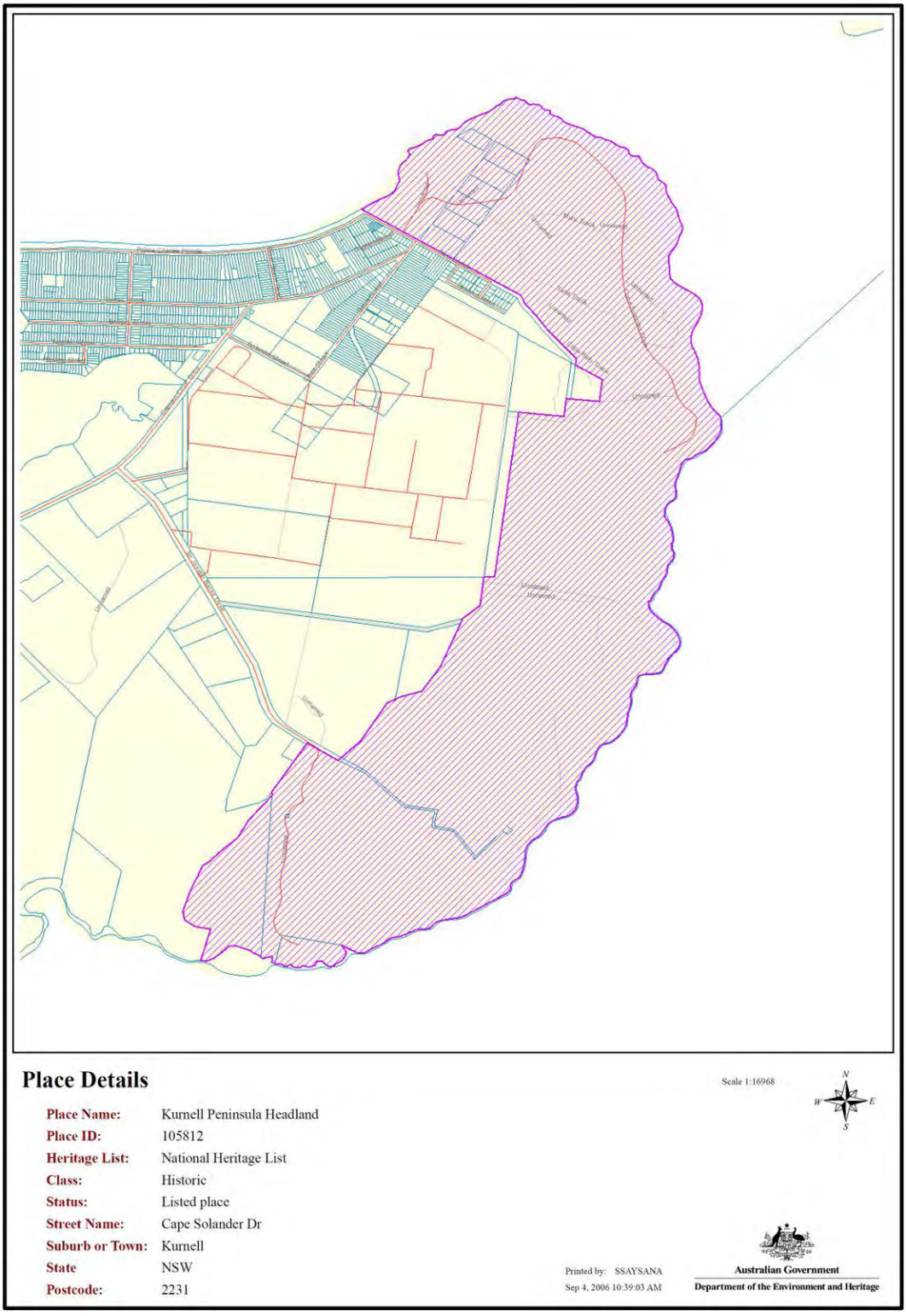


Figure 2.1 Boundary map of the NHL listed Kurnell Peninsula Headland.

2.2 National Parks and Wildlife Act 1974

Under the provisions of the *National Parks & Wildlife Act 1974* (amended 2010; NSW NPW Act), the Director-General of the National Parks and Wildlife Service (NPWS; now OEH) is responsible for the care, control and management of all national parks, historic sites, nature reserves, state conservation areas, karst conservation reserves and regional parks. The Director-General is also

responsible, under this legislation, for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW.

All Aboriginal Objects are protected regardless of their significance or land tenure under the NSW NPW Act. Aboriginal Objects can include pre-contact features such as scarred trees, middens and open camp sites, as well as physical evidence of post-contact use of the area such as Aboriginal built fencing and fringe camps. The NSW NPW Act also protects Aboriginal Places, which are defined as a place that 'in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture'. Aboriginal Places can only be declared by the Minister administering the NSW NPW Act.

Under Section 90 of the Act, it is an offence for a person to destroy, deface, damage or desecrate an Aboriginal Object or Aboriginal Place without the prior issue of an Aboriginal Heritage Impact Permit (AHIP). The Act requires a person to take reasonable precautions and due diligence to avoid impacts on Aboriginal Objects. AHIPs may only be obtained from the Environmental Protection and Regulation Division (EPRD) of OEH.

Under Section 89J(c) of the NSW EP&A Act, Caltex is not required to apply for an AHIP, as the proposed works are declared to be State Significant Development (see Section 2.4 below). However, under Schedule 2 of the *Environmental Planning and Assessment Regulation 2000,* the Director-General is required to consult with OEH in the preparation of environmental assessment requirements, and to assess key issues raised by OEH with respect to the proposed works.

2.2.1 Aboriginal Heritage Information Management System (AHIMS)

Part of the regulatory framework for the implementation of the NSW NPW Act is the Aboriginal Heritage Information Management System (AHIMS), maintained by OEH. AHIMS includes a database of Aboriginal heritage sites, items, places and other objects that have been reported to the OEH. Also available through AHIMS are site cards, which describe Aboriginal sites registered in the database, as well as Aboriginal heritage assessment reports, which contribute to assessments of scientific significance for Aboriginal sites. The AHIMS is not a comprehensive list of all Aboriginal heritage sites in NSW, rather it reflects information which has been reported to OEH. As such, site co-ordinates in the database vary in accuracy depending on the method used to record their location. Heritage consultants are obliged to report Aboriginal sites identified during field investigations to OEH, regardless of land tenure, or whether such sites are likely to be impacted by a proposed development. The results of a site search for the local area are presented in Section 4.2.

2.3 Heritage Act 1977

The *Heritage Act 1977* (NSW Heritage Act) provides protection for heritage places, buildings, works, relics, moveable objects or precincts that are important to the people of NSW. These include items of Aboriginal and non-Aboriginal heritage significance. Where these items have particular importance to the State of NSW, they are listed on the State Heritage Register (SHR).

The following place is within 100m of the La Perouse shoreline, to the northwest of the project Site:

Ref	Name	Primary Address	Significance
00978	Bare Island Fort	La Perouse, NSW 2036	State

Based on the hydrodynamic modelling for the proposed works, the La Perouse shoreline would not be affected by the proposed works. As such, the Bare Island Fort is not considered further in this report.

The NSW Heritage Act also provides statutory protection to relics, archaeological artefacts, features or deposits. The Heritage Act defines an archaeological relic as:

> *any deposit, artefact, object or material evidence that:*
> *(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
> *(b) is of State or local heritage significance.*

Under Section 89J(c) of the NSW EP&A Act, Caltex is not required to apply for approvals or excavation permits under the NSW Heritage Act for State Significant Development (see Section 2.4 below). However, under Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* the Director General is required to consult with the Heritage Branch in the preparation of environmental assessment requirements, and to assess key issues raised by the Heritage Branch with respect to the proposed works. Under Section 146 of the NSW Heritage Act, the discovery of a relic also requires that *a person who is aware or believes that he or she has discovered or located a relic (in any circumstances, and whether or not the person has been issued with a permit) must:*

> *(a) within a reasonable time after he or she first becomes aware or believes that he or she has discovered or located that relic, notify the Heritage Council of the location of the relic, unless he or she believes on reasonable grounds that the Heritage Council is aware of the location of the relic, and*
> *(b) within the period required by the Heritage Council, furnish the Heritage Council with such information concerning the relic as the Heritage Council may reasonably require.*

The relics provisions of the Act also cover maritime archaeology. Should physical remains of a shipwreck or other maritime heritage relics be identified during dredging works, the applicant is required to cease work in that area and contact the Heritage Council of NSW.

2.3.1 Historic Shipwrecks

Part 3C of the NSW Heritage Act provides statutory protection to historic shipwrecks. The Act defines a historic shipwreck as *the remains of any ship (including any articles associated with the ship):*

> *(a) that have been situated in State waters, or otherwise within the limits of the State, for 75 years or more, or*
> *(b) that are the subject of a historic shipwrecks protection order.*

Articles associated with the ship include:

> *(a) any article that appears to have formed part of the ship, and*
> *(b) any article that appears to have been installed on, or carried in, the ship, and*
> *(c) any article that appears to have been constructed or used by a person associated with the ship.*

The Heritage Council maintains a Register of Shipwrecks within NSW. The NSW Maritime Heritage Shipwreck Database and the NSW section of the Australian National Shipwreck Database list the following vessels, which are known to have been wrecked within Botany Bay and may be in the vicinity of the Dredge Footprint:

Vessel Name	Year Wrecked	Vessel Type	Where Wrecked
Eileen	1934	Trawler	Kurnell
Magnet	1874	Sailing Vessel	Sydney, Botany Bay, off

Vessel Name	Year Wrecked	Vessel Type	Where Wrecked
Minnie Wamsley	1903	Single screw steamer	Botany Bay
Prompt	1881	Sailing vessel	Botany Bay, ashore near govt wharf
Swan	1836	Sailing vessel	Botany Bay, Seven Mile Beach, off

Archival research by the ANMM has also identified the following shipwrecks, which may be in the vicinity of the Dredge Footprint (see Section 5.6):

Vessel Name	Year Wrecked
George	1877
Reclama	1930
Unknown Shipwreck – possible the ketch Arab	1907
Unidentified Barge	1953

2.3.2 OEH Heritage and Conservation Register (Section 170 Register)

Section 170 of the NSW Heritage Act requires government departments and agencies to maintain a Heritage and Conservation Register (Section 170 Register). This Register provides a list of assets which may have State or local heritage significance, including:

(a) items that are listed as heritage items under an environmental planning instrument made under the Environmental Planning and Assessment Act 1979,
(b) items that are subject to an interim heritage order,
(c) items that are listed on the State Heritage Register,
(d) items identified by the government instrumentality concerned as having State heritage significance.

Section 170A of the Act requires that a government department or agency must give the NSW Heritage Council not less than 14 days written notice before the government instrumentality:

(a) removes any item from its register under section 170, or
(b) transfers ownership of any item entered in its register, or
(c) ceases to occupy or demolishes any place, building or work entered in its register.

The government department or agency is also responsible for ensuring that the items listed on its Section 170 Register are maintained with due diligence in accordance with State Owned Heritage Management Principles.

OEH maintains a database of historic heritage items that have been identified on OEH managed estate, known as the Historic Heritage Information Management System (HHIMS). The database includes records regarding the location, nature and current status of known items, and a reference collection of reports relating to their management. Items on the OEH Section 170 Register are a subset of the database HHIMS. It has not been possible to access the information on the HHIMS for this report; however, Context Pty Ltd has previously noted that the HHIMS database for Kamay Botany Bay National Park contained 58 items and 'complexes' (collections of items). Of these, 22 items were within the Meeting Place Precinct and 13 individual items and one complex (the monument group) were included on the OEH Section 170 Register. A heritage assessment of the

Meeting Place Precinct recommended listing on the SHR (Design 5, 2006), and a Conservation Management Plan (CMP) has subsequently been prepared for the site (Context Pty Ltd 2008). It is unlikely that this listing has substantially changed.

2.4 Environmental Planning and Assessment Act 1979

The EP&A Act is the main act regulating land use planning and development in NSW. Part 4 Division 4.1 of the Act provides a new process for the assessment and approval of State Significant Development (SSD). The proposed works are declared to be SSD in accordance with Schedule 1(18) of *State Environmental Planning Policy (State and Regional Development) 2011*:

> *Development for the purpose of port facilities or wharf or boating facilities (not including marinas) that has a capital investment value of more than $30 million.*

Applications made under Part 4 Division 4.1 of the NSW EP&A Act are subject to environmental assessment requirements, prepared by the Director General of Planning and Infrastructure. Under Schedule 2(3)(4) of the *Environmental Planning and Assessment Regulation 2000* the Director-General is required to

> *consult relevant public authorities and have regard to the need for the requirements to assess any key issues raised by those public authorities*

This should include consultation with OEH and the Heritage Branch regarding items, places and archaeological sites that have heritage significance.

Director General's Environmental Assessment Requirements (DGRs) for the proposed works were issued on 9 August 2012. The DGRs require the EIS to address the following specific matters:

> *Heritage – including but not limited to:*
> - *Aboriginal and historic heritage items and values of the site and surrounding area (including known or probable maritime heritage sites and appropriate surveys); and*
> - *taking into account of the NSW Heritage Manual (NSW Heritage Office, 1996), Assessing Heritage Significance Guidelines (NSW Heritage Office, 2001) and Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005).*

The NSW EP&A Act also controls the making of environmental planning instruments (EPIs). Two types of EPIs can be made: Local Environmental Plans (LEPs), covering LGAs; and State Environment Planning Policies (SEPPs), covering areas of State or regional environmental planning significance. LEPs commonly identify and have provisions for the protection of local heritage items and heritage conservation areas. In the case of the Kurnell Peninsula, heritage items are protected by the *State Environmental Planning Policy (Kurnell Peninsula) 1989* (SEPP Kurnell Peninsula).

2.4.1 State Environmental Planning Policy (Kurnell Peninsula) 1989

The aims and objective of the SEPP Kurnell Peninsula include:

> 1. *(a) to conserve the natural environment of the Kurnell Peninsula and ensure that development is managed having regard to the environmental, cultural and economic significance of the area to the nation, State, region and locality,*
> *(b) to apply environmental performance criteria which will ensure that the environment is not adversely affected by development,* and

2. *(d) to identify and conserve areas, sites and features of natural, ecological, historic or cultural significance,*
   (i) to conserve the environmental heritage of the Kurnell Peninsula.

Clauses 23A-23D of the SEPP Kurnell Peninsula includes provisions for the protection of local heritage items, relics, and archaeological sites. Schedule 2 'Archaeological sites' and Schedule 3 'Heritage items' lists the following heritage items or places within Botany Bay, or within 100 m of the Kurnell shoreline facing the project Site:

Ref	Name	Primary Address	Significance
L015—S	Botany Bay National Park (Kurnell Historic Site)		National*
L016—S	Kurnell monuments (in National Park)		National*
A081	Captain Cook's landing place	Cape Solander Drive	National*
A082	Captain Cook's landing site	Cape Solander Drive	National*
A084	Banks Memorial	Cape Solander Drive	National*
A085	Solander monument	Cape Solander Drive	National*
A086	Captain Cook monument	Cape Solander Drive	National*
A087	Forby Sutherland monument	Cape Solander Drive	National*
A088	Landing place wharf abutment	Cape Solander Drive	National*
A089	Alpha Farm Site	Cape Solander Drive	National*
A090	Captain Cook Watering hole	Cape Solander Drive	National*
A091	Captain Cook Watering well	Cape Solander Drive	National*
A092	Flagpole	Cape Solander Drive	National*
A093	Yena track	Cape Solander Drive	National*
A094	Muru track	Cape Solander Drive	National*
A038	Australian Oil Refinery	Sir Joseph Banks Drive	Local
L0ll	Bonna Point Reserve	Prince Charles Parade	Local^
B341	Crown Land, boatshed	Prince Charles Parade	Local
L012	Silver Beach and roadway	Prince Charles Parade	Local

*These items are within the NHL listed Kurnell Peninsula Headland (see Section 2.1 above).
^These are items of natural environmental heritage and as such are not addressed further in this report.

2.5 National Trust of Australia

The National Trust of Australia is a private, not-for-profit organisation committed to conserving Australia's heritage. Listing with the National Trust of Australia does not have statutory authority; however, it does have a role in raising public awareness of heritage issues.

The following item is classified by the National Trust:

Ref	Name	Primary Address
681	Botany Bay Entrance Landscape Conservation Area	Comprising on the South Side the extremity of Kurnell Peninsula north of Cape Bailey and on the North side La Perouse Peninsula southward of the general line of Anzac Parade and the southern limit of the residential area near the reservoir and a line through the golf courses to the coast south of Little Bay.

2.6 Register of the National Estate

The Register of the National Estate (RNE) was originally established under Section 22 of the *Australian Heritage Commission Act 1975* (C'th AHC Act). Since the establishment of the NHL and CHL, there is now a considerable level of overlap between the RNE and heritage lists at the national, state and territory, and local government levels. In February 2012, all reference to the RNE was removed from the C'th EPBC Act and the AHC Act. The RNE is now maintained on a non-statutory basis as a publicly available archive.

The following places in the vicinity of the study area are listed on the RNE:

Place ID	Name	Primary Address	Significance
3335	Captain Cooks Landing Place Historic Site	Cape Solander Dr, Kurnell, NSW, Australia	Historic
3337	Kurnell Peninsula Towra Point Area	Captain Cook Dr, Kurnell, NSW, Australia	Natural^

^Items of natural environmental heritage are not addressed in this report.

3 Environmental Context

An understanding of environmental factors within the local landscape provides a context for past human occupation and history of an area. The analysis of environmental factors contributes to the development of the predictive modelling of archaeological sites, but it also is required to contextualise archaeological material and to interpret patterns of past human behaviour. In particular, the nature of the local landscape including topography, geology, soils, hydrology and vegetation are factors which affect patterns of past human occupation.

3.1 Geology & Topography

Botany Bay is a structural depression known as the Botany Basin, which is situated within the much larger Sydney Basin. The Sydney Basin was formed in a huge freshwater lake bordered by a mountain range, during the Permian and Triassic Periods between 350 and 300 million years ago. A series of sedimentary beds, with a total thickness of more than 1000 m, were formed in the lake as the surrounding mountains eroded. The sedimentary beds consisted of a layer of rotting vegetation which would later become the Permian coal beds, a layer of mud and sand which became the shales and sandstones of the Narrabeen series, a layer of almost pure white sand which would become the Hawkesbury sandstone, and a thin layer of clay which became the Wianamatta shales (Hawkins 1947:140-141). The layers of sedimentary rocks were slowly uplifted in the north, south and west, and the lower land in the middle formed the basin (URS 2003:18-2).

Sea levels fluctuated in the late Pleistocene and early Holocene. In the period leading up to the Last Glacial Maximum when sea levels were falling, between 60,000 and 30,000 years ago, a number of valley systems were carved into the sedimentary rocks of the Sydney Basin by fluvial and marine erosion processes. When sea levels rose between c. 21,300 and 7,000 years ago, the deepened river valleys were flooded by the sea, a process known as the postglacial marine transgression, with tidewater penetrating inland to form the saltwater estuary of Botany Bay (Roy & Crawford 1981:171; Attenbrow 2010:37-38).

The Kurnell Peninsula is a coastal sand barrier complex within Botany Bay, predominantly made up of Quaternary estuarine sediments and marine quartz sand, with exposed Hawkesbury Sandstone on the coastal headlands. The local topography is characterised by gently undulating to rolling coastal dunefields and relict dunes. Gently inclined concave swales with isolated swamps also occur. Local relief is less than 20m, and slope gradients 1-10%. In the vicinity of Kurnell township, the beach ridges have been levelled and swampy swales filled (Hazelton & Tille 1990:86; Albani & Rickwood 1998).

3.2 Soils

Two major rivers drain into Botany Bay; Cooks River from the north east, and the Georges River from the south east. Despite both these rivers draining into the western shoreline, the majority of the sediment found in the Bay is marine in origin and not derived from modern fluvial processes associated with rivers and streams and the deposits and landforms created by them (Roy & Crawford 1981:169; Albani & Rickwood 1998; Frost 2011:20).

The Kurnell Wharf is located next to Silver Beach, which is within the Kurnell soil landscape (Figure 3.1). Formed from Aeolian processes, the Kurnell soil landscape occurs along the northern side of the Kurnell Peninsula, and typically contains deep (>200cm) podzols on dunes and in swales. The dominant soil materials include topsoil of loose brown sand (up to a depth of 80cm), and subsoils of grey brown mottled sand, brown soft sandy iron pan (also known as coffee rock), and loose yellowish brown sand. Black sticky peat is also found as subsoil in poorly drained swales.

The coastal headland on the eastern side of the peninsula is within the Bundeena soil landscape. It is characterised by yellowish brown sandy loam, which generally occurs as topsoil on crests and plateaux, up to a depth of 150cm. In localised areas, it overlies up to 60cm of earthy, yellowish brown, light sandy clay loam subsoil. Friable yellowish brown clayey sand can also occur as subsoil in wet areas on lower slopes. The soil materials in both these landscapes are highly erodible (Hazelton & Tille 1990:31-33, 86-88).

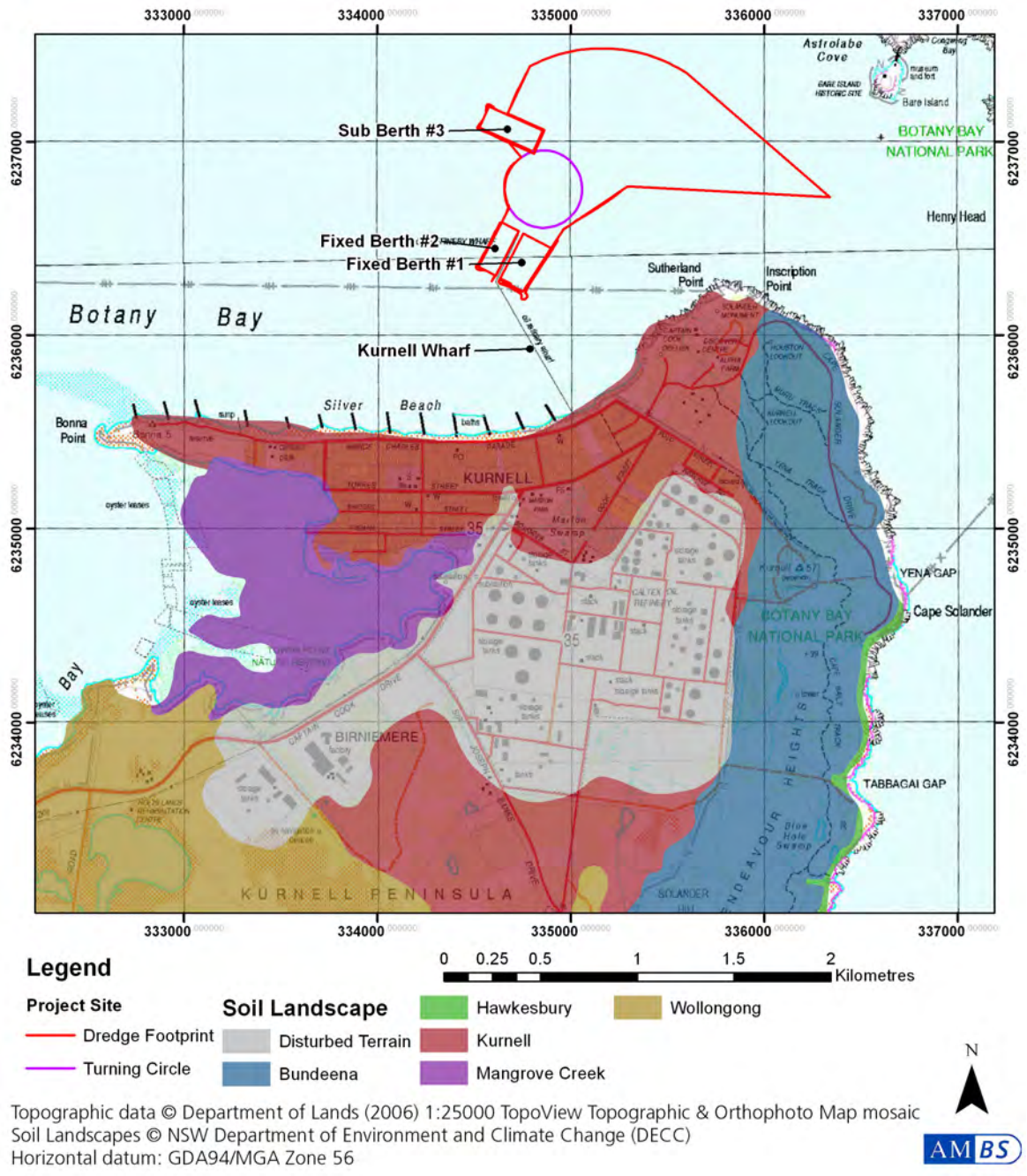


Figure 3.1 Soil landscapes in the vicinity of the Kurnell Port and Berthing Facility Upgrade Site

3.3 Hydrology

Botany Bay is a large, semi-land-locked estuary, measuring approximately 8km across at its widest point. Water depths are shallow, and generally range between 0 to 4 m below Chart Datum (CD), increasing to approximately 18 to 20 m below CD at the entrance to the Bay (Roy & Crawford 1981:166; URS 2012:34).

On the Kurnell Peninsula, Cook's Stream would have been a semi-permanent source of fresh water for local Aboriginal people. It arises from a dune ridge on the coastal headland, and flows north east into Botany Bay. The stream was first mapped in 1770 by Lieutenant James Cook, Commander of the HMS Endeavour, who *[…] sent a party of men a shore in the morning to the place where we first landed to dig holes in the sand by which means and a small stream they found fresh water sufficient to water the ship* (2004 [1770]) (Figure 3.2). The stream was dammed in the early twentieth century, but was re-opened in 2008 (Irish 2010:15).

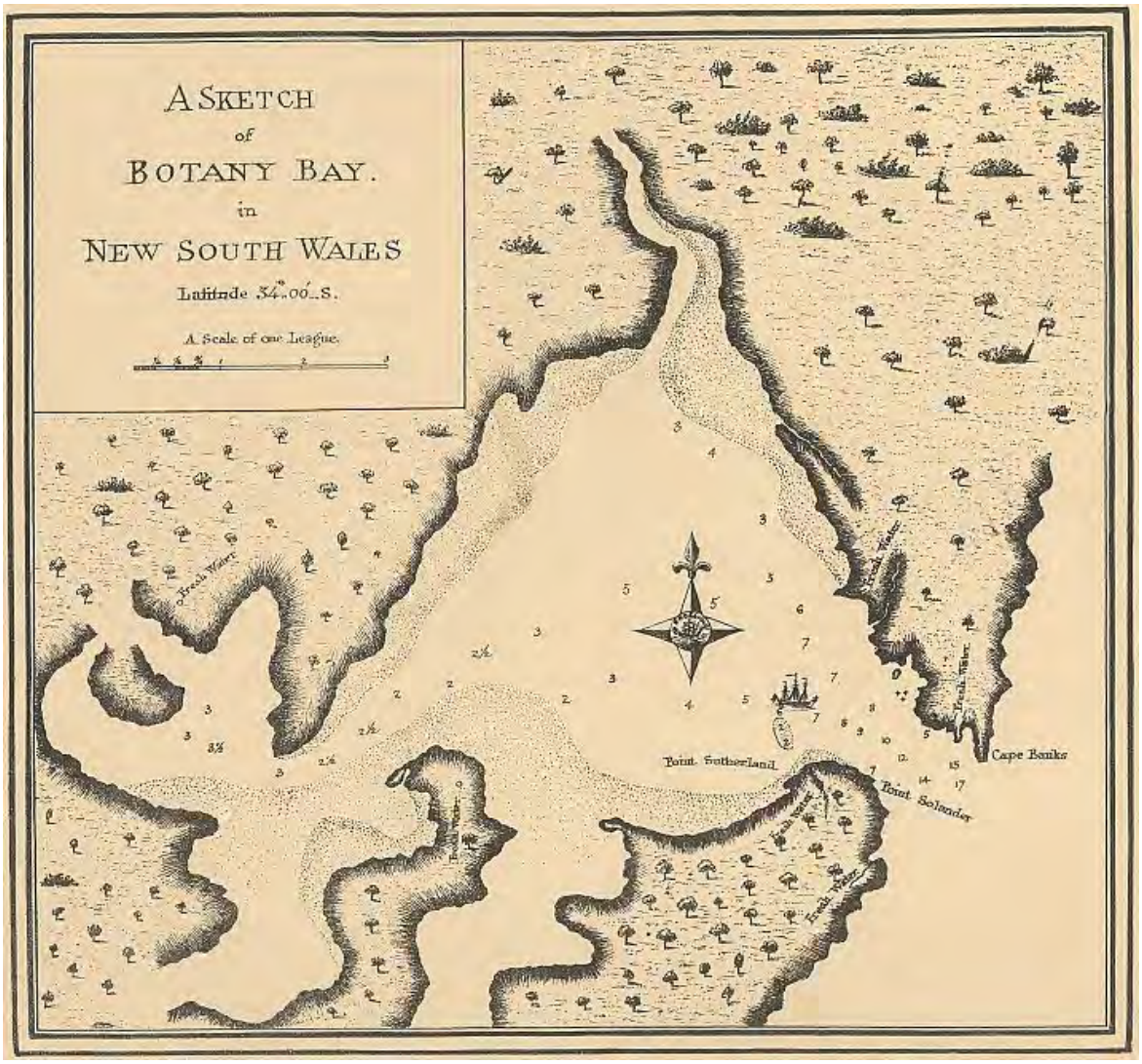


Figure 3.2 Captain Cook's chart of Botany Bay, 1770 (Source: National Library of Australia, http://nla.gov.au/nla.map-rm2456d)

3.4 Flora & Fauna

Cook named Botany Bay after *The great quantity of Plants Mr. Banks and Dr. Solander found in this place […]* (Cook 2010 [1768-1770]). At the time of European contact, plant communities on the Kurnell Peninsula are likely to have included coastal scrub/woodland, littoral rainforest, swamp forest, dune woodland, sedge-swamp and mangroves (Benson & Eldershaw 2007). Bark from native woodland species such as the Bangalay (*Eucalyptus botryoides*), Swamp Oak/Grey She Oak (*Casuarina glauca*), and stringybarks (for example, *E. agglomerata* and *E. acmeniodies*) would have been used by Aboriginal people to build canoes and shelters (huts) (Martin 1994:325; Attenbrow 2010:112-113).

Faunal remains recovered from coastal middens can indicate faunal types exploited as food resources by Aboriginal people in this area. Archaeological excavation of the 'Watering Place' in Botany Bay

National Park (also known as Captain Cooks Landing Place midden), recovered shell material mixed with fish bones, predominantly snapper and bream. Seal, dolphin and whale bones were represented in the midden, as were terrestrial animals including wallaby, kangaroo and dingo. Mussel and common mud oyster were identified as the major edible species of mollusc present (Megaw 1997:10-12).

3.5 Land Use & Disturbance

The low, sandy foreshore at Silver Beach is affected by a number of natural coastal processes, including severe storm erosion, and wind and wave action. Disturbance and erosion have the potential to affect the presence and integrity of any Aboriginal sites in this area, and coastal midden sites in particular are susceptible to these factors. A number of groynes were constructed in 1969, 1980 and 1992 in response to severe erosion of the shoreline, and sand was imported in 1970 to stabilise the beach (Roy & Crawford 1981:215; URS 2012:35).

4 Aboriginal Heritage Context

4.1 Historical & Ethnographic Context

4.1.1 Living as Australia's earliest inhabitants

Aboriginal occupation of the Sydney region, of which the study area is a part, is likely to have spanned at least 20,000 years, although dates of more than 40,000 years have been claimed for artefacts found in gravels of the Cranebrook Terrace on the Nepean River (Nanson et al. 1987; Stockton 1993; Stockton & Holland 1974). Late Pleistocene occupation sites have been identified on the fringes of the Sydney basin and from rock shelter sites in adjoining areas. Dates obtained from these sites were 14,700 BP at Shaws Creek in the Blue Mountain foothills (Kohen et al. 1984), c.20,000 BP at Burrill Lake on the South Coast (Lampert 1971), and c.11,000 BP at Loggers Shelter in Mangrove Creek (Attenbrow 1981, 2004). The majority of sites in the Sydney region, however, date to within the last 3,000 to 5,000 years, with many researchers proposing that occupation intensity increased from this period (Kohen 1986; McDonald & Rich 1993; McDonald 2008). This increase in sites may reflect an intensity of occupation which was influenced by rising sea levels, which stabilised approximately 6,500 years ago. Older occupation sites along the now submerged coastline would have been flooded, with subsequent occupation concentrating on and utilising resources along the current coastlines and in the changing ecological systems of the hinterland (Attenbrow 2010:55-56).

Radiocarbon dates have been obtained for a number of Aboriginal occupation sites on the Kurnell Peninsula (Table 3.1). The nearest of these is Captain Cooks Landing Place, within Botany Bay National Park, which was excavated by Megaw in 1970-1971. Charcoal samples obtained from Trench F4 Square BB4, toward the base of the midden deposit, returned a date of 1293 ±120 years BP (ANU-721) (Irish 2010 18-19).

Table 4.1 Earliest radiocarbon dates for excavated Aboriginal sites on the Kurnell Peninsula (after Attenbrow 2010:18-20)

Site name	Radiocarbon date (years BP)	Sample material
Captain Cooks Landing Place BB4	1,293 ±120 (ANU-721)	charcoal
Quibray Bay 2	4,130 ±111 (SUA-518)	shell
McCue Midden	1,840 ±40 (Beta-165771)	charcoal
260 Captain Cook Drive	2,262 ±38 (Wk-22797)	shell
Quibray Bay 1	2,210 ±360 (ANU-261)	bone
Cronulla STP1	3,240 ±70 (Wk-8845)	charcoal
Potter Point	5,620 ±70 (Wk-ANU-402)	charcoal
Doughboy Head 1	12,190 ±110 (Beta 36920)*	charcoal
Botany Cone Swamp 5	1,520 ±90 (SUA-2857)	charcoal
Boat Harbour 1	1,953 ±70 (ANU-895)	charcoal
Bate Bay BHW	2,402 ±88 (NZA-2323)	charcoal

*The early date from Doughboy Head 1 has been questioned, because of inadequate documentation of the stratigraphy and sample retrieval process, and the similarity of the artefact typology to other sites on the Peninsula that date to within the last 5,000 years (Dallas 1996:9).

4.1.2 Utilising natural resources

Early European accounts of the Kurnell Peninsula area indicate that small groups of Aboriginal people camped near the water, sometimes in bark huts. Extensive evidence of fishing and shellfishing activity was observed (Smith *et al.* 1990:33-43). The area was inhabited by the Gweagal people at the time of European contact:

> *[…] Each family has a particular place of residence, from which is derived its distinguishing name. This is formed by adding the monosyllable Gal to the name of the place: thus the southern shore of Botany Bay is called Gwea, and the people who inhabit it stile themselves Gweagal (Collins 2003 [1798]).*

Fishing

Fish played an important part in the diet of coastal Aboriginal people, and fishing equipment included the hook and line, and the fiz-gig (fishing spear). Early observations by Europeans suggest that Aboriginal women fished from canoes with a hook and line; using mussels and cockles, or boiled fish, as bait. The canoes were constructed of bark, and varied in length between 8 feet and 20 feet (approximately 2.4m to 6m). They lay low in the water, and were propelled with paddles or by hand (Attenbrow 2010:87-88; Collins 2003 [1798]) (Figure 3.3 and Figure 3.4). Most archaeological fish hook specimens from the Sydney region, such as those excavated by Megaw from the Captain Cooks Landing Place midden, are made of Turban shell. The hooks are curved and unbarbed in design, with small notches that were used to secure lines made of twisted bark or vegetable fibre (Attenbrow 2010:87, 98; Megaw 1997:12). Collins (2003 [1798]) described their manufacture:

> *The lines used by the women are made by themselves of the bark of a small tree which they find in the neighbourhood. Their hooks are made of the mother-of-pearl oyster, which they rub on a stone until it assumes the shape they want.*

According to Collins, men always used fiz-gigs or fishing spears, which had wooden shafts between 15 and 20 feet in length (approximately 3.7m to 6m). They were often constructed in segments in order to increase the length of the spear in deeper water, and the joints were fastened together with gum. Fishing spears had between one and four prongs about 30cm in length, which were pointed and barbed with shell, fish teeth, animal bone or wood (Attenbrow 2010:86-87,98; Collins 2003 [1798]).

Figure 4.1 Aboriginal men fishing, by Tupaia, 1770 (Source: British Library, London. Add. Ms. 15508, f.10(a), (no. 10)); in Nugent 2005:11)

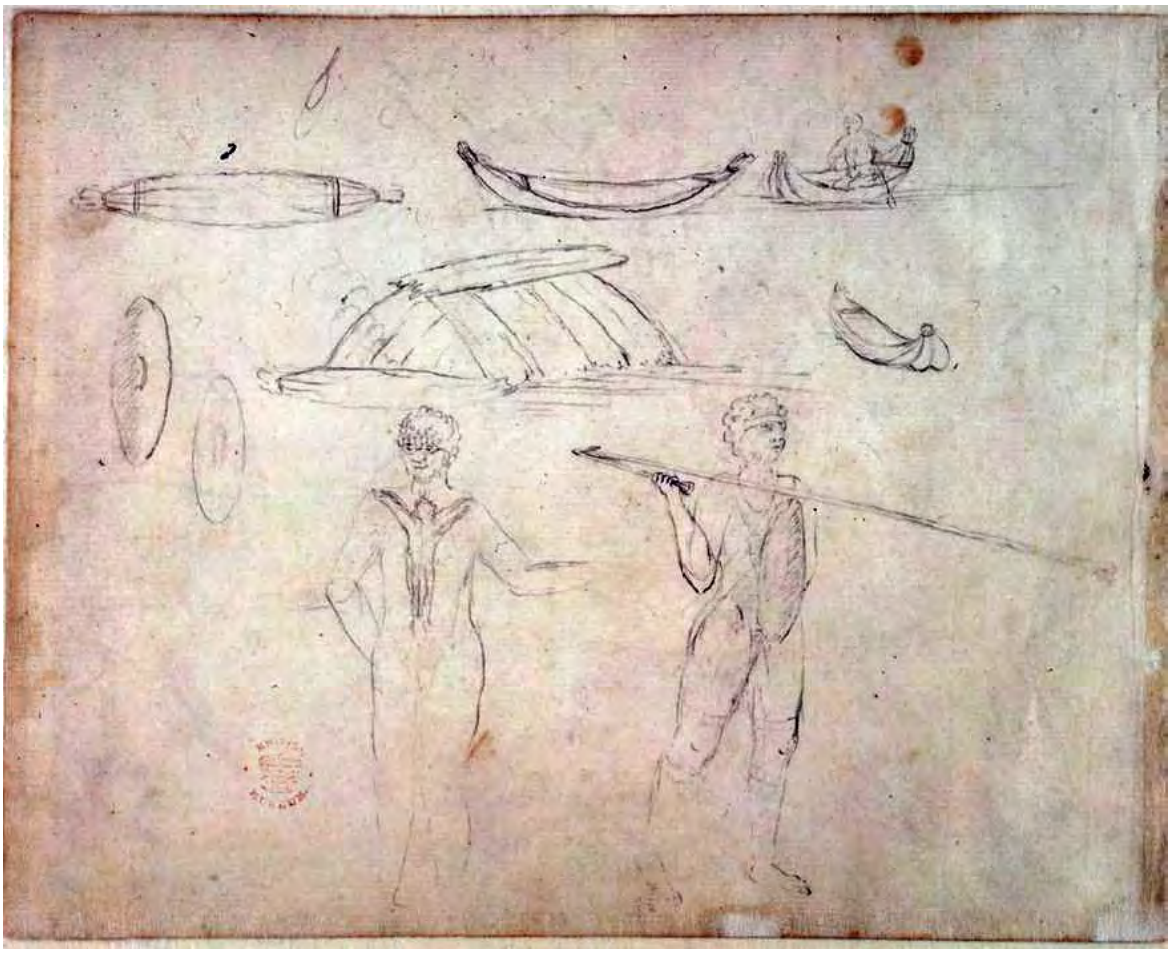


Figure 4.2 Two Australian Aborigines and other drawings, by Sydney Parkinson, 1770 (Source: British Library, London. Add. Ms. 9345, f.14v; in Nugent 2005:24)

Shellfishing

There are few historic documentary accounts of shellfishing (Attenbrow 2010:82). In 1770, during the voyage of the Endeavour along the east coast of New South Wales, Lieutenant James Cook noted in his log that:

> *[…] on the sand & Mud banks [of Botany Bay] are Oysters, Muscles [sic], Cockles & which I believe are the Chief support of the inhabitants who go into Shoald Water with their little Canoes, & pick them out of the sand & Mud with their hands […] (Cook 2010[1768-1770]).*

In February 1788, Hunter described Aboriginal men diving in the surf for shellfish, which they gathered from underwater rocks in Port Jackson. The shellfish were then cooked on a fire by the shore (Hunter 2003 [1793]). Coastal middens are the result of Aboriginal exploitation and consumption of shellfish in marine or estuarine contexts. Debris is discarded in the same location and accumulates over time. Middens may also include faunal remains such as fish or mammal bone, stone artefacts, hearths, charcoal, and human burials (OEH 2011).

4.2 Aboriginal Archaeological Context

This section describes the nature of the known Aboriginal archaeology of the study area, based upon a review of relevant archaeological reports and publications, and a search and review of previously recorded sites in the OEH AHIMS database. Summary descriptions of site types are provided in Table 4.2 below.

Table 4.2 Summary descriptions of Aboriginal site types referred to in this report

Site Type	Details
Open camp sites/ stone artefact scatters/ isolated finds	Open camp sites represent past Aboriginal subsistence and stone knapping activities, and include archaeological remains such as stone artefacts and hearths. This site type usually appears as surface scatters of stone artefacts in areas where vegetation is limited and ground surface visibility increases. Such scatters of artefacts are also often exposed by erosion, agricultural events such as ploughing, and the creation of informal, unsealed vehicle access tracks and walking paths. These types of sites are often located on dry, relatively flat land along or adjacent to rivers and creeks. Isolated finds may represent a single item discard event, or be the result of limited stone knapping activity. The presence of such isolated artefacts may indicate the presence of a more extensive, *in situ* buried archaeological deposit, or a larger deposit obscured by low ground visibility. Isolated artefacts are likely to be located on landforms associated with past Aboriginal activities, such as ridgelines that would have provided ease of movement through the area, and level areas with access to water, particularly creeks and rivers.
Rock engravings	Rock engravings are a type of Aboriginal art, and are often located on high vantage points along ridge lines at the headwaters of creeks, but can be located on any suitable fine grained stone surface.
Shelter sites with art (engraving, painting or drawing) or occupation deposit	These are art or occupation sites located in areas where suitable rock outcrops and surfaces occur, where weathering has resulted in suitable overhangs or recesses in boulder outcrops or cliff-lines.
Middens	Shell middens result from Aboriginal exploitation and consumption of shellfish, in marine, estuarine or freshwater contexts. Middens may also include faunal remains such as fish or mammal bone, stone artefacts, hearths, charcoal and occasionally, burials. They are usually located on elevated dry ground close to the aquatic environment from which the shellfish has been exploited and where fresh water resources are available. Deeper, more compacted, midden sites are often found in areas containing the greatest diversity of resources, such as river estuaries and coastal lagoons.
Burial sites	Aboriginal burial of the dead often took place relatively close to camp site locations. This is due to the fact that most people tended to die in or close to camp (unless killed in warfare or hunting accidents), and it is difficult to move a body long distances. Soft, sandy soils on, or close to, coastal dunes, rivers and creeks allowed for easier movement of earth for burial; and burials may also occur within rockshelters or middens. Aboriginal burial sites may be marked by stone cairns, carved trees or a natural landmark. Burial sites may also be identified through historic records, or oral histories.
Contact/ historical sites	These types of sites are most likely to occur in locations of Aboriginal and settler interaction, such as on the edge of pastoral properties or towns. Artefacts located at such sites may involve the use of introduced materials such as glass or ceramics by Aboriginal people, or be sites of Aboriginal occupation in the historical period.

4.2.1 Known Aboriginal Sites

An extensive search of the AHIMS database was undertaken on 28 August 2012 (AHIMS client service number #78255), and 75 registered Aboriginal sites were identified within a 6km x 7km area centred on the project Site. The search results are presented in Figure 4.3 and summarised in Table 4.3. Details of the Aboriginal sites recorded near the study area are attached in Appendix A.

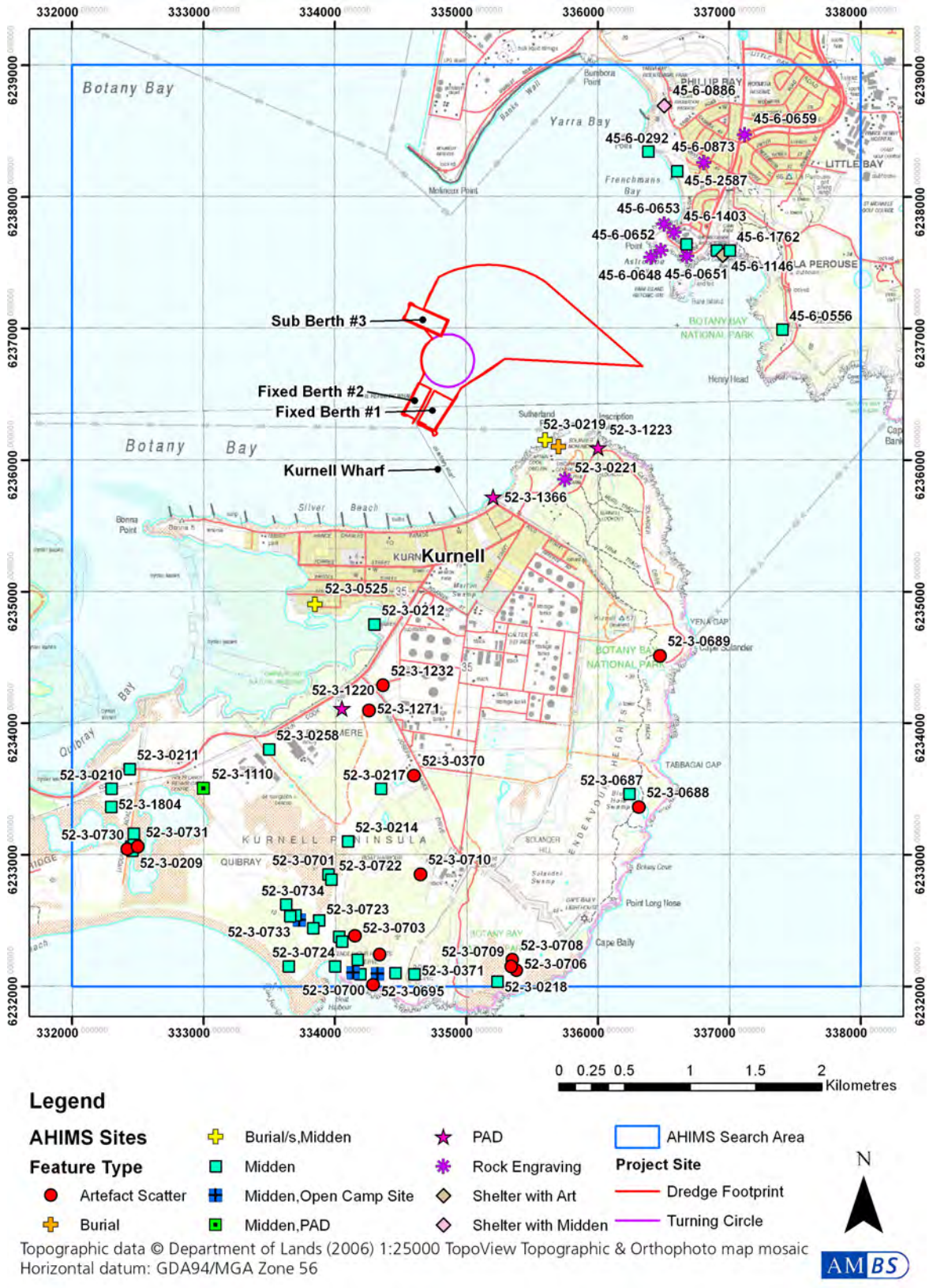


Figure 4.3 Location of Aboriginal sites previously recorded near the Kurnell Port and Berthing Facility Upgrade Site.

Table 4.3 Summary of Aboriginal sites previously recorded near the study area

Site Type	Number Present	Percentage (to 2 decimal places)
Artefact Scatter	14	18.67%
Burial	1	1.33%
Burial/s,Midden	2	2.67%
Midden	36	48.00%
Midden,Open Camp Site	3	4.00%
Midden,PAD	1	1.33%
PAD	3	4.00%
Restricted	3	4.00%
Rock Engraving	10	13.33%
Shelter with Art	1	1.33%
Shelter with Midden	1	1.33%
Total	**75**	**100.00%**

A number of Aboriginal sites have been identified on the Kurnell Peninsula Headland, to the south of the project Site. Midden deposits and Aboriginal burials have been recorded on the shoreline at Captain Cook's Landing Place (AHIMS 52-3-0219), within the Kurnell Meeting Place Precinct (Figure 4.4). Some of the earliest formal archaeological excavations on the Kurnell Peninsula were undertaken at Captain Cooks Landing Place by Megaw in 1970-71 (Megaw 1997). Recent investigations by Irish entailed archaeological test excavation across various parts of the precinct to determine the subsurface archaeological potential of the area, monitoring of works, and limited salvage excavation. The result of these investigations found that although some Aboriginal archaeological remains had been disturbed, the material recovered was nonetheless informative. An *in situ* midden was also identified near the Cook's Stream Dam, and recommendations were made to avoid the area where possible (Irish 2007a; 2007b; 2009; 2010). The Meeting Place Precinct Conservation Management Plan identified the following site elements in the vicinity of the shoreline as having Aboriginal heritage significance (Context Pty Ltd 2008:45):

- Landscape as an entity;
- Freshwater stream [Cook's Stream];
- Foreshore midden areas [including AHIMS 52-3-0219];
- Burial places: known and unknown [including AHIMS 52-3-0219]; and the
- Meeting Place Precinct as a whole.

To the west of the Kurnell Peninsula Headland, Navin Officer identified two areas of PAD adjacent to Silver Beach; Kurnell Potential Archaeological Deposit 1 (K PAD 1; AHIMS 52-3-1366), and the Kurnell Pipeline PAD (not registered on AHIMS) (Navin Officer 2006; 2007) (Figure 4.5). K PAD 1 is described as encompassing *the whole of the foreshore from the high water mark to Torres Street*. Despite some disturbance from roads and landscaping, the sand dunes in this area were assessed as having moderate to high potential for *in situ* subsurface archaeological deposits and burials to present (Navin Officer 2006:34). The Kurnell Pipeline PAD is located between Sir Joseph Banks Drive and Silver Beach. It includes *the fore and hind dune deposits behind Silver Beach, the eastern margin of the Quibray Bay estuarine basin, and the dune and swale deposits along Sir Joseph Banks Drive*. It was assessed as having moderate archaeological potential for remnant midden deposits, subsurface artefact occurrences and burials to be present (Navin Officer 2007:12).

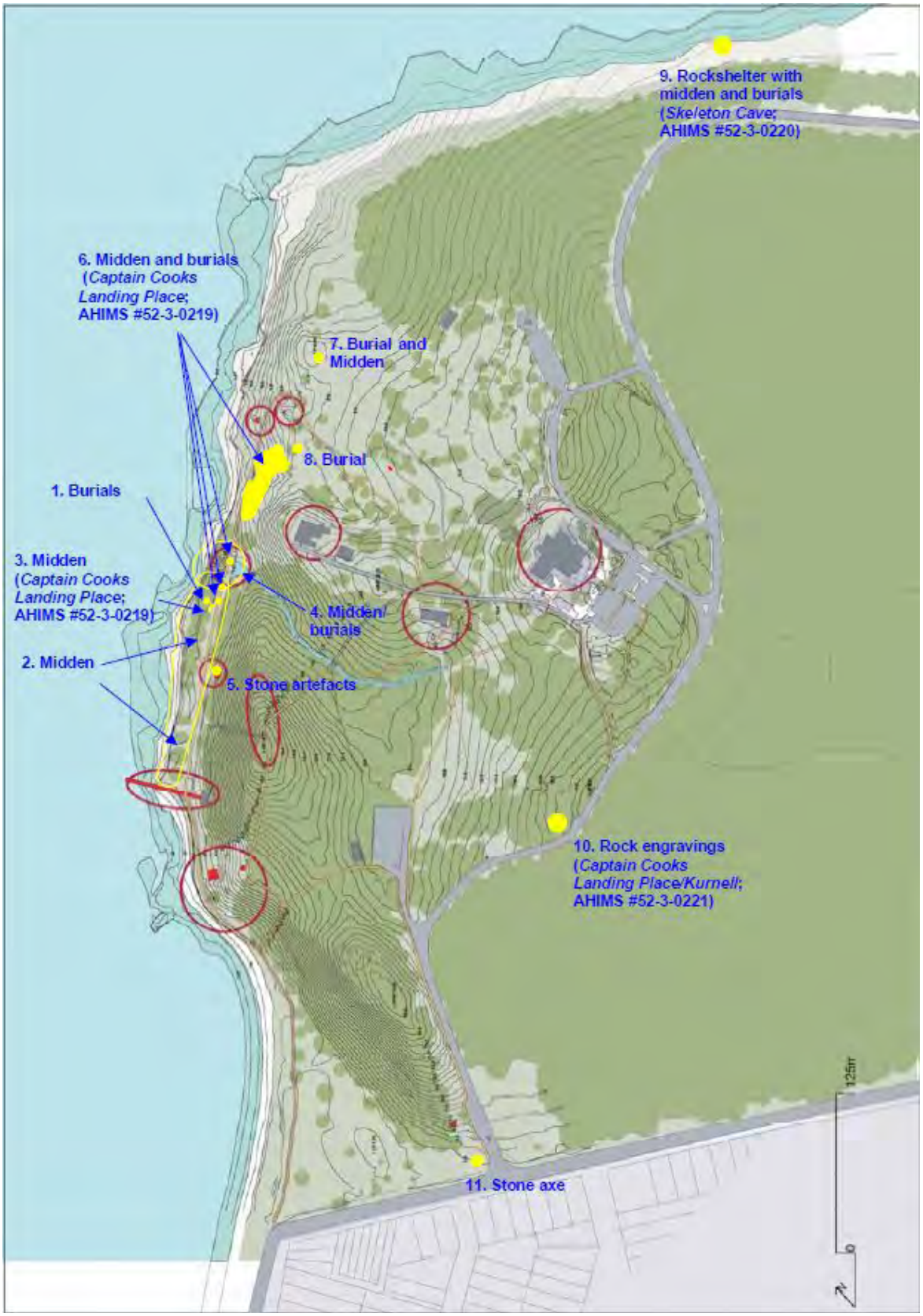


Figure 4.4 Known Aboriginal archaeological remains within the Meeting Place Precinct (Irish 2007a:7)

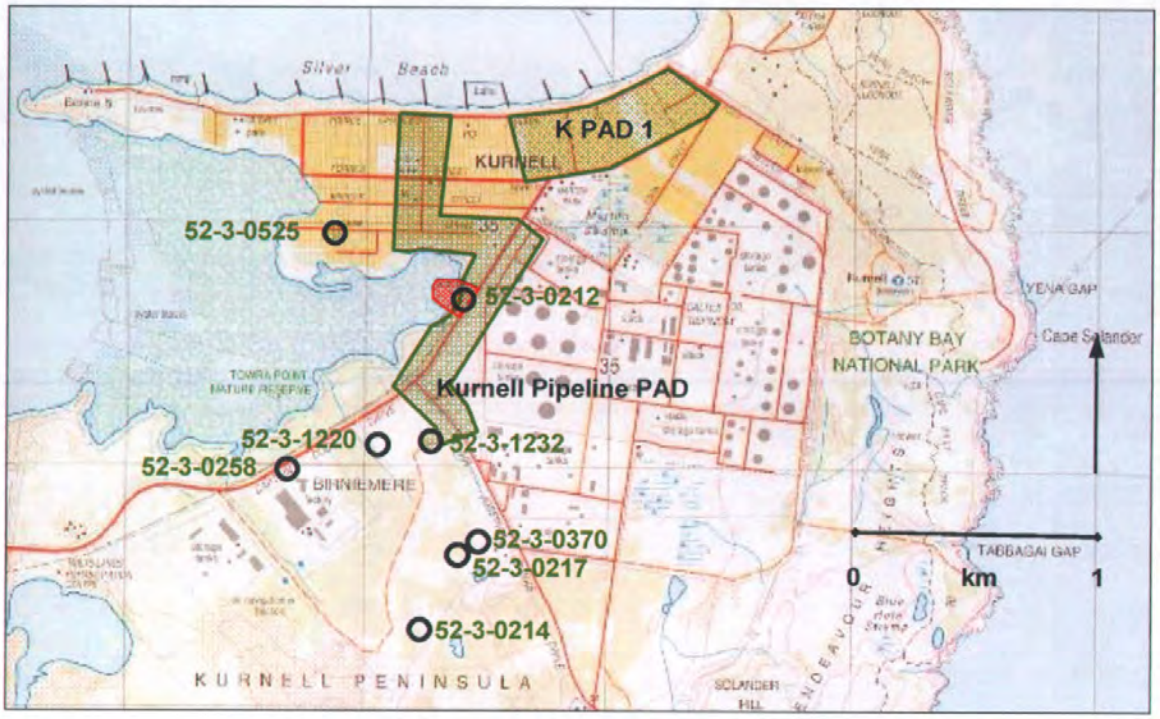


Figure 4.5 PADs near the Silver Beach foreshore identified by Navin Officer (2007:12)

In 1990, Smith, Rich and Hesp prepared a management study for Aboriginal sites on the Kurnell Peninsula. This included surveying 11 areas, one of which (Survey Area [SA] 11) is on the Kurnell Headland, and in which one engraving site was recorded (AHIMS 52-3-0221; Figure 4.6; see also Figure 4.3). The engraving site comprised abraded grooves depicting outlines of fish and other unidentified figures, on a badly weathered sandstone rock face. Aboriginal occupation of the Kurnell peninsula was considered to have been focused in the area between Boat Harbour and Doughboy Head/Cape Baily, given the number of large sites in this location. Smith *et al.* (1990:135) considered that the headland was more likely to contain greater numbers of sites than the isthmus. In general, sites on the Kurnell peninsula were considered to have high archaeological, public and interpretive significance in the Sydney region, with archaeological potential to provide information about Aboriginal use of coastal resources, including changes through time, based on different stratigraphic layers observed in the area, and the presence of hearths (Smith *et al.* 1990:127-8).

4.2.2 Summary

The majority of Aboriginal common site types previously recorded near the study area are midden sites, followed by artefact scatters (also known as open camp sites) and rock engravings. Midden sites have been identified in the sand dunes and sandy soils of the Kurnell Peninsula, particularly around Boat Harbour and Quibray Bay, and are also known to occur on the Kurnell Peninsula Headland. Subsurface midden material is unlikely to be present in areas that have been subject to high levels of coastal erosion, such as Silver Beach, or ground disturbance, such as the Caltex Oil Refinery.

Artefact scatters usually comprise flaked stone artefacts, although ground stone, bone or shell artefacts may also occur. Such sites are generally interpreted as camp sites; however, they can also represent other types of activity within the landscape. Artefact scatters have been identified across the Kurnell Peninsula.

Rock engravings are present in areas with suitable sandstone outcrops, although they are more common to the north of the project Site, on the rocky headland at La Perouse.

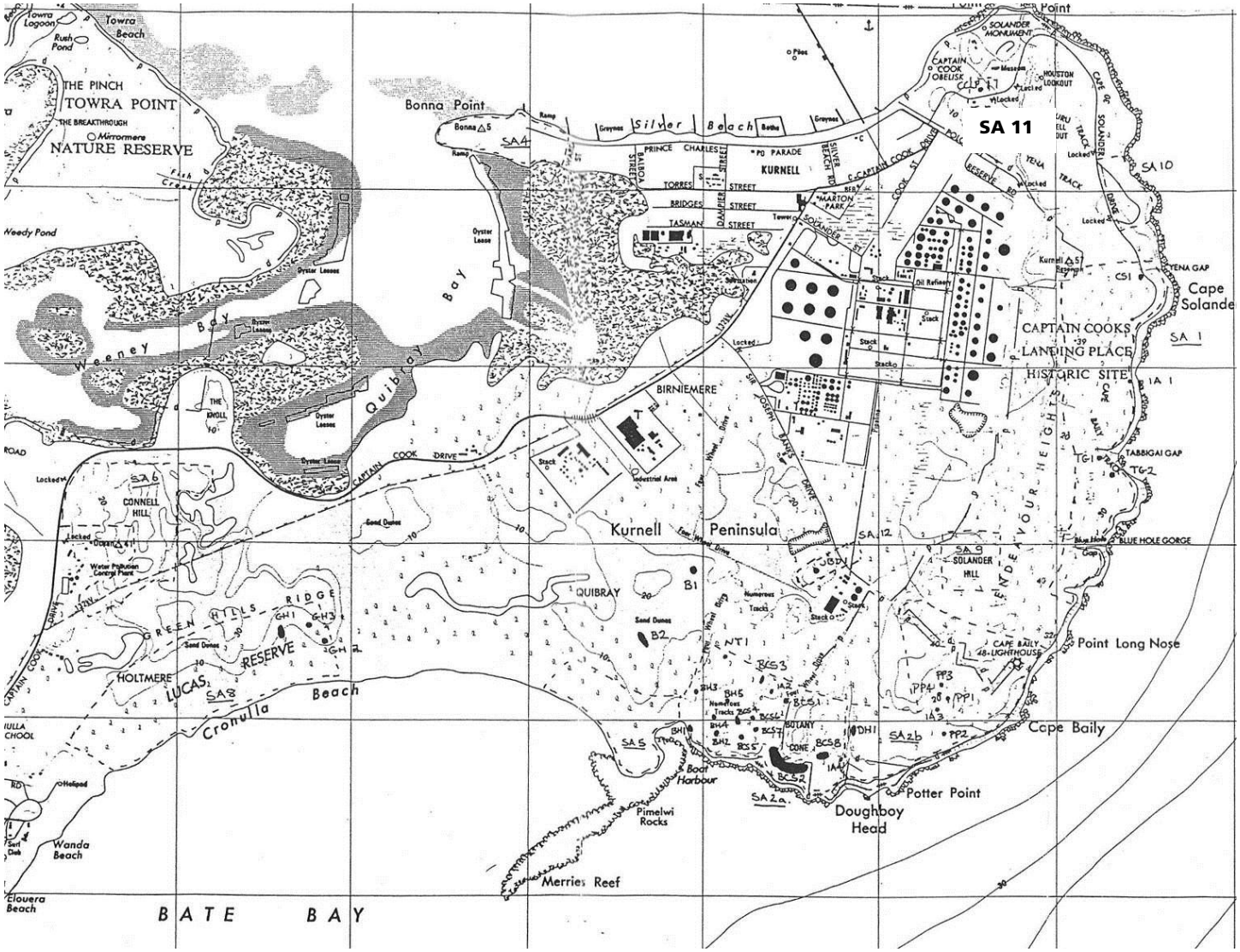


Figure 4.6 Survey areas and sites recorded by Smith et al. in 1990 (Source: Smith et al. 1990:Map 2)

5 Historic Heritage Context

The Kurnell Peninsula Headland is famous for being the place where British explorer Lieutenant (later Captain) Cook first set foot on the shore of eastern Australia in April 1770. It is also the place where crew of the *Endeavour* first encountered the Indigenous occupants of the land, and naturalists Joseph Banks and Daniel Solander collected the first scientific type-specimens of Australian flora and fauna. It was intended to be the location of the first British penal colony in Australia; however, Captain Arthur Phillip found the land to be unsuitable, and decided to establish Sydney to the north at Port Jackson. Despite this, the site of Captain Cook's landing place quickly became a commemorative landscape, where heroes of science and exploration and the events of 1770 could be memorialized and celebrated. From 1899, it was developed as a park, focused on the landing site and its symbolic importance for a national identity. However, the park also became popular for non-historical reasons, and was commonly used by Sydney-siders for bush-walking, fishing, picnicking and camping.

In the second half of the twentieth century, the Kurnell Peninsula became a contested landscape, symbolising for some the 'birth of the nation,' for others an important natural environment within the Sydney area, and for others again, the marginalisation and dispossession of Aboriginal people. Moreover, despite the perceived historic, social and ecological significance of the Kurnell Peninsula to various Indigenous and non-Indigenous members of the community alike, much of the area was developed in the mid-twentieth century for heavy industry, including sand mining, the Kurnell Oil Refinery, and chemical and pharmaceutical manufactories.

5.1 The Meeting Place: First Contact between British Explorers and Aboriginal People in Australia

The European history of the Kurnell Peninsula is closely associated with the 1768-1771 voyage of the Endeavour, commanded by Lieutenant James Cook. Cook was originally sent to the Pacific by the British Admiralty to observe the transit of the planet Venus across the face of the sun. Once the observations in Tahiti were completed, Cook opened secret instructions to search the Pacific for signs of a great land or continent thought to be located south and west of New Zealand. The instructions document the British Admiralty's concern to discover exploitable natural resources, and to expand Britain's control of strategic trading posts around the globe:

> *If you discover the Continent abovementioned … You are to employ yourself diligently in exploring as great an Extent of the Coast as you can … You are also carefully to observe the Nature of the Soil, and the Products thereof; the Beasts and Fowls that inhabit or frequent it, the Fishes that are to be found in the Rivers or upon the Coast and in what Plenty and in Case you find any Mines, Minerals, or valuable Stones you are to bring home Specimens of each, as also such Specimens of the Seeds of the Trees, Fruits and and Grains as you may be able to collect, and Transmit them to our Secretary that We may cause proper Examination and Experiments to be made of them. You are likewise to observe the Genius, Temper, Disposition and Number of the Natives, if there be any and endeavour by all proper means to cultivate a Friendship and Alliance with them, making them presents of such Trifles as they may Value inviting them to Traffick, and Shewing them every kind of Civility and Regard; taking Care however not to suffer yourself to be surprized by them, but to be always upon your guard against any Accidents.*
>
> *You are also with the Consent of the Natives to take Possession of Convenient Situations in the Country in the Name of the King of Great Britain: Or: if you find the Country uninhabited take Possession for his Majesty by setting up Proper Marks and Inscriptions, as first discoverers and possessors.* (Secret Instructions to Captain Cook, 30 June 1768)

Cook first sighted land along the east coast of Victoria, then sailed northwards along the coast before dropping anchor in Botany Bay, on 29 April 1770. As the Endeavour came into the bay, Cook had noted a number of Aboriginal men, women and children, and a few huts on the shore. A landing party was dispatched in a longboat, with the intention of trying to speak to them. Cook recorded his impressions of this first contact with the local people in his journal:

> *… as we approached the shore they all made off except two Men who seem'd resolved to oppose our landing - as soon as I saw this I orderd the boats to lay upon their oars in order to speake to them but this was to little purpose for neither us nor Tupia [a Tahitian interpreter] could understand one word they said. we then threw them some nails beeds &C a shore which they took up and seem'd not ill pleased with in so much that I thout that they beckon'd to us to come a shore but in this we were mistaken for as soon as we put the boat in they again came to oppose us upon which I fired a musket between the two which had no other effect than to make them retire back where bundles of thier darts lay and one of them took up a stone and threw at us … Mr Banks being of opinion that the darts were poisoned made me cautious how I advanced into the woods - We found here a few Small hutts made of the bark of trees in one of which were four or five small children with whome we left some strings of beeds &C a quantity of darts lay about the hutts these we took away with us - three Canoes lay upon the bea[c]h the worst I think I ever saw they were about 12 or 14 feet long made of one peice of the bark of a tree drawn or tied up at each end and the middle kept open by means of peices of sticks by way of Thwarts* (Daily Entry, 29 April 1770)

Beryl Timbery-Beller, a descendant of Aboriginal people who witnessed the landing, has related the alternative view from the shore that day:

> *When they saw a big white bird sailing into the Bay, that's what was handed down to me, they saw this big white bird coming, these two Aborigines went down as a warning party to let them get the children and hide them. They stood their ground and the others were in the bushes – a back up to protect the family groups. On the rock stood two warriors, and there were about thirty marines. Two against thirty!'* (Quoted in Salt 2000:18)

The following day, the British explorers returned to the Kurnell headland, where they found a fresh water stream sufficient to supply the ship, now known as Cook's Stream. Over the following week, they continued to explore the Botany Bay area, gathering food, collecting scientific samples and observing the land and charting the coast. Joseph Banks and Daniel Solander collected 132 unique plant specimens during this visit. To celebrate the place where this impressive botanical collection was made, Captain Cook eventually named it Botany Bay, and the northern and southern headlands Cape Banks and Point Solander respectively. Able Seaman Forby Sutherland, who died of tuberculosis, was also buried near the water source during the visit; Cook named Point Sutherland after the seaman. Despite several encounters with local Aboriginal people, Cook was unable to establish communication, although the crew noted the behaviour and activities of the local people, including details of their clothing (or lack thereof), camping, fishing, using trees for bark and food, collecting shells and cooking fish. They also noted that they themselves were being closely observed by the Aboriginal people (Salt 2000:18-23; Nugent 2005:17).

Cook's favourable description of Botany Bay as being *capacious, safe and convenient*, along with the impressions recorded by Sir Joseph Banks in his various publications and reports to the British Government, greatly influenced the Government in recommending Botany Bay as being a suitable location for the establishment of penal settlement. However, when the First Fleet arrived on the 18 January 1788, they found that the bay had a difficult entrance, was exposed to the prevailing easterly winds, and was too shallow to provide a suitable anchorage. Captain Arthur Phillip subsequently abandoned Botany Bay in favour of the much more sheltered and suitable deep water harbour just to the north, which became known as Port Jackson (Cook 1821:88-89; Frost 1994:87-97). .

5.1.1 Memorialisation

The results of Cook's expedition eventually led to the British occupation of the Australian continent. Although Captain Arthur Phillip subsequently chose Port Jackson as for the site of the first penal colony, the name Botany Bay became entrenched in popular nineteenth century poems and songs as a place of convict punishment and exile. As the colony developed, the place also developed a symbolic mystique, as a place of natural beauty and scientific discovery. Natural features, such as Cook's stream, could be visited and experienced by colonists seeking to 'remember' and make a historical connection with the early explorers. Soon commemorative plaques and other memorials were installed at Kurnell, in recognition of the British explorers and scientists who landed there in 1770. The first memorial was an inscription plate attached to the cliff face at Point Solander in 1822, dedicated to Cook and Banks by Philosophical Society of Australasia. The second was a sandstone obelisk dedicated to Cook, erected in 1870 by Thomas Holt on the centenary of the *Endeavour*'s arrival in Botany Bay (Figure 5.2). In 1881, the site was visited by the Royal Highnesses, Princes Albert (Duke of Clarence) and George (later King George V), who planted four trees. Numerous other commemorative trees have been planted on the site since then (Salt 2000:24; Nugent 2005:36, 67-80)

Figure 5.1 Captain Cook's Landing at Botany, A.D. 1770. Published in the Christmas edition of the *Town & Country Journal*, 21 Dec 1873. It has been noted that this depiction of the landing, which became popular in the nineteenth century, shows the Aboriginal men on the beach in an aggressive pose while Captain Cook is presented as conciliatory. (Source: National Library of Australia, http://nla.gov.au/nla.pic-an7890396)

Figure 5.2 Captain Cook's monument, Botany Bay, N S Wales, by Thomas George Glover, 1878. The Cook monument was erected in 1870 by Mr Thomas Holt. This obelisk has become a prominent feature of the landscape and can be seen from the opposite headland of the bay. (Source: National Library of Australia, http://nla.gov.au/nla.pic-an4335757)

By the end of the century the process of memorialisation became entwined with notions of nationhood and territorial possession, with Captain Cook as founding father of the land. In 1899, as the Australian colonies were moving towards Federation, approximately 250 acres of land at Kurnell Peninsula was resumed by the Government and dedicated as the Captain Cook Landing Place Reserve for the 'use and enjoyment of the public for all time' (Figure 5.3). The site became the focus of numerous commemorative events, including further tree planting, picnics, speeches, re-enactments of the landing and flag-raising ceremonies (Nugent 2005:36, 67-80). In 1984, the Landing Place Reserve became part of Botany Bay National Park.

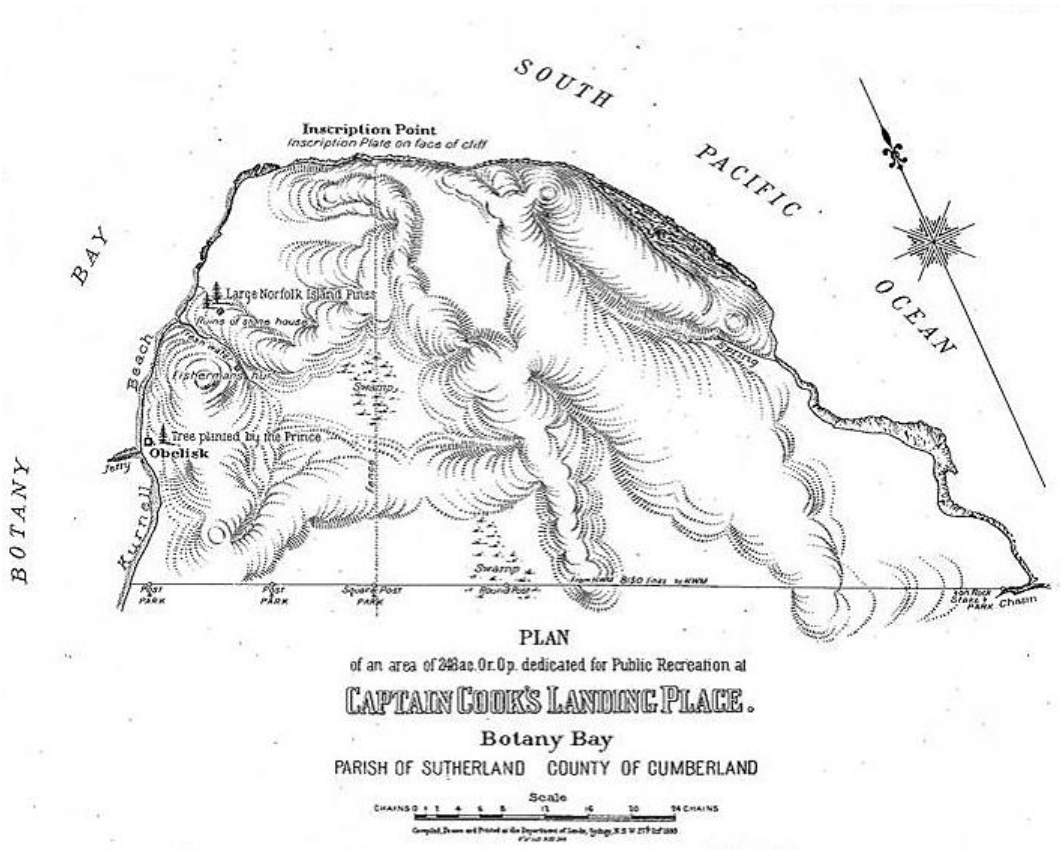


Figure 5.3 Map of Captain Cook's Landing Place Reserve, 1899. (Source: Botany Bay National Park; in Nugent 2005:68)

In more recent decades, commemorational activities at the site have sought to recognise other layers of significance of the site, and in particular to acknowledge that the place also symbolises the beginnings of dispossession of Aboriginal people from the land. Cook's landing at Kurnell was remembered by the local Aboriginal people, and indeed Captain Cook stories were spread throughout the Indigenous nations of Australia. However, it was the 1970 bicentenary of Cook's arrival in Botany Bay that provided the watershed moment, where Aboriginal people began to challenge the dominant European version of Cook's landing, which highlighted the discovery and founding of the Australian nation. During a re-enactment of Cook's landing, performed before Queen Elizabeth II, an Aboriginal protest and mourning ceremony was held on the opposite headland of La Perouse. In 1988, during bicentenary celebrations of the 1788 founding of the colony, Aboriginal protesters similarly converged on the Kurnell landing site, to voice their opposition to the public celebrations. Since that time, the focus of interpretation at the landing place site has shifted, and NPWS moved to involve local Aboriginal people in future planning and interpretation of the place. In 1998, on the occasion of the first national Sorry Day, local Aboriginal elders hosted a smoking ceremony at the site to clear away ill feeling. The concept of a 'meeting place' precinct has been developed to address the multi-faceted physical, historical and social implications of that first contact, and to set the groundwork for future reconciliation. In 2002, NPWS adopted a dual Aboriginal-English name for the park: Kamay Botany Bay National Park. On 20 September 2004, the Kurnell Peninsula Headland was included in the National Heritage List (Nugent 2005:130-150).

5.2 European Settlement and Subdivision of the Kurnell Peninsula

When the Parish of Sutherland was proclaimed in 1835, there was very little European settlement on the southern shores of Botany Bay (Figure 5.4). The soil was considered to be unsuitable for agriculture, and there were was little in the way of other resources to attract settlers or investment (Larkin 1998:10).

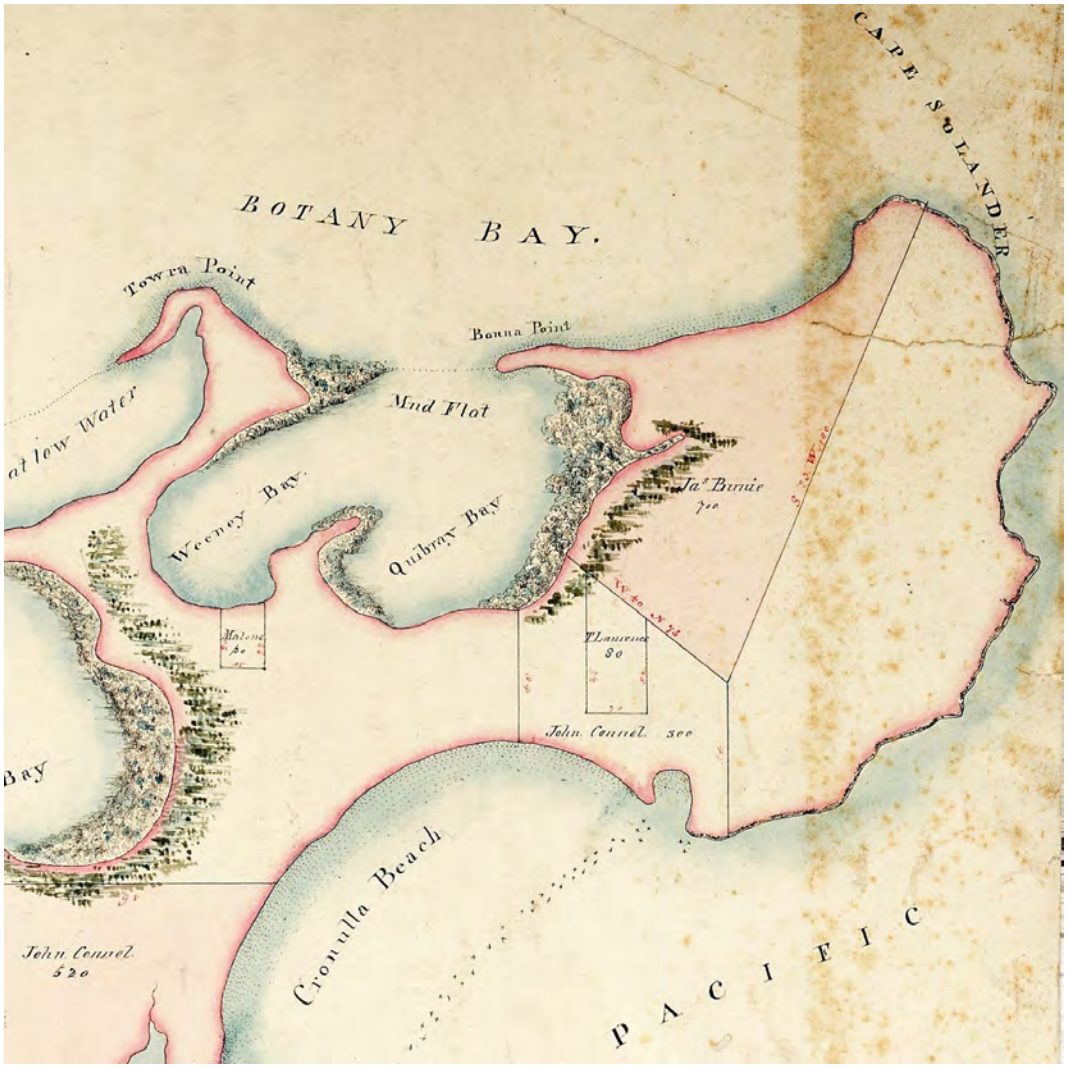


Figure 5.4 Detail of parish map of Sutherland, c1830s. (Source: © NSW Land Information Centre, Ref: 14066401)

The first land grant in the area was made by Governor Lachlan Macquarie to James Birnie in 1815. Birnie was a merchant and ship owner, involved in the local sealing and whaling industry. He received a grant of 700 acres of land on the western side of the Kurnell Peninsula, where he intended to build a whaling station, along with 160 acres of saltwater marshes. The grant included Captain Cook's landing place. Birnie established a farm, market garden and dairy on the property, which he named *Alpha Farm*. Birnie never lived on the grant, but he built a three-roomed homestead for a caretaker, named *Curnell*, and another smaller cottage for servants. The caretaker cut a dock into the foreshore for harbouring boats at high tide, and transported fresh fish and produce to market in Sydney by boat. Convicts were assigned to the property to cut down the trees and clear the land. (Salt 2000:25, 37, 77; Nugent 2005:56).

Figure 5.5 Kurnell Reserve, Botany Bay, from a print by W.J. Carruthers, 1906. The photo shows the ruins of Alpha House. (Source: State Library of NSW, Government Printing Office 1 – 10519)

James Birnie was declared insane in 1828, and his executors sold *Curnell* and *Alpha Farm* to John Connell, who also owned land at the south end of Cronulla Beach. Connell likely cut timber and ran cattle on the property, and eventually extended his holding in the area to 3,000 acres. Connell erected *Alpha House* on the foundations of Birnie's *Curnell*, which was occupied by his son John Connell Jnr. Following Connell Snr's death in 1849, his land passed to his grandsons John Connell Laycock and Elias Pearson Laycock (Larkin 1998:10; Salt 2000:25).

In the period between Cook's landing and the first European land grants, Aboriginal people continued to live on the Peninsula and maintain a connection to the land, although their numbers were likely reduced by the diseases and violence of the colonists. In 1827, assistant surveyor Robert Dixon surveyed the coast around Botany Bay and Port Hacking, and recorded Aboriginal names for various features on the maps he was making. Local historical Daphne Salt has suggested that Birnie named his cottage *Curnell* after the Aboriginal name for the area; while other sources suggest that Kurnell was an Aboriginal corruption of the name Connell. Historian Maria Nugent has further pointed out that John Laycock's son was one of the main informants in the early twentieth century for the location of Forby Sutherland's grave, and that Laycock's information had come from a local Aboriginal woman, Sally Mettymong, who he had known as a young boy when living on his father's estate (Salt 2000:25; Nugent 2005:47-54, 56-57).

5.2.1 Thomas Holt

In 1861, Thomas Holt purchased 4,600 acres from John Laycock, who was heavily in debt, including the Birnie estate on the Kurnell Peninsula. In the same year, the eastern side of the Peninsula was reserved by the Government from settlement (Figure 5.6).

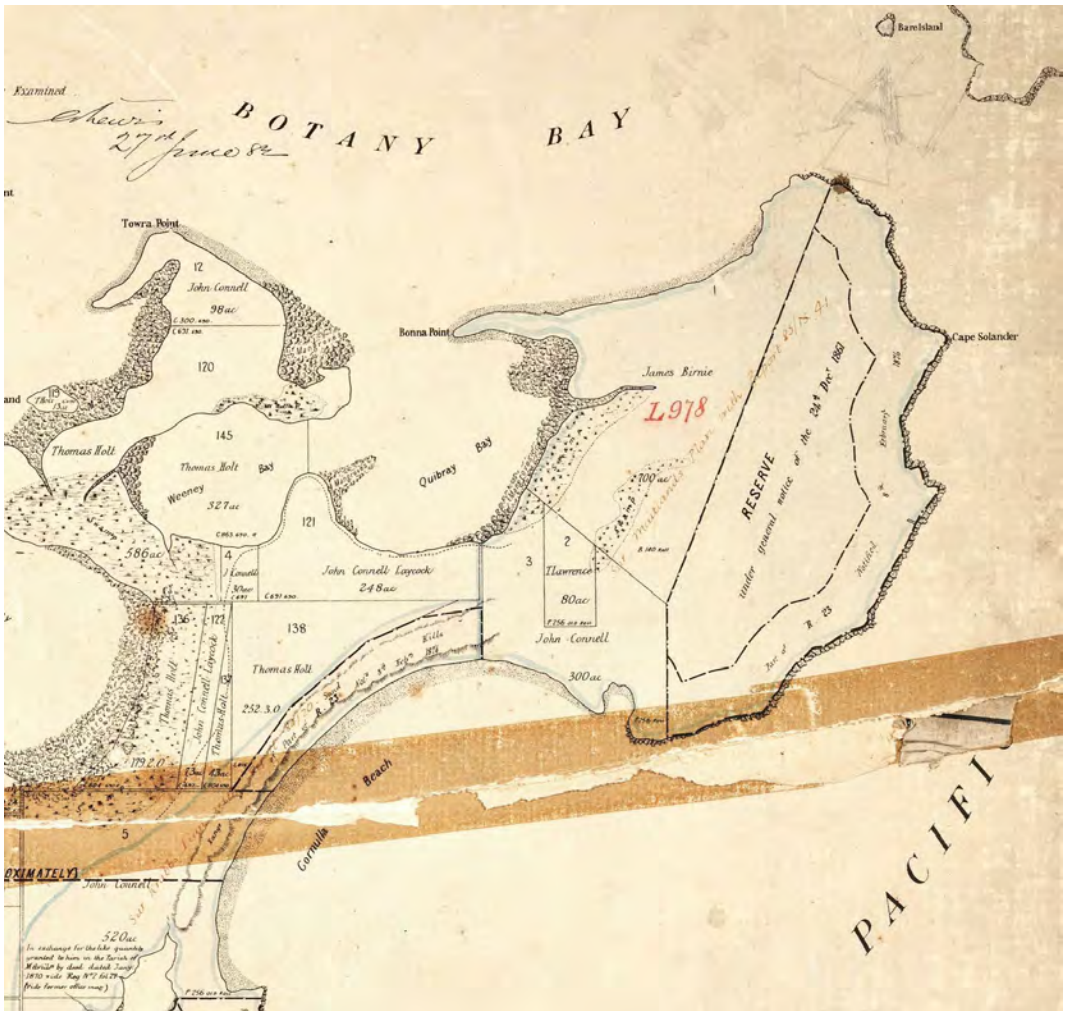


Figure 5.6 Detail of parish map of Sutherland, c1882. (Source: © NSW Land Information Centre, Ref: 14033901)

Holt was a wool merchant, financier, and politician. He was also a foundation director and member of several gold-mining, insurance and railway companies. He went on to purchase most of the unsold Crown land lots in the Sutherland district, and by 1875 he owned approximately 12,000 acres (4856ha), from Kurnell in the east to the Woronora River in the west. This land, originally known as the South Botany Estate and later as the Sutherland Estate, was divided into 11 paddocks and systematically cleared of trees by ringbarking. The trees were sold for timber, and the remaining vegetation was burned to encourage grass for sheep and cattle. Holt also imported and planted grass seed from Germany; however, the land proved to be unsuitable for grazing, and by the 1870s large areas of grassland on the Peninsula had been overtaken by sand dune. In an effort to control the movement of the dunes, Holt imported buffalo grass from America to supplement the native and imported grasses he had planted. Holt also established a number of oyster breeding grounds in Weeney and Gwawley Bays (Larkin 1998:10-12; Salt 2000:27-31).

Holt retained the Connell overseer, Mr Justice, on-site at Kurnell, but also appointed a local Aboriginal man, William Rowley, as his foreman. It is likely that other Aboriginal people lived and worked on Holt's estate in the 1860s and 1870s. However, by the end of the nineteenth century, most had moved away, some to the government reserve at La Perouse on the north shore of Botany Bay and others to a camp at Saltpan Creek on the Georges River (Salt 2000:29; Nugent 2005:59-61).

5.2.2 Kurnell Township

In 1881, Holt formed the Holt-Sutherland Estate Land Company Limited. The objective of the company was to lease land from Holt's Sutherland Estate and prepare it for settlement. The terms of the lease entitled the company to grant subleases to tenants for up to 99 years. In 1882, Richardson & Wrench offered a subdivision of the Sutherland Estate, known as The Maritime Township of Kurnell. The blocks were small, and were envisaged as weekender blocks rather than residences (Figure 5.7). Few peoples showed interest in the subdivision, and in the early years the village was little more than a fishing camp, with shanties improvised from scrap and local scrub. Other building materials were brought in by boat from La Perouse, Botany, or Sans Souci. During the Depression in the late 1920s and 1930s, many out of work families also settled in camps in the bush on the southern shore of the peninsula, or in little houses set into the cliffs (Salt 2000:48-50, 123-127).

Figure 5.7 Detail of parish map of Sutherland, c1900-1913, showing the subdivisions of the Township of Kurnell. (Source: © NSW Land Information Centre, Ref: 14039602)

Kurnell village became more established in the period between the wars, continuing to attract out of work people and retirees. During the construction of the Kurnell Oil Refinery, between 1952 and 1956, a Dutch dredging company brought a team of Dutch workers to operate the dredges. A residential hostel was erected near Bonna Point, Kurnell to house the workers. Following the completion of the Refinery, the Dutch company moved on to its next project, but its workers and their families elected to stay and settle permanently in Kurnell. A significant Dutch community remains today. After the road was built from Cronulla to service the Refinery, a large number of inexpensive houses were also relocated to the village, trucked to the area from other parts of the Shire (Salt 2000: 99-100, 125-127).

5.3 Transport

Until the mid-twentieth century, the only access to the Kurnell Peninsula was on foot or by boat. The first known wharf was built by Thomas Holt in the 1880s, adjacent to the Cook obelisk. This wharf was replaced by the Department of Lands in 1902, for the use of visitors to the Captain Cook's Landing Place Reserve (Figure 5.8). Regular private ferry services ran from Sans Souci and La Perouse to the Captain Cook Landing Place Reserve from at least 1902. These services were operated by the Fisher family, based in La Perouse. These services became intermittent from the 1950s, and were finally stopped in 1965. The wharf was continued to be maintained by NPWS, but was destroyed by a storm in 1974 (Salt 2000:103-107).

Figure 5.8 Wharf beside the Cook obelisk, Captain Cook's Landing Place Reserve, c1906. (Source: National Library of Australia, http://nla.gov.au/nla.pic-an20043808-22)

A second wharf at Dampier Street in Kurnell Township was also constructed by professional fishermen in the 1940s (Figure 5.9). This wharf could only be used during high tide, and quickly went out of use (Salt 2000:105-106). By 1955, it is no longer visible on aerial photos of the peninsula.

Figure 5.9 Wharf off Dampier Street, Kurnell, c1946. (Source: Sutherland Shire Libraries, MF002424)

The Fisher family, who owned and ran the ferry service, also erected a boat shed on Kurnell Beach in the 1920s, adjacent to Silver Beach Road (Figure 5.10). The shed, which was towed to Kurnell from Sydney Harbour, was variously used for boat building, a sailing club, seaweed harvesting. Bill Fisher sold the shed in the 1960, and it remained in use until at least 2000 (Salt 2000:81-82). An analysis of aerial photos of the site indicate that the boatshed was removed in approximately 2010-2011.

Figure 5.10 Fisher's Kurnell boatshed, 1949. (Source: Salt 2000:72)

The Kurnell Refinery Wharf and the first main road to the Peninsula were constructed in the period 1953-56 to facilitate construction of the oil refinery (see Sections 5.5.1 and 5.6.3 below). Prior to this time, the only road access was a rough track over the sand dunes, which was maintained by local residents with motor vehicles. The new road, now known as Captain Cook Drive, was the first fully sealed road connecting Kurnell to Cronulla. It was constructed by Sutherland Shire Council, but substantially paid for by Caltex, with some assistance from a Federal Aid Grant (Kirkby 1973:113, 129-133; Salt 2000:116-117; Hill and Knowlton c1960:2).

5.4 Recreation and Leisure

The relative isolation of the Kurnell Peninsula from residential settlement and development meant that it attracted visitors in search of natural beauty, places to picnic, fish and hunt, and of course some people looking to re-discover the historical sites and features associated with Cook's landing (Nugent 2000:61-66). In one late nineteenth century newspaper article, Kurnell was described as 'a veritable sportsman's paradise':

> *Half-a-century back the place abounded with game of great variety—wallaby, quail, ducks, curlew whelps, spurwing and golden plover, were there in great numbers. ... He was indeed a poor shot who, in those days, visited Kurnell and failed to secure a weighty bag.* (*Sunday Times*, 30 April 1899; quoted in Nugent 2000:5)

In the 1880s, the Thomas Holt's caretaker at Alpha House provided meals and accommodation for visitors to the Peninsula (Salt 2000:37).

Following the dedication of Captain Cook's Landing Place Reserve in 1899, the Captain Cook Landing Place Trust initiated a series of improvements to the headland, including a new wharf, a shelter shed for picnickers, walking paths, camping grounds, and an first-class accommodation house with bedrooms and a café (Salt 2000:47, 51-55). Despite the naming of the reserve, many visitors came to uses these recreational facilities, rather than to visit the landing place per se (Nugent 2005:83-84).

Figure 5.11 View of Captain Cook's Landing Place Reserve, 1910, showing the Trustees cottage and wharf. (Source: NSW State Library, Government Printing Office 1 - 11952)

Figure 5.12 Visitors to Kurnell, 1906. (Source: NSW State Library, Government Printing Office 1 – 10451)

Camping holidays were popular in the 1940s and 1950s, particularly during school holidays. With construction of the Kurnell Oil Refinery Road in the 1950s, the numbers of visitors to the park increased, often coming in large family or social groups. When the Captain Cook Landing Place Reserve came under the provisions of the NPWS Act in 1967, camping was no longer permitted on the headland. The NPWS initiated a program of re-vegetation and feral animal control, in an attempt to restore a pre-1770 ecological environment to the area. In 1988, the park was expanded and became part of Botany Bay National Park (Salt 2000:52-57; Nugent 2000:141-142)

5.5 Industrial Development

The earliest industries in the Botany Bay area focused on the water-based resources of the bay and shoreline. Commercial fishing was established on the north side of the bay as early as 1790, and by the 1850s fishermen had also built shacks on the shores of Boat Harbour, Weeney, Woolooware and Quibray Bays, sending their catch by water to the markets in Sydney. Shell-gathering or digging was also important, particularly as a source of lime for lime putty mortar, used in the construction of masonry buildings, stuccoing, and plastering over other inferior building materials. Aboriginal shell middens were a major source of shells, and shell diggers would dig up the middens at low tide and transport them to lime kilns in Sydney for burning. In the 1850s and 1860s, as the more accessible middens were exhausted, some shell gatherers resorted to taking live oysters from the water. These activities were implicated in the depletion of fresh oyster supplies in Sydney Harbour, and in 1868 the Government passed an Act prohibiting the burning of live oysters for lime (Salt 2000:73-77; see also Section 5.6.2 below).

From 1864, Thomas Holt began experimenting with oyster farming for the food industry, establishing farms in Gwawley and Weeney Bays at Towra Point. Holt used convict labour to establish the first European spawning and maturing areas. Holt's venture proved to be an expensive failure; however, once established, the oyster farming industry continued to utilise Botany Bay and the Georges River for much of the twentieth century. In 1994, an outbreak of QX disease stopped oyster farming in all areas of Botany Bay, except for the leases in Quibray Bay and Woolooware Bay. Most of the oyster leases around Towra Point have now been abandoned (Salt 200075-77).

The relative isolation of the Kurnell Peninsula from more heavily populated areas of Sydney also attracted the attention of the noxious industries trade, which had been pushed to the outskirts of the city following the passing of the 1848 Slaughter House Act. Before the widespread understanding of germ theory, it was widely accepted that disease was spread by bad smells or miasmas, and that these industries were therefore a danger to public health. Between 1881 and 1886, the government considered various proposals to reserve 2970 acres of land at Kurnell for noxious trades, such as abattoirs, tanneries, and a cemetery. Although the bill enforcing the reservation was never formally enacted, much of the Kurnell Peninsula was kept free of residential development, and in the post-War period various heavy industries have established factories and other operations on the land, including sand mining, the Kurnell Oil Refinery, two carbon black manufactories, and various chemical and pharmaceutical manufactories (Figure 5.13-Figure 5.14).

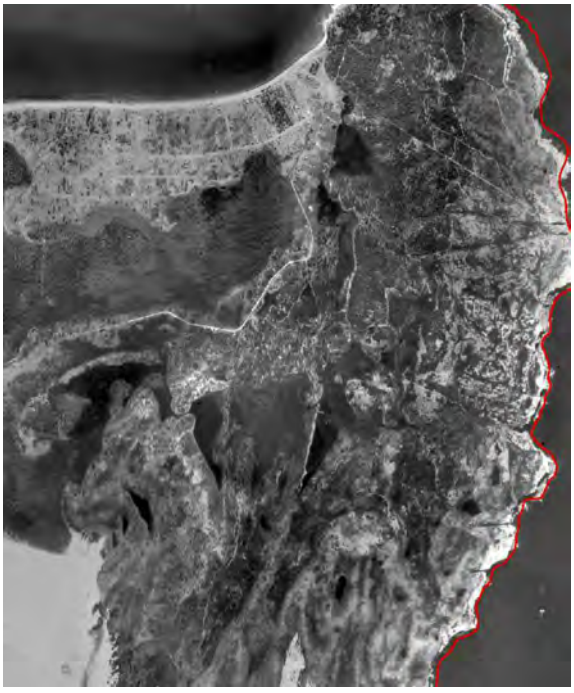


Figure 5.13 Aerial photo of Kurnell peninsula, 1943. (Source: Sutherland Shire Maps)

Figure 5.14 Aerial photo of Kurnell peninsula, 1978. (Source: Sutherland Shire Maps)

The reclamation of foreshore land and associated dredging activities for industrial development around Botany Bay has changed the original shape of the shoreline. In 1890, the city established a Sewage Farm on the northern shore of the bay, adjacent to the mouth of the Cooks River. This land was redeveloped in the mid-twentieth century as part of the expansion of Kingsford Smith Airport, and the Cooks River was diverted to a new outlet in the bay. Dredging and construction of the Kurnell Oil Refinery wharf and Banksmeadow Oil Terminal (1953-56), and the Port Botany Container Terminal (from 1970), have further altered the local environment. In 1969, a series of groynes were constructed along Kurnell Beach in order to reduce erosion caused by altered wave actions within the bay (Salt 2000:87-92; see Section 5.6.3).

The construction of the Kurnell Oil Refinery, and the ongoing heavy industrialisation of the Kurnell Peninsula, was resisted by many community groups, including environmental groups concerned that the industry would destroy the natural heritage and recreational values of the area, and others concerned that industrial facilities would desecrate the historical and social significance of the Captain Cook Landing Place Reserve (Kirkby 1973:128-129; Nugent 2005:126-128).

5.5.1 Oil Refining

The modern petroleum industry took off in mid-nineteenth century, when increasing demand for kerosene as a lighting fuel led to the development of commercial oil wells in Azerbaijan, Poland, Romania, USA, and Canada. The US firm Vacuum Oil was the first oil company to establish a presence in Australia, setting up an office in Melbourne in 1895. In approximately 1902, the Colonial Oil Company established Sydney's first oil storage depot, at Pulpit Point in Hunters Hill, and began importing kerosene and motor spirits (petrol) into Australia. The Colonial Oil Company merged with Vacuum Oil in 1908, and in 1924 Vacuum Oil opened its first bulk petroleum products terminal at the Pulpit Point site. Vacuum Oil (which later became Mobil) operated its Hunter's Hill depot until 1988 (ExxonMobil 2008).

In 1920, as motor vehicles became more popular in Australia, the Australian Federal Government formed the Commonwealth Oil Refineries (COR) and by 1924 it had built Australia's first oil refinery, at Laverton in Victoria. By 1926, John Fell and Company had also begun refining petroleum at Clyde in Sydney. The Clyde site had originally been established to refine kerosene shale oil. The Clyde refinery was purchased by The Shell Company of Australia Ltd in 1928 (Murray 2001:18).

In the post-War years, as motor car use and aviation technology boomed, petroleum companies took advantage of the world-wide supply of cheap oil and invested in new Australian-based refineries. In 1951, Shell proposed a new refinery at Geelong, VIC, Vacuum Oil proposed a new refinery at Altona, VIC, and Caltex proposed a new refinery at Botany Bay, near to Sydney's Kingsford Smith Airport (*SMH* 25 July 1951; 31 August 1951; 15 September 1951). The airport was at that time being upgraded to accommodate two new runways and an international terminal. A Botany Bay location would also enable easy distribution to local markets, good access to labour, and good access to water needed to cool the plant (Caltex 1984:5)

Australian Oil Refinery

Sutherland Shire Council objected to a proposed site of 300-400 acres at Kurnell because of its proximity to Captain Cook's landing place, which they regarded as *consecrated soil*, and overall *effect of such a dominating industry in the locality* (Kirkby 1973:128). Cumberland County Council also rejected Caltex's application to build new £25 million oil refinery at Kurnell, in an area then zoned as Open Space. Caltex argued that the refinery would not produce smoke nuisance of any kind, and that some 600 employees would be recruited locally. Sutherland Shire Council later withdrew its objection, although its reasons were not specified, and in June 1952 the State Government approved the project, provided that the company bear the cost of dredging and constructing a jetty-head, which would have to be as far distant as possible from the Captain Cook's Landing Place Reserve, and bear the cost of necessary roads and other infrastructure (*SMH* 28 March 1952; 11 June 1952; Kirkby 1973:129).

Caltex was originally established as an international company in 1936, as a joint venture of the Texas Oil Company (Texaco) and the Standard Oil Company of California (Socal). The proposed Botany Bay refinery would enable Caltex to process and distribute oil from its successful Minas Oil Fields in Sumatra, Indonesia (Hill and Knowlton c1960:4). Prior to construction, Caltex established an Australian subsidiary company to construct and operate the refinery: the Australian Oil Refining Pty Ltd (AOR). In May 1995, the petroleum refining and marketing assets of Caltex Australia and Ampol Limited were merged.

Caltex initially purchased 174 hectares of swamp land at Kurnell, and subsidised construction by Sutherland Shire Council of an access road from Cronulla, now known as Captain Cook Drive. Construction of the main refinery began in December 1953, and was completed in 1956 (Figure 5.15,

Figure 5.18-Figure 5.19). The principal contractor was E B Badger and Sons Pty Ltd, which built the process units, power plant, and installed the piping. Chicago Bridge and Iron Company built 56 tanks for crude oil and product storage. During the peak of construction in 1955, approximately 3,000 people were employed to drain swamps, clear scrub, install water and sewerage facilities, and build the main refinery. At the same time, a submarine pipeline was constructed between Kurnell and a terminal at Banksmeadow in order to transport jet fuel to the airport and other refined oils to the dockyards for sea transport. A wharf approximately 1.2 km long was also provided on the south shore of Botany Bay (Figure 5.16-Figure 5.17). The wharf structure was designed by the London office of Danish civil engineering firm Christiani & Nielson, which specialised in maritime projects and was renowned for its pioneering work in reinforced concrete. It incorporated a cooling water pump house, shipping office, breasting island capable of berthing two large tankers, and a mooring and turning dolphin (Figure 5.16). The wharf and submarine pipeline were constructed by Fletcher-Merritt-Raymond Construction Company of New Zealand (Salt 2000:99-101; Hill and Knowlton c1960:2-3). By February 1956, the refinery was pumping oil products across Botany Bay via the submarine pipelines to the Banksmeadow Oil Terminal, where they were transferred to road and rail tankers for further distribution throughout NSW (Hill and Knowlton c1960:2).

Figure 5.15 Aerial view of construction of the Australian Oil Refinery, 1955, with wharf in the background. (Source: State Library of NSW, Australian Photographic Agency – 00036)

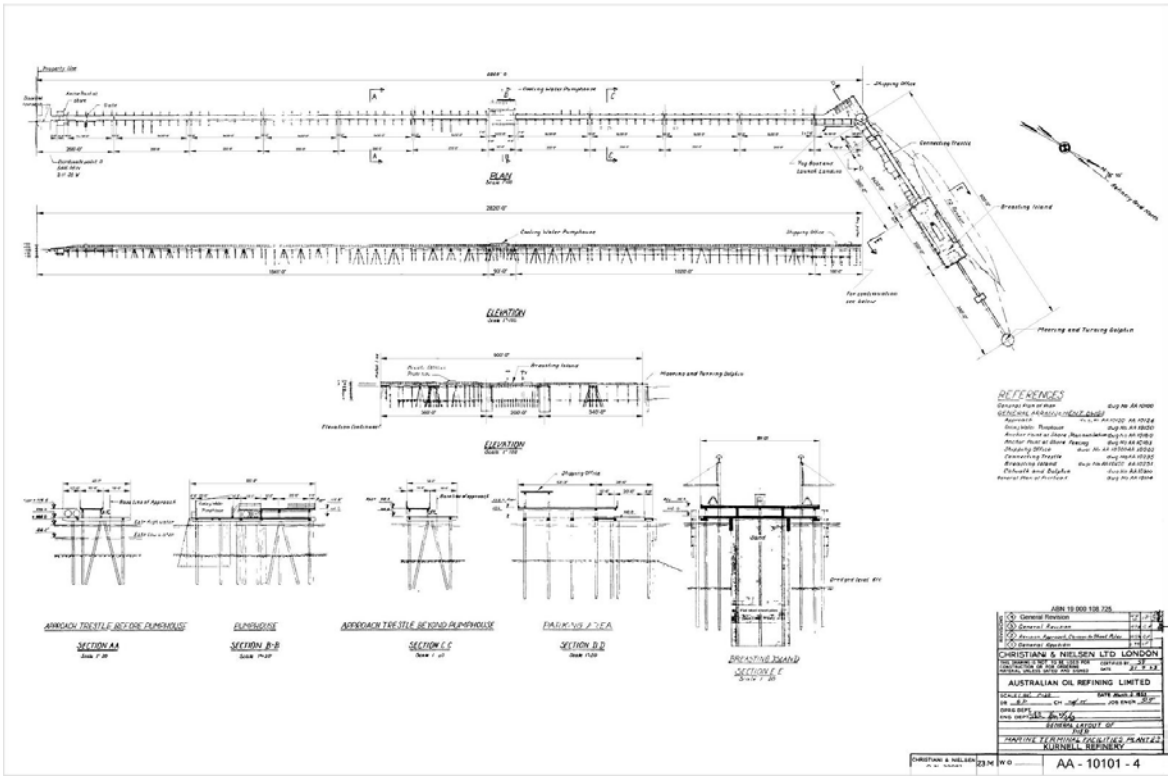


Figure 5.16 General layout plan for the AOR Wharf, 1953; by Christiani & Nielson Ltd London. (Source: Caltex)

Figure 5.17 Oil tanker Caltex Bombay at the AOR Wharf, 1956; photo by Curly Fraser. (Source: State Library of NSW, Australian Photographic Agency – 00970)

At the time of construction, AOR was the largest petroleum installation in NSW, and the largest industrial plant built by private enterprise in the State. It initially included 56 storage tanks, and processed 22,000 barrels or 770,000 imperial gallons (3,500,491 litres) of oil per day. The refinery

was progressively expanded to accommodate increased demand for oil and other refinery products (Figure 5.18-Figure 5.19). A major period of expansion began in 1961, and by 1964, refinery capacity had been increased over 400%, to 90,000 barrels of crude per day (Caltex 1984:6). From 1961, the Australian Lubricating Oil Refinery (ALOR) was constructed on Crown Land, adjacent to the main refinery (Figure 5.19). ALOR was initially conceived as a joint venture by Caltex (50%) Golden Fleece (25%) and Ampol (25%), but was later purchased outright by Caltex. The ALOR refinery began operating in 1963, producing Arabian crude oil to produce base stocks for lubricants and greases, naphthenic products, and waxes used in waterproofing, building products and cosmetics (Caltex1984:6; Salt 2000:102). Also in the mid-1960s, the wharf was upgraded, with the introduction of loading arms to the fixed berths reducing the need for manual handling. The discovery of various viable Australian oil fields further changed the nature of the Australian refining industry. In particular, Esso/BHP's off-shore wells in Bass Strait came on stream in 1969, prompting the refineries to construct new plant to cater to the new, low sulphur feedstock. At Kurnell, an additional plant to refine the Australian-produced Bass Strait crude oil was completed in 1973. By 1984, AOR was refining 150,000 barrels per day, with 70% coming from Australian oil fields in Bass Strait and the Cooper Basin in Central Australia (Caltex 1984:6; Salt 2000:101; Wilkinson 2004:81).

Figure 5.18 AOR, 1955. (Source: Sutherland Shire Maps)

Figure 5.19 AOR and ALOR (bottom left), 1970. (Source: Sutherland Shire Maps)

In more recent decades the Kurnell Oil Refinery has undergone a number of major upgrades to accommodate new safety and environmental standards, as well as repairs to aging equipment. Modifications to the wharf include upgrades to the fenders on both fixed berths (1994), extensions to the wharf office (2000), replacement of the loading arms on Fixed Berth 2 (2005), and replacement of timber launch jetty with new steel jetty (2009-2010). In July 2012, Caltex announced that it will close the Kurnell Refinery, and convert the site to a fuel import storage facility. The wharf will remain in use as part of this facility.

5.5.2 Sand Mining

Nineteenth century clearing and sheep and cattle grazing on the Kurnell Peninsula degraded the land to such an extent that large areas reverted to sand dune. However, land that was uneconomic for nineteenth century pastoral activities, in the twentieth century became economic for the building and construction industry. It is likely that sand has been mined on the peninsula from at least the 1930s,

when the State Government granted mining leases on freehold land. However, the mining took off in the 1950s, when the State Government suspended the Kurnell peninsula from the Cumberland County Planning Scheme. Companies owned by Thomas Essington Breen and the Holt Group have mined sand on freehold and leasehold land from 1953 onward (Salt 2000:93-96). Since that time the dunes have been systematically removed, transforming the landscape. In 2003, the last major exposed sand dune on the peninsula was listed on the State Heritage Register, as part of the Cronulla Sand Dune and Wanda Beach Coastal Landscape (State Heritage Inventory).

5.6 Marine Heritage Context

5.6.1 Known Shipwreck Resources

According to historical records, archival sources, The Australian National Shipwrecks Database (SEWPaC), and the NSW Maritime Heritage Shipwreck Database (OEH), 25 vessels over 10 tons are known to have been wrecked in the vicinity of Botany Bay including Kurnell between 1788 and 1990. Of those 25 vessels, seven were wrecked on the northern headland, Henry Head, Congwong Bay, Cruwee Bay and Cape Banks and are considered to be outside the area covered by this report:

- Advance (1884)
- Advance (1902)
- Fanny (1870)
- Minmi (1937)
- Olive (1930)
- Peri (1874)
- Sea Breeze (1883)

Four were wrecked on the southern headland, Cape Solander and the eastern side of the Kurnell Peninsular and are considered to be outside the area covered by this report:

- Cambrian Packet (1861)
- Clara (1877)
- Flying Fox (1847)
- William Broughton aka Sir William Broughton (1820)

Six were wrecked offshore from Cape Banks and Cape Solander and are considered to be outside the area covered by this report:

- Emmanuel (1890)
- Kelloe (1902)
- Pioneer (1883)
- Prince of Wales (1886)
- Swan (1836)
- Woniora (1882)

The remaining nine vessels were wrecked inside Botany Bay and potentially may lie inside the Dredge Footprint addressed by this report. These vessels are:

- Eileen (1934)
- George (1877)
- Magnet (1874)

- Minnie Wamsley (1903)
- Prompt (1881)
- Reclama (1930)
- Swan (1836)
- Unknown Shipwreck – possible the ketch Arab (1907)
- Unidentified Barge (1953)

The following sections provide a brief summary of each of these nine vessels.

Eileen (1934)

The small wooden fishing vessel Eileen with a crew of five was swamped and driven ashore onto the western side of the Kurnell Peninsula during a severe 'southerly buster' in December 1934 (*SMH* 26 December 1934). The site of the Eileen has not been located.

George (1877)

The Australian Town and Country Journal reported the wreck of the wooden cutter George in Botany Bay in July 1877. The vessel dragged its anchor during a gale and was driven ashore on Seven Mile Beach (Lady Robinson Beach) and became a total loss (*Australian Town and Country Journal* 21 July 1877).

Magnet (1874)

The Australian built 17 ton (gross) wooden, two-masted ketch Magnet (11.6m x 3.5m) was reported to have been wrecked in Botany Bay in November 1873 (British Register, Port of Sydney, 20/1849). The site of the Magnet has not been located.

Minnie Wamsley (1903)

The Australian built 17 ton (gross), wooden, single screw steamer Minnie Wamsley (14.9m x 3.5m) was reported lost in the vicinity of Botany Bay in November 1902 (British Register, Port of Sydney 37/1884). The site of the Minnie Wamsley has not been located.

Prompt (1881)

The wooden, two masted schooner Prompt was wrecked alongside the Government Wharf on north western side of Botany Bay during a gale in January 1881 (*SMH* 1 February 1881). The site of the Prompt has not been located.

Reclama (1930)

Various newspapers reported that a sand dredge capsised and sank in Botany Bay half a mile offshore from the Bunnerong Power Station during a gale in August 1930 (*The Advertiser*, 15 August 1930; *SMH* 15 August 1930).

Swan (1836)

The Australian built 40 ton (gross) wooden, single masted cutter Swan (12.7m x 4.6m) with a general cargo foundered in a gale off the south head of Botany Bay with the loss of fourteen lives whilst on a voyage from Wollongong to Sydney in February 1836. Wreckage from the Swan was located on Seven Mile Beach (now known as Lady Robinson or Ramsgate Beach) on the western shore of Botany Bay three weeks after the cutter disappeared (*Sydney Herald* 21 March 1836).

Unknown Shipwreck – possible the ketch Arab (1907)

On the 27 June 1907 the *Sydney Morning Herald* reported the discovery of an unidentified sunken vessel, possible the missing Australian built ketch Arab, about half mile to the south east of Henry Head – the northern headland of Botany Bay (*SMH* 27 June 1907). The wreck does not appear to have been identified.

Unidentified Barge (1953)

The *Sydney Morning Herald* reported that a barge used in shell grit operations and dredging had sunk off Quibray Beach on the western side of the Kurnell Peninsula in December 1953. The barge was later reported to be lying in 16 feet (5 m) of water, three quarters of a nautical mile west of Bunnerong Point in Botany Bay (*SMH* 5 December 1953; 17 February 1954).

5.6.2 Other Types of Underwater Maritime Heritage

The study area may also contain other types of underwater cultural heritage which may be impacted on by the proposed dredging operations. These are summarised below (after Cosmos Archaeology Pty Ltd 2011, Section 2.6,).

Moorings and Anchor Fields

Small ports and ports without developed wharfing facilities often had established designated anchorages allowing vessels to discharge their cargo into lighters in relative safety. In some cases these designated anchorages contained purpose made clump and mooring anchors.

In New South Wales this practise occurred at many of the coastal outports such as Coffs Harbour and Woologoolga and was also evident in Sydney Harbour during the nineteenth century where mooring fields were laid in Sydney Cove.

In the nineteenth century clump and mooring anchors usually consisted of obsolete anchors which had been modified by the removal of one of their arms so that the anchor would lie flush on the seabed. According to Cosmos Archaeology Pty Ltd, by the early twentieth century the moorings could consist of reinforced concrete blocks, angle iron, train carriage wheels and bogies and large engine blocks joined together by stud linked anchor chain (2011:28).

Ballast Mounds

Prior to the introduction of water ballasting and containerisation in the late 1950s, it was not uncommon for large and small vessels to offload expendable ballast such as stone, shingle and gravel in a convenient and relatively sheltered spot such as a cove or bay before taking on cargo at a nearby port, for example Ballast Point.

Commercial and amateur fishing equipment

Since the 1840s Botany Bay, Quibray Bay and the Cooks and Georges River have been intensively harvested for fish and shellfish stating that two 'fishing towns' or villages had been established on the northern shoreline of Botany Bay by 1841 (Navin Officer 2003: 15-16).

In some instances commercial and amateur fishers in the Bay may have lost fishing ground tackle such as nets, trawls and traps in the area to be impacted on by the proposed dredging operations.

Seaweed Harvesting

The harvesting of seaweed in Botany Bay for gelatine production (used in the pharmaceutical industry and as a thickening agent in food) commenced on the Kurnell side of Botany Bay during WWII. The seaweed was initially harvested by dragging an anchor or rake through the beds of seaweed but this method was later abandoned in favour of cutting chains dragged along by boats. The kelp was brought ashore and processed in drying sheds (Salt 2000:69-72).

It is possible that some kelp harvesters may have lost equipment within the study area.

Shell grit and lime production

The burning of sea shell, especially oyster, for lime production for the building industry, was one of Botany Bay's earliest industries. Lime burners were operating in the Bay from as early as 1802 (Navin Officer 2003:16). Whilst these early operations relied on the existence of extensive shell middens along the shores of Botany Bay and the Georges Rivers, once the middens were exhausted the operators commenced dredging the Bay for suitable shell.

Shellgrit gathering for the pet and poultry industry is reported to have commenced in Botany Bay around 1900 with commercial gatherers dredging the Bay for deposits of shell as well as exploiting the beach at Boat Harbour. The industry slowly declined and by the mid-1950s most shell grit was being sourced from commercial oyster growers (Salt 2000:74).

5.6.3 Dredging and Land Reclamation in Botany Bay

The waters of Botany Bay are notoriously shallow, with a maximum water depth of 22.0 m to the south west of Bare Island shelving within the Bay to an average depth of between 5.5 and 6.0 m at the centre of the Bay, and to depths of less than 3.0 m within 500 m of the shore on the north western (Lady Robinsons Beach) and south eastern (Kurnell Beach) foreshores (AUS Chart 198, 2012).

When Commander Mathew Flinders of HMS *Investigator* charted the Australian coast, between 1798 and 1803, he carried out a limited hydrographic survey of Botany Bay noting the shallow waters of the Bay particularly in the area to the south of Sutherland Point and the present day town of Kurnell (Figure 5.20).

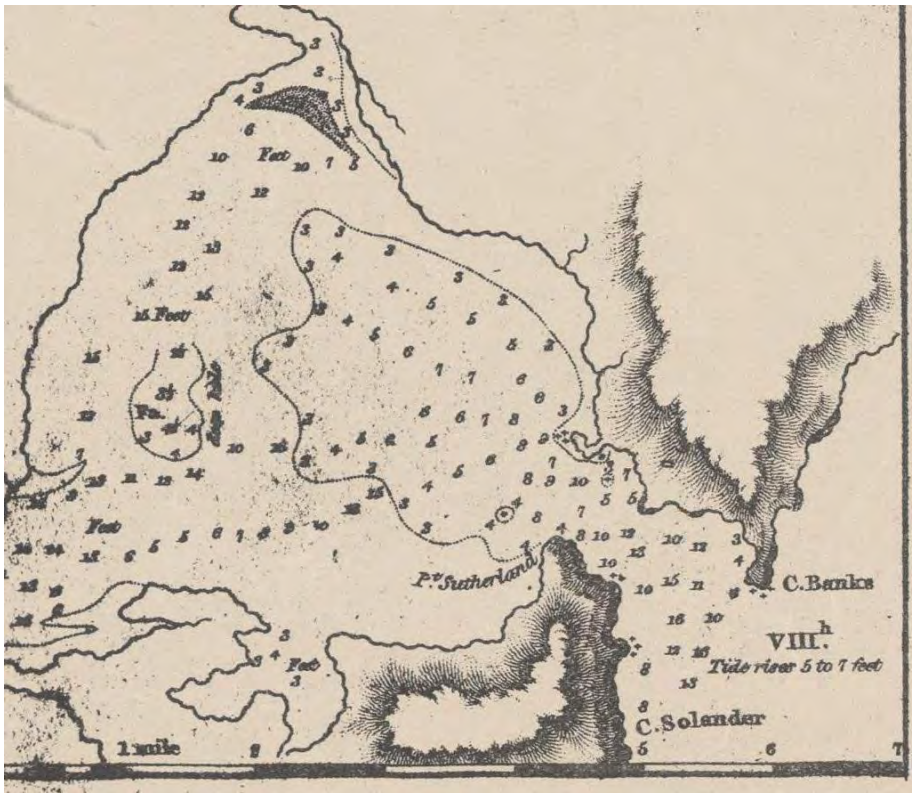


Figure 5.20 Extract of *Chart of Terra Australis*, 1803, by M Flinders. (Source: National Library of Australia, http://nla.gov.au/nla.map-rm761)

Additional hydrographic survey work was carried out in Botany Bay by Captains Owen Stanley and JL Stokes between 1848 and 1851 (Figure 5.21). The average depth of water in the vicinity of the present day town of Kurnell can been seen to vary between ¾ of a fathom (4' or 1.29 m) to 4 fathoms (24 feet or 7.3 m).

Figure 5.21 Extract of map of Australia, East Coast, Botany Bay and Port Hacking, 1848-1851. (Source: National Library of Australia, http://nla.gov.au/nla.map-vn3791500)

Stanley and Stokes also note that the deepest part of Botany Bay was the channel between Bare Island at La Perouse on the northern side of the channel and Inscription Point at Kurnell on the southern side, where the average depth was given as between 8 and 9 fathoms (48 feet (14.6 m) and 54 feet (16.4 m)).

The Reg Alder Fishing Maps of New South Wales, dated 1935, show the waters in the vicinity of the anchorage (marked by a stylised anchor in Figure 5.22) are in the approximate position of the present day berths at the Kurnell Wharf. These are shown to be between 14 and 29 feet (4.2 m – 8.8 m)

Figure 5.22 Extract of fishing chart of Botany Bay, Fishing Maps of NSW, 1935. (Source: National Library of Australia, http://nla.gov.au/nla.map-rm3523)

Whilst several proposals to dredge sections of Botany Bay including the Cooks River to improve the navigability of the Bay were raised as early as 1870, it was not until the late 1940s that large scale dredging with bucket dredges commenced at the north western end of the Bay, around the then mouth of the Cooks River (*SMH* November 1870; 19 March 19491). With the development of the Kingsford-Smith airport, further extensive dredging and land reclamation work (including the relocation of the mouth of the Cooks River) was carried at the north western end of the Bay between 1954-1959; 1964-1966; 1970-1971 and 1991 (*SMH* 18 October 1954; Jones 1981:371; Navin Officer 2003).

Early in the 1950s, as part of the works to construct the Kurnell Oil Refinery, Fletcher, Merritt, Raymond Construction Company of Auckland were contracted to build the 3600 foot long Kurnell Wharf and Australian Dredging and General Works Pty Ltd of Williamstown in Victoria were contracted to dredge a channel, turning circle and berths alongside the wharf to a depth of 33 feet (11.0 m) (*SMH* 16 February 1954; Maritime Services Board 1959). Over 2,600,000 tons of sand and sediments were removed from the wharf area, turning basin and approaches during the first series of dredging operations, and the overall average depth of dredging work was nearly 15 feet (4.6 m) (Sweetman 1955). Additional dredging work to a depth of 13.0 m was carried out on the approaches to the refinery between 1960 and 1965 (Figure 5.23) (Jones 1981:371; Navin Officer 2003:24).

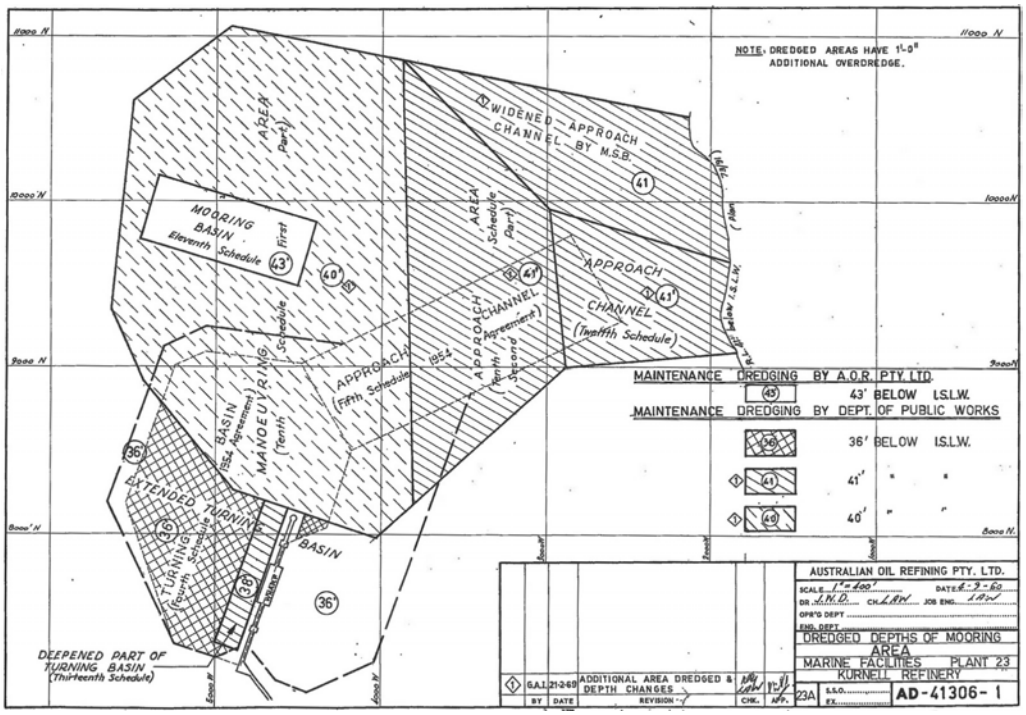


Figure 5.23 Dredge depths of the Australian Oil Refinery mooring area, 1960. (Source: Caltex)

A proposal to develop a second major port for Sydney in Botany Bay was first raised by the Maritime Services Board in 1951 (*SMH* 7 May 1952). In July 1962, the Board commissioned the Hydraulics Research Station of the British Ministry of Technology to investigate Botany Bay's hydraulic characteristics and the feasibility of opening a second port. After extensive survey and research work the Hydraulics Research Station reported back in 1966 that it was feasible to open a second port so long as the northern shoreline of the Bay was protected by an armoured embankment (The Port Botany Revetment). Extensive dredging work was undertaken at the entrance to Botany Bay to modify the wave energy produced in the Bay by offshore storms, and a series of rock groynes were constructed along Silver Beach at Kurnell to protect the beach from erosion. Dredging work commenced in 1970 on a 70 foot (21.3 m) deep V-shaped channel between the headlands at the entrance to the Bay and according to the Maritime Services Board over seven million cubic yards of sand and sediment were removed the process (Maritime Services Board 1971). This channel was augmented by additional dredging in between 1972 and 1975 and maintenance dredging has continued on a regular basis.

In 1981, Glenys Jones, Division of Fisheries Research Cronulla, conducted a major review of the impact of dredging on the sand and sediments of Botany Bay as part of an environmental assessment into the impact of the development of the Port Botany Revetment and the Kingsford-Smith Airport. At the time of his study, Jones reported that approximately 550 hectares of Botany Bay, representing about 15% of the total area of Botany Bay, had been dredged (Figure 5.24).

Figure 5.24 Map of approximate location of dredging events, dredging depths, and the years dredging took place. (Source: Jones 1981)

Leading on from Jones's work, Frost (2011) has stated that additional dredging in the entrance channels to Botany Bay and at Port Botany between 1981 and 1998 has resulted in an additional 60 million tonnes of sand and sediment being dredged from the Bay, with more than half being used in the construction of the third run way at Charles Kingsford-Smith Airport in the early 1990s. In 2009, Energy Australia dredged a route east of Kurnell Wharf between Silver Beach and La Perouse, to lay a new submarine 132 kV cable.

Comparison of Dredging Data

A comparison of the historical chart information from 1803, 1848-1851 and 1935 with a 2012 edition of AUD Chart 198 (Datum WGS84) which shows the waters of Botany Bay indicates that dredging operations carried out in the Bay in the vicinity of the Kurnell Wharf between 1953 and 1965 removed from the original seabed, between 2 to 4 metres in the eastern section of Area 1 (Sub-berth approach); between 3 and 5 metres in Area 2 (Sub-berth 3), and between 1 and 3 metres in Area 3 (Fixed Berths 1 and 2).

5.6.4 Archaeological Potential of Underwater Cultural Heritage in Botany Bay

Archaeological potential describes the likelihood for archaeological sites, features and/or relics to be preserved in situ within the environment:

Archaeological Potential	Description
Low	No archaeological feature present
Medium/Moderate	There is potential for archaeological features/sites/relics
High	There are known archaeological features/sites/relics

The archaeological potential of underwater sites is affected by a number of processes (Muckelroy 1978:160-165). These processes include:

- The quantity of fetch (distance over which wind will travel and the size of the wave produced by this wind) which surrounds the item of heritage
- The extent of sea horizon
- Percentage of hours during which a strong wind blows over the site
- Maximum speed of tidal stream over the site
- Minimum and maximum depths of water over the site
- Depth of principle deposit on site
- Average slope of seabed
- Underwater topography (rocky, sandy, mud, coral etc.)
- Nature of the coarsest material within deposit
- Nature of the finest material
- The actual wrecking process (stranding, fire, capsize, storm driven)
- Access to and process of salvage (controlled by depth of water, isolation of site etc.) and
- The size, displacement, material and manufacturing or building technique used in the construction of the item of heritage

In addition, underwater cultural heritage is subject to various extractive and scrambling processes including:

- Dredging and reclamation works
- Exploitative industries such as mining, quarrying, shell gritting and shell collecting, bottom trawling and mechanical seaweed harvesting

Due to these processes (especially weather, sand dredging, sea bed mining and salvage) shallow water sites are less likely to retain intact archaeological material than deeper water sites. However, shallow water shipwreck sites, of less than 10 metres, that contain significant quantities of centralised stone or iron ballast can protect the more fragile remains of timber or cargo and thus have a higher archaeological potential.

Previous experience has demonstrated that there is potential for the shipwrecks to survive in highly trafficked and disturbed areas. In 1987, the remains of a wooden shipwreck, later identified as the 208 ton, two masted brig *Fame*, were located in 12 to 18 m of water, in an area between the Western Channel and the Sow and Pigs Reefs in Sydney Harbour (Smith 1992). This area had been extensively disturbed since 1924 by bucket dredge and by harrowing, where a four-ton drag or sweep was slung under a barge and towed up and down, removing any rock pinnacles (Ward 1951). Although the location of the vessel was known, it was subsequently severely damaged in December 1990 by a bucket dredge, during operations associated with dredging fill for the Sydney Harbour Tunnel Project (Smith 1992).

6 Assessment of Significance

6.1 Preamble

A primary step in the process of cultural heritage management is the assessment of significance. The Burra Charter defines cultural significance as *aesthetic, historic, scientific, social or spiritual value for past, present or future generations*. Significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.

6.2 Aboriginal Cultural Heritage Significance

Aboriginal cultural heritage significance concerns the value(s) of a site, or feature, to a particular community group, in this case the local Aboriginal community. As this is a preliminary assessment, Aboriginal community consultation has not been undertaken in accordance with the *Interim Community Consultation Requirements for Applicants* (DEC 2004). The description of Aboriginal cultural heritage values presented below is based on a collation of information from previous assessments.

6.2.1 Kurnell Peninsula Headland

The Kurnell Peninsula Headland is listed on the NHL as a place of national heritage significance. The NHL includes the following Summary Statement of Significance for the place:

> *Kurnell Headland (comprising Botany Bay National Park and the Sydney Water land at Potter Point), Kurnell Peninsula, is of outstanding heritage value to the nation as the site of first recorded contact between Indigenous people and Britain in eastern Australia. The place symbolically represents the birthplace of a nation, and the dispossession of Indigenous people. The first landing at Kurnell Peninsula in April 1770 by Lt James Cook has been commemorated since 1822. The Meeting Place Precinct, including Captain Cook's Landing Place, features memorials and landscape plantings celebrating the events. Attributes specifically associated with its Indigenous values include the watering point and immediate surrounds, and the physical evidence of Indigenous occupation in the area broadly encompassed by the watering place and the landing stage. The story of Cook's first landing on the east coast of Australia is nationally important and an integral part of Australian recorded history and folklore.*
>
> *Cooks' running-survey of the east coast of Australia in 1770 and his survey of Botany Bay as a safe harbour, was an outstanding technical achievement, enabling the continental characteristics of Terra Australis to be defined for the first time, with the exception of Bass Strait, building on the work of earlier maritime explorers. Cook's first landfall in Australia at Botany Bay in 1770 informed the subsequent British declaration of terra nullius and began the process which led to British possession of the Australian continent by 1830. The headland area of Kurnell Peninsula, comprising most of Botany Bay National Park, and described by Cook in his Journal as a significant coastal landmark at the entrance to Botany Bay, is significant to the nation as the destination of the First Fleet under Captain Arthur Phillip in 1787.*
>
> *On this, Cook's first of three voyages to the Pacific, Joseph Banks was botanist, assisted by Daniel Solander and the artists Sydney Parkinson, Alexander Buchan and Herman Sporing, were to produce botanical, zoological and ethnographic drawings. Banks and Solander collected 83 specimens whilst at Botany Bay, many of which are now the type specimens of species and genera, including Banksia, named after Joseph Banks. Kurnell Headland, was the first site on the eastern coast of the Australian continent to be explored by scientist from Britain, with many of the first type-specimens of flora collected at the Kurnell Peninsula landing site by both Banks and Solander. Cape Banks and Point Solander have defined the entrance to Botany Bay since 1770. Cook's naming of 'Botany Bay' in 1770 would result in its adoption as an emotive term for a distant destination, which came to be associated with convictism for much of the nineteenth century.*

The Kurnell Peninsula Headland satisfies the following NHL criteria: (a) Events and processes; (b) Rarity; (g) Social value; (h) Significant People.

The CMP for Meeting Place Precinct ranks the various elements of the place and their contribution to the significance of the place as a whole. Table 6.1 lists the Aboriginal heritage elements of the site that are adjacent to the foreshore, and which have been identified as contributing to the overall significance of the precinct:

Table 6.1 Significance of Aboriginal heritage elements of the Meeting Place Precinct on or immediately adjacent to the high tide mark (based on Context Pty Ltd 2008:46)

Element	Contribution to the significance of the place as a whole
Landscape as an entity	Exceptional
Freshwater stream (Cook's Stream)	Exceptional
Foreshore midden areas (including AHIMS 52-3-0219)	Exceptional
Burial places: known and unknown (including AHIMS 52-3-0219)	Exceptional

6.2.2 Kurnell Potential Archaeological Deposit 1 (K PAD 1) & Kurnell Pipeline PAD

While all Aboriginal sites contain intrinsic cultural value, no specific Aboriginal cultural heritage values have been identified in association with the Kurnell Potential Archaeological Deposit 1 (K PAD 1; AHIMS 52-3-1366), and the Kurnell Pipeline PAD.

6.3 Historic Heritage Significance

As identified in Section 2, the following historic heritage items are within or associated with the study area:

- Kurnell Peninsula Headland – incorporating:
  - Captain Cook's landing place
  - Captain Cook's landing site
  - Banks Memorial
  - Solander monument
  - Captain Cook monument
  - Forby Sutherland monument
  - Landing place wharf abutment
  - Alpha Farm Site
  - Captain Cook Watering hole
  - Captain Cook Watering well
  - Flagpole
  - Yena track
  - Muru track
- Silver Beach and roadway
- Crown Land, boatshed
- Australian Oil Refinery

The significance of the historical heritage items and places has been researched and assessed as part of the statutory listing process and does not require reconsideration for this report. However, the assessment of significance provides the framework for the development of conservation and management policies, to protect the item or place for future generations. Previous assessments of these items are summarised below.

6.3.1 Kurnell Peninsula Headland

The Kurnell Peninsula Headland is listed on the NHL as a place of national heritage significance (see Section 6.2.1, above). Numerous historical elements associated with the NHL site are also separately listed on the SEPP Kurnell Peninsula.

Table 6.2 lists the historic elements of the site that are identified in the CMP for the Meeting Place Precinct as being on, or immediately adjacent to the high tide mark, and important views associated with the place (Context Pty Ltd 2008). It also includes an assessment of the relative contribution of each element to the cultural significance of the place as a whole.

Table 6.2 Significance ranking of historic elements of the Meeting Place Precinct on or immediately adjacent to the high tide mark. (Based on Context Pty Ltd 2008:45-57, Tables 1-3)

Element	Contribution to the significance of the place as a whole	Archaeological potential
Landscape (incl built elements)		
Land form profile	Exceptional	
Rocky sandstone coastal edge	Exceptional	
Sandy beaches	Exceptional	
Water of Botany Bay	Exceptional	
Birnie's Channel	High	
Trust Wharf	Exceptional	High
Holt's jetty remains	Exceptional	High
Coursed stone sea wall	Exceptional	High
Tipped stone sea wall	Moderate	High
Isaac Smith Monument	High	
Captain Cook Buoy	[not ranked in CMP]	
Views		
Orientation of the site to the bay (including historic, visual and physical relationships)	Exceptional	
Views of Kurnell Peninsula Headland across Botany Bay	High	
Views of La Perouse from Kurnell Peninsula Headland	High	

6.3.2 Silver Beach and Roadway

Silver Beach and Roadway is listed on the SEPP Kurnell Peninsula as a place of local heritage significance. The Sutherland Shire Heritage Study Inventory includes the following Summary Statement of Significance for the place:

> *Beach with remnant native vegetation in important setting on Botany Bay, affording dramatic views over Botany Bay. Combined with a series of rare stone groynes, set along beach to protect sandy beach from storms.*

The beach and roadway has aesthetic and scientific significance and rarity value.

6.3.3 Crown Land, boatshed

The Crown Land, boatshed is listed on the SEPP Kurnell Peninsula as a place of local heritage significance. However, Sutherland Shire Council has confirmed that the boatshed has been

demolished (pers. comm. Claudia Miro 11 September 2012; Sutherland Foreshore Heritage Study Inventory). The site no longer has any heritage significance.

6.3.4 Australian Oil Refinery

The Australian Oil Refinery is listed on the SEPP Kurnell Peninsula as a place of local heritage significance. The Sutherland Shire Heritage Study Inventory includes the following Summary Statement of Significance for the place:

> *Australian Oil Refinery is significant as being one of only two refineries in the Sydney area.*

It should be noted that, with the closure of the Shell Clyde refinery in September 2012, the Caltex (AOR) Refinery is the only extant refinery in NSW. The refinery has historic, technical and scientific significance, and representative value.

6.4 Maritime Heritage Significance

There has not been a survey of the study area to determine the presence, or otherwise, of maritime heritage. However, URS, with Grey's Diving, did undertake a preliminary survey in August 2012, during which no evidence of maritime heritage was noted. It is unknown whether there are relics associated with known or unidentified shipwrecks, or other maritime heritage within the study area and as such an assessment of the significance of any maritime heritage is not possible.

As the nature of the dredging works have the potential to uncover maritime relics and artefacts, care must be taken and the excavation must cease if any relics of State or local significance are unexpectedly discovered and the Heritage Council notified in writing in accordance with section 146 of the NSW Heritage Act. Depending upon the nature of the discovery, additional assessment and possible excavation may be required prior to the recommencement of excavation in the area.

7 Analysis and Assessment of Impacts

This section assesses the impacts of the proposed works on the heritage significance or values of Aboriginal, historic, and maritime heritage items, places, and archaeological sites within or in the vicinity of the project Site.

7.1 Aboriginal Heritage

Archaeological investigations carried out near the foreshore demonstrate that despite disturbance across the Kurnell Peninsula, *in situ* archaeological deposits may be in situ. However, all Aboriginal heritage sites which have been identified on the Silver Beach foreshore and on the Kurnell Peninsula Headland within the National Park, are located above the high water mark. Given the results of sediment modelling, which suggest there would be minor sediment build up along the Kurnell Headland foreshore (less than 1mm), it is unlikely that Aboriginal heritage values would be directly or indirectly affected by the proposed works.

7.2 Historic Heritage

The study area includes three main sites of historic heritage significance: the nationally significant Kurnell Peninsula Headland; locally significant Australian Oil Refinery; and locally significant Silver Beach and roadway. Each of these sites has a strong aesthetic, historical, and social connection with the waters of Botany Bay.

7.2.1 Kurnell Peninsula Headland

The National Heritage listed Kurnell Peninsula Headland is the southern headland of Botany Bay, and forms part of Kamay Botany Bay National Park. The northern foreshore of the headland has been developed as a recreational park, now known as the Meeting Place Precinct. This precinct has various historical monuments and plantings, which commemorate Captain Cook's 1770 expedition to Australia, the first recorded contact between Indigenous and British people in eastern Australia, and the subsequent consequences of this meeting, namely the colonisation of Australia and dispossession of Aboriginal people from the land. A foreshore walking path connects the various monuments and plantings, and explanatory signage interprets these elements as well as the broader symbolic significance of the site (Figure 7.1-Figure 7.2). Small pockets of native vegetation have been conserved near the shore, to represent the vegetation present at the time of Cook's landing.

Figure 7.1 View from Kamay Botany Bay National Park towards Kurnell Village. A foreshore walking path connects the various monuments and commemorative plantings in the park. The Cook Monument (left) is one of the most prominent monuments, and was designed to be highly visible from the water.

Figure 7.2 Interpretive signage at the Meeting Place Precinct, with view of the Kurnell Wharf beyond.

Views between the Meeting Place Precinct, Botany Bay, and La Perouse beyond make an important contribution to the historic, aesthetic, and social values of the place (Figure 7.4). The Meeting Place

Precinct CMP identifies the relationship and orientation of the site to the bay as making an exceptional contribution to its overall heritage significance. This incorporates views of the bay from the water, on approach to the site, the natural beauty of the site, and the historic visual and physical relationship between the site and the bay. The CMP also identifies views of the site from across Botany Bay, and views of La Perouse and Kurnell from the site as making a high contribution to the overall significance of the site (Figure 7.4). Together, these aspects enable visitors to experience or make a connection with the landscape setting of Cook's first landing on the east coast of Australia, of Banks and Solander's collection of specimens, and of a place that was lived in by the original Aboriginal inhabitants of the land. However, this experience can be diminished by the twentieth century industrial history of the bay, which detracts from the historical integrity of the place. The Kurnell Wharf is a prominent, albeit distant element in views from the Precinct across the bay to the east, while the Botany Bay Container Terminal is a dominant feature of long views across the bay to the north (Figure 7.5-Figure 7.7). Similarly, the Kurnell Oil Refinery is a discordant feature of views towards the Meeting Place Precinct from the headlands to the north, and on approach from the bay, although the refinery becomes less visible closer to the site (Figure 7.8). As such, the CMP recommends that significant views from and to the Meeting Place Precinct should be conserved and/or enhanced as enduring aspects of the landscape setting of the place, and that the integrity of the approach experience from the bay should be restored.

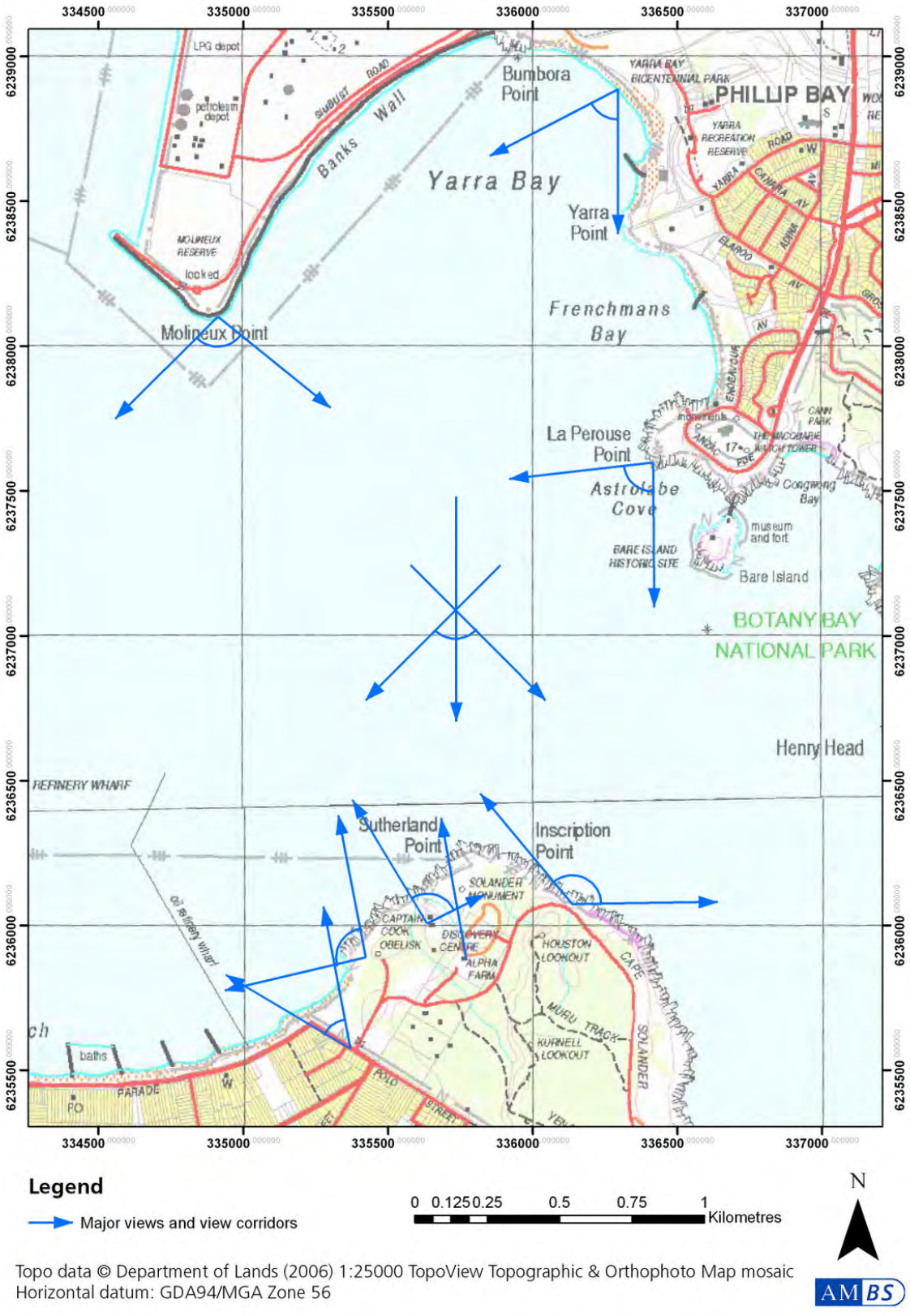


Figure 7.3 Significant view corridors associated with the Meeting Place Precinct, based on Design 5 2006:74, 78 and Context Pty Ltd 2008:50).

Figure 7.4 View from the Meeting Place Precinct Commemoration Flat towards Bare Island, La Perouse in the northeast.

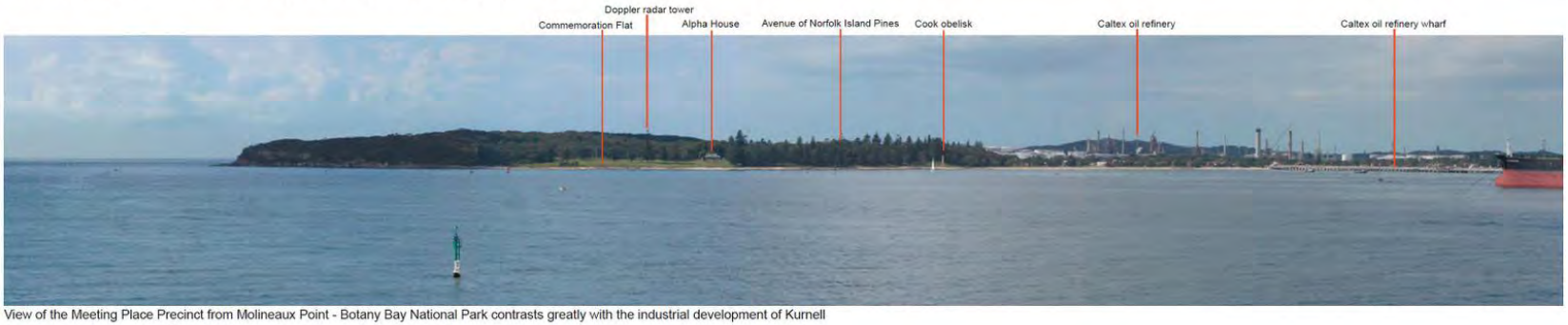
Figure 7.5 View from the Meeting Place Precinct Commemoration Flat towards the Kurnell Wharf to the west.

Figure 7.6 View from the Meeting Place Precinct Landing Place towards the Kurnell Wharf to the west.

Figure 7.7 View from the Meeting Place Precinct Landing Place towards the northwest, with the Botany Bay Container Terminal in the background to the right.

View of Cape Solander and the Meeting Place Precinct from La Perouse

View of the Meeting Place Precinct from Yarra Bay - the chimneys of the oil refinery project above the study area



View of the Meeting Place Precinct from Molineaux Point - Botany Bay National Park contrasts greatly with the industrial development of Kurnell

View of Cook Obelisk from the water on approach across Botany Bay - it stands in a cleared area framed by Norfolk Island Pine trees

Figure 7.8 Views of the Meeting Place Precinct from headlands to the north, and from the water on approach. (Source: Design 5 2006:75)

Several important historical elements of the Meeting Place Precinct are located below, or immediately adjacent to the high tide mark. A sandstone block seawall has been constructed in various stages along the foreshore, separating the park and foreshore path from the intertidal rock platform (Figure 7.9-Figure 7.11). The oldest sections of this wall are associated with early wharfs, which provided boat access to the park (Design 5 2006:88). Archaeological evidence of Holt's 1880s wharf can be seen adjacent to the Cook Monument, consisting of rectangular post holes cut into the top of the rock platform and residual timber piles (Figure 7.12). The remains of a second wharf, initially built by the Captain Cook Landing Place Reserve Trust, adjoins the seawall to the northeast of Holt's wharf. These remains include part of a built sandstone wharf pier or abutment, which is covered by a new timber deck, and various other sandstone blocks scattered around (Figure 7.13). The seaward end of the wharf has been demolished by wave action (Figure 7.14).

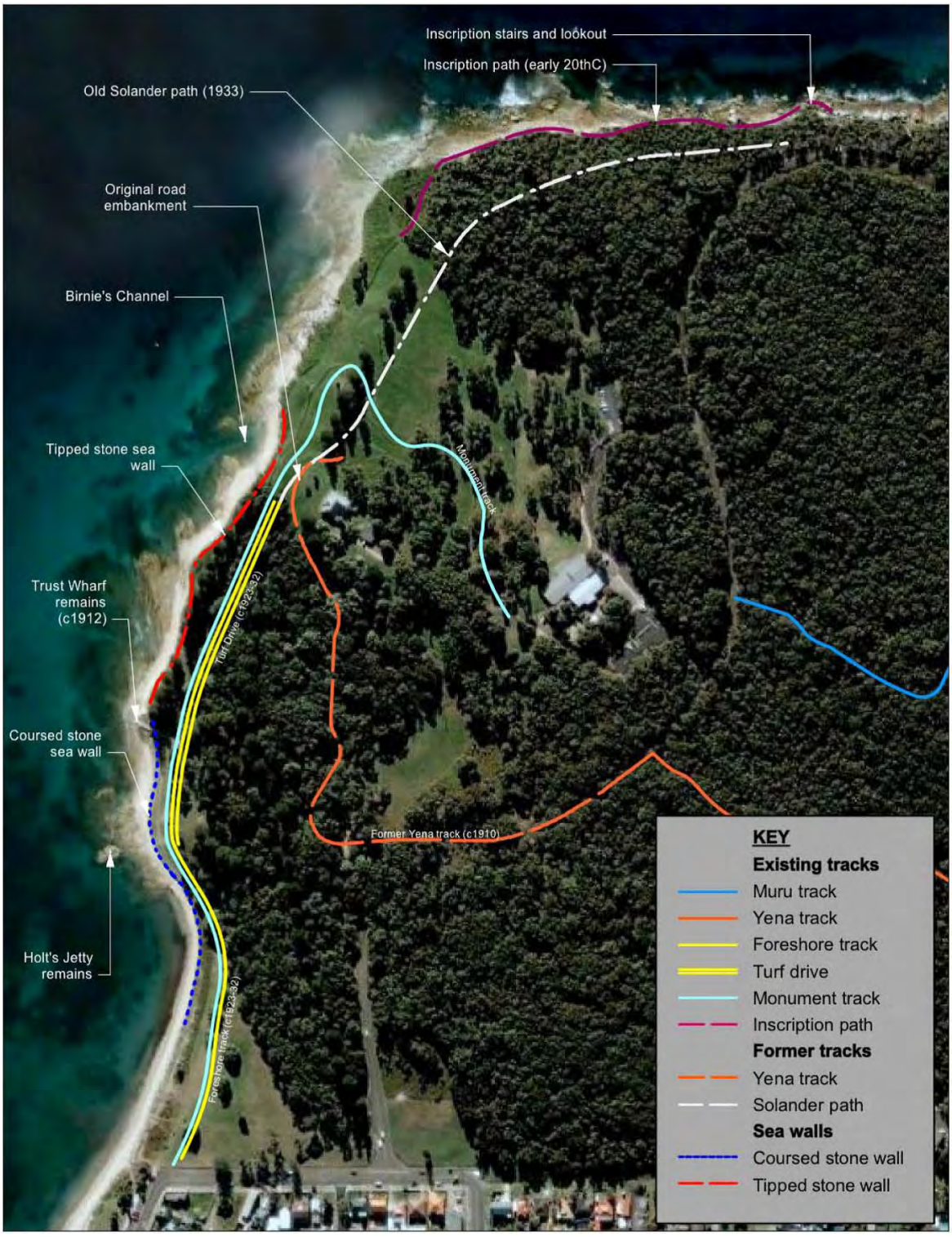


Figure 7.9 Map of the Meeting Place Precinct, showing approximate location of seawalls and foreshore elements. (Source: Context 2008:28, Fig 2.3)

Figure 7.10 A sandstone block seawall, separating the park from the intertidal rock platform.

Figure 7.11 Sandstone block seawall in front of Alpha House.

Figure 7.12 Rectangular post holes cut into the intertidal rock platform and residual timber posts (red arrows) provide archaeological evidence of Holt's 1880s wharf structure.

Figure 7.13 Archaeological remains of a sandstone wharf pier or abutment are protected by a new timber deck.

Figure 7.14 Wave action has destroyed the seaward end of the sandstone pier.

A small trachyte monument known as the Isaac Smith Memorial or the Landing Rock Monument is sited on the intertidal rock platform, approximately 40m west of the Cook monument (Figure 7.15-Figure 7.16). The inscription on the monument commemorates Isaac Smith, the first British subject to set foot on Australian soil in 1770. This monument was first erected on the site in 1948, but has since been re-installed on a concrete pad and faces the opposite direction from the original installation (Design 5 2006:83). Pedestrian access to the monument is dependent on the tides.

Figure 7.15 View of Isaac Smith Memorial (Landing Rock Monument), with Kurnell Wharf behind.

Figure 7.16 View of foreshore, showing relationship between Isaac Smith Memorial (red arrow) and Cook Monument.

A broad straight channel cut in the intertidal rock platform to the west of Alpha House is thought to be a dock cut for James Birnie, the first European owner of the site (Figure 7.17). Square peg post holes cut into the rock platform to the north of this site may also indicate an earlier timber structure (Design 5 2006:89).

Figure 7.17 View of rock-cut channel to the west of Alpha House.

Assessment of Impacts

The proposed dredging works, including the location of dredging equipment within the bay and changes to water turbidity, would have a minor, temporary impact on important views of Botany Bay

from the Meeting Place Precinct, the visual and physical relationship between the site and the bay, and the natural beauty of the place, which all contribute to the national heritage values of the Kurnell Peninsula Headland. The historical integrity of significant views from the Meeting Place Precinct to the north and northwest is already diminished by distant views of the existing infrastructure of the Kurnell Wharf and the Botany Bay Container Terminal. The proposed upgrades to the Kurnell Wharf fixed berth infrastructure, including installation of a hydraulic loading arm system to Fixed Berth 1 would not substantially alter the present views of the wharf from the site, insofar as there will be little or no change to the bulk or vertical scale of the existing berthing structures. Extension of the wharf structure by the addition of a third mooring island, similar to the existing mooring islands, will not interrupt views to the Meeting Place Precinct from the headlands to the north, and will have little or no impact on the existing approach experience to the site from the bay. Overall, the proposed works would not have any long-term or significant impact on the current view corridors or the orientation of the site to the bay, previously assessed as having high and exceptional heritage value, or the national heritage values of the place.

Hydrodynamic modelling of the proposed works have predicted some minor sediment build up along the Kurnell Headland foreshore (less than 1mm). Any sediment build up could obscure significant archaeological evidence of early wharves and rock cuttings along the foreshore, including, in particular, important archaeological evidence of Holt's wharf and Birnie's dock, associated with the Kamay Botany Bay National Park Meeting Place Precinct. This build up would not impact on the physical fabric of the rock cuttings, but there is a possibility it could interfere with the visual appreciation or interpretation of these elements by the general public. Taking into consideration the dynamic nature of the intertidal environment and minimal changes to water movement within the bay, any sediment build up is likely to be temporary and as such would not have a significant impact on the National heritage values of the place. Although the Isaac Smith Memorial is sited off-shore, the predicted sediment build up is unlikely to have an adverse impact on the stability or setting of the monument.

Hydrodynamic modelling of the proposed works indicates that there would not be any changes to wave energy in the vicinity of the National Park. As such there are unlikely to be any impacts on fabric or significance of the remains of the Isaac Smith Memorial, the Trust wharf, or original elements of the sandstone seawall as a consequence of increased wave energy.

7.2.2 Silver Beach and Roadway

Silver Beach is a long, picturesque white sand beach along the northern side of the Kurnell Peninsula (Figure 7.18). Prince Charles Parade runs the length of the beach, and forms the northern boundary of Kurnell Village. One and two storey houses line the south side of the road, most dating to the post-WWII era (Figure 7.19). The north side of the road is separated from the beach sand by a narrow verge, which in some areas has been stabilised with native vegetation. Much of the verge is supported by a tipped sandstone retaining wall. Beach erosion is controlled by a series of 14 long groynes, also constructed of sandstone rubble (Figure 7.20).

Figure 7.18 Silver Beach and Prince Charles Parade; view to the west.

Figure 7.19 Prince Charles Parade; view to the west.

Figure 7.20 Sandstone groyne on Silver Beach, with the Kurnell Wharf behind.

Assessment of Impacts

Hydrodynamic and wave impact modelling of the proposed dredging works indicate that there would be indiscernible changes in wave energy along the length of Silver Beach, and that there would be no, or negligible, impacts on beach erosion or the structural integrity of the sandstone groynes. Changes to water turbidity would have a minor, temporary impact on important views of Botany Bay. The works are unlikely to have long term impacts on the amenity or aesthetic significance of the beach and roadway.

7.2.3 Crown Land, boatshed

The heritage item Crown Land, boatshed, referred to on the Kurnell Peninsula SEPP, is no longer extant, and the site of the former boatshed has been revegetated. As such there would be no impacts on the heritage significance of this item from the proposed works.

Figure 7.21 Site of former heritage item Crown Land, boatshed, opposite 88 Prince Charles Pde.

7.2.4 Australian Oil Refinery

The industrial heritage item Australian Oil Refinery refers to the original elements of the Kurnell Oil Refinery constructed by Caltex's subsidiary AOR between 1953 and 1956, including storage areas, power plant, yard, wharf, and submarine pipeline, as well as the 1960s Australian Lubricating Oil Refinery and the 1970s Bass Strait complex (Figure 7.22).

The wharf extends from Silver Beach approximately 1.2 km into Botany Bay (Figure 7.23). The southern end of the wharf is approximately 250 m southwest of the entrance to Kamay Botany Bay National Park. The wharf consists of a reinforced concrete superstructure supported by reinforced concrete piles. It terminates in a breasting island capable of berthing two large tankers, and a mooring and turning dolphin.

The wharf is considered to be an important, original element of the Australian Oil Refinery site, and continues to function as the sole entry point for the feedstock of crude oil and other petroleum product imports that are processed at the refinery. AMBS did not inspect the fabric of the wharf for this report. However, Caltex's records indicate that the following upgrades and repairs have been undertaken as part of the ongoing maintenance and use of the wharf since it was first constructed in the 1950s:

- the introduction of loading arms to the fixed berths in the mid-1960s;
- subsequent replacement of the loading arms on Fixed Berth 2 in 2005;
- replacement of fenders on the fixed berths in 1994;
- extension of the wharf office in 2000;
- replacement of the launch jetty in 2009-2010;
- installation of quick release hooks on Fixed Berth 2 in 2010

Although the relative significance of individual elements of the AOR site have not been assessed for this or earlier reports, the existing loading arms are likely to have moderate heritage significance in the context of the overall site. The loading arms on Fixed Berths 1 and 2 are not original fabric, but they provide evidence of changes in technology and practice over the life of the wharf. The long-term, cumulative impacts of upgrades to the wharf structure detract from the overall scientific value of the AOR site, but contribute to the historical and technical significance of the AOR as an early and ongoing operational refinery.

Figure 7.22 Approximate area of local heritage item Australian Oil Refinery is outlined in green. (Source: Written description of site contained in Sutherland Shire Heritage Inventory; Background imagery: Google Earth; © 2012 Whereis® Sensis Pty Ltd; © 2012 Sinclair Knight Merz; © 2012 DigitalGlobe; © 2012 TerraMetrics)

Figure 7.23 Kurnell Wharf; view from Silver Beach.

Assessment of Impacts

The proposed upgrades to the Kurnell Wharf fixed berth infrastructure aim to keep the wharf in operation and as such would support the primary industrial heritage significance of the overall AOR site as a rare, active oil refinery in NSW. However, consideration should be given to the impacts of the proposed works on the original and/or important existing fabric of the wharf, and how that fabric illustrates the history of the operation of the refinery.

The installation of a new hydraulic loading arm system, manifold, and quick release hooks on Fixed Berth 1 would involve the permanent removal of the remaining 1960s loading arm technology from the site. This change would have a minor adverse impact on the historical and scientific significance of the site. However, the impact could be mitigated by an archival recording of the existing fabric and use of the loading arms and associated elements of the wharf before they are removed, and the ongoing use of the wharf for petroleum product transfers in association with the operation of the main AOR site.

Construction of four, standalone breasting dolphins to allow the berthing of larger ships is unlikely to have adverse impacts on significant original fabric of the wharf structure, and would also support the primary technical heritage significance of the overall site by contributing to the ongoing use of the wharf for petroleum product transfers.

The proposed works would not have any impact on the fabric of the main refinery site, and are consistent with the technical significance of the site as an operational refinery.

7.2.5 Summary of Impacts on Historic Heritage Items

Table 7.1 summarises the assessment of impacts on the heritage significance of statutory heritage items and places:

Table 7.1 Summary of impacts on statutory heritage items and places.

Heritage Item	Listing	Significance	Potential Impacts
Kurnell Peninsula Headland	• NHL • OEH s170 Register • SEPP Kurnell Peninsula	National	• Minor, temporary impacts on important views arising from dredging equipment in the bay and changes to water turbidity. • Little or no impact on important views arising from upgrades to Kurnell Wharf. • Minor, temporary impacts on historical archaeological resources arising from sediment build-up. • No impacts arising from changes in wave energy.
Silver Beach and Roadway	• SEPP Kurnell Peninsula	Local	• Little or no impact arising from changes in wave energy. • Minor, temporary impacts on important views arising from changes to water turbidity.
Crown Land, boatshed	• SEPP Kurnell Peninsula	Local	• No impacts. Heritage item no longer extant.
Australian Oil Refinery	• SEPP Kurnell Peninsula	Local	• Minor adverse impacts arising from installation of new hydraulic loading arm system, manifold, and quick release hooks on Fixed Berth 1 of Kurnell Wharf.

7.3 Maritime Heritage

7.3.1 Shipwrecks

Historical information indicates the possibility that at least nine undetected shipwreck sites lie within the waters of Botany Bay. These sites include:

Vessel Name	Year Wrecked
Eileen	1934
George	1877
Magnet	1874
Minnie Wamsley	1903
Prompt	1881
Reclama	1930
Swan	1836
Unidentified Barge	1953
Unknown Shipwreck – possible the ketch Arab	1907

Given the nature of the material used in the construction of the Eileen (1934), George (1877), Magnet (1874), Minnie Wamsley (1903), Prompt (1881), Swan (1836) and the Unknown Shipwreck (1907), the relatively small size of the vessels, the exposed nature of the seabed, and the extensive dredging and other extractive processes which have occurred in Area 2 (Sub-berth) and Area 3 (Fixed Berths 1 and 2) it is predicted that the potential to disturb these shipwrecks in these areas is very low.

Given the less extensive, and limited, dredging and other extractive processes which have occurred in the western parts of Area 1 (Turning Circle and approaches), particularly in the area north of the sub-berth, it is predicted that the potential to disturb items of underwater cultural heritage is moderate.

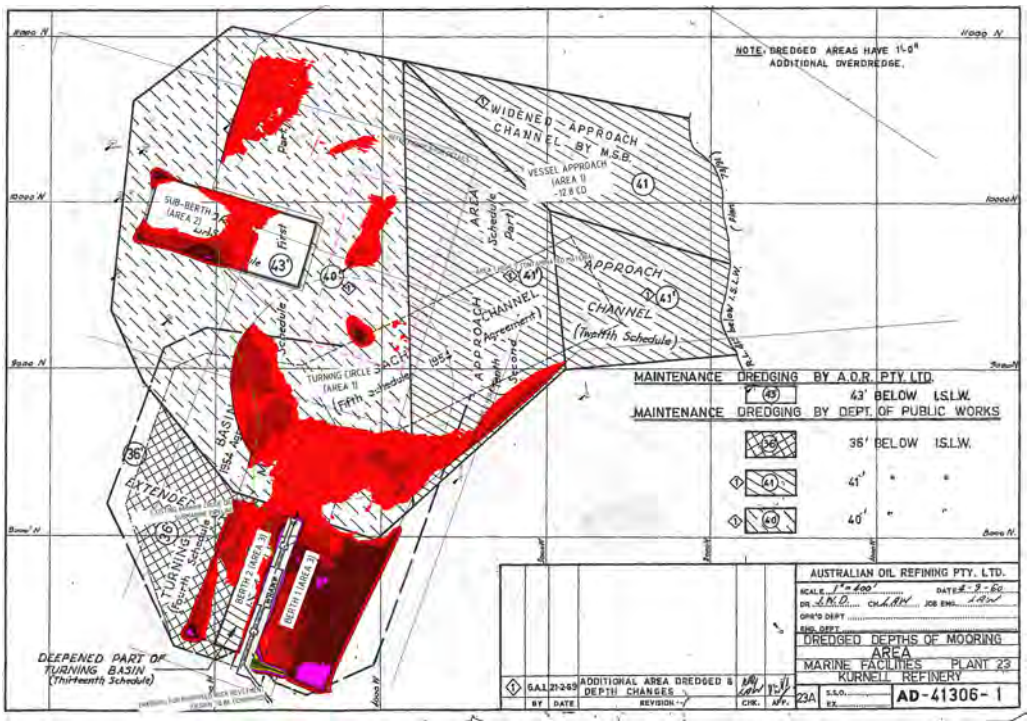


Figure 7.24 Approximate overlay of proposed dredge footprint and previously dredged areas (1960)

It is also predicted, based on historical information, that the Reclama (1930) and the Unidentified Barge (1953) lie outside the study area.

7.3.2 Other Types of Underwater Maritime Heritage

Historical information indicates the possibility for other items of underwater cultural heritage to lie beneath the waters of Botany Bay, including relics associated with early fishing, extractive industries such as shell gritting, kelp harvesting and anchoring and mooring. Given the nature of the material used in the construction of these items, their relatively small size, the exposed nature of the seabed, and the extensive dredging and other extractive processes which have occurred in the vicinity of the study area, it is predicted that the potential to disturb these items is low.

8 Conclusions and Recommendations

8.1 Aboriginal Heritage

No Aboriginal archaeological sites, objects or places, or areas of archaeological potential or Aboriginal sensitivity, were identified within the project Site. Given the proposed works are likely to result in minor sediment build up along the Kurnell Headland foreshore, and only indiscernible changes in wave energy along the length of Silver Beach, it is unlikely that Aboriginal heritage sites above the high water mark on the northern side of the Kurnell Peninsula would be impacted by the port upgrades and dredging works. As such, Aboriginal cultural heritage values of the study area are not likely to be affected, and no further assessment of the study area is required prior to works.

Recommendation 1

There are no Aboriginal heritage constraints on the proposed works. No further Aboriginal cultural heritage assessment is required prior to works.

As the statutory representatives of the local Aboriginal community, La Perouse Local Aboriginal Land Council should be provided with a copy of this report, and given an opportunity to comment on the Aboriginal heritage recommendations. Any feedback should be appended to the report.

Recommendation 2

A copy of this report should be supplied to La Perouse Local Aboriginal Land Council for review and comment. Any feedback provided should be appended to this report.

8.2 Historic Heritage

The proposed dredging works and upgrades to the Kurnell Wharf would have some temporary impacts on important views and historical archaeological resources associated with the National Heritage listed Kurnell Peninsula Headland. In particular, care should be taken to minimise the dispersion and settlement of sediments along the Kurnell Headland foreshore, to reduce the potential for sediment build up, which could obscure significant archaeological evidence of early wharves and rock cuttings along the foreshore.

Overall, the effects of the dredging would not permanently damage, destroy, or substantially alter significant historic heritage fabric or views associated with the national heritage values of the Kurnell Peninsula Headland. As such, Caltex is not required to submit a referral to SEWPaC for an assessment and approval by the Minister under the provisions of the C'th EPBC Act.

The proposed works would not have long term or adverse impacts on the heritage significance of local heritage item Silver Beach and roadway. However, the proposed wharf upgrades would have a minor impact on significant fabric of the wharf, which contributes to the overall historic and technical significance of the local heritage item Australian Oil Refinery. Taking into consideration the long-term, cumulative impacts of upgrades to the wharf structure on the heritage significance of the place, it would be appropriate to make an archival recording of the physical fabric and operation of the wharf, which could in future be used to illustrate the history of the place.

Recommendation 3

Consideration should be given to preparing a photographic recording of the existing fabric and operation of Kurnell Wharf prior to the upgrade works, including in particular the existing infrastructure at Fixed Berth 1, which would be replaced as part of the proposed works. This record would become part of the history of the place and should be maintained for the appreciation of present and future generations.

8.3 Maritime Heritage

Although no shipwrecks or other elements of maritime heritage have been identified or noted within the study area, there is moderate potential for unexpected maritime relics to be exposed during the dredging works in the northwest part of the dredge footprint within Area 1 (Turning Circle and approaches). Should maritime relics be unexpectedly found during the dredging works, works in the area of the relics should cease and the Heritage Council of NSW should be notified, in accordance with Section 146 of the NSW Heritage Act. Mitigation may include archaeological excavation of the relics.

To mitigate against the potential for an unexpected discovery of relics delaying the works program, existing side scan data of the north-western section of the dredge footprint in Area 1 (Turning Circle and its approaches) should be reviewed by a maritime archaeologist prior to works. If this data is not available, a remote sensing survey should be undertaken by a maritime archaeologist prior to works. This could be undertaken in conjunction with geotechnical and/or other preconstruction surveys. In addition, works in Areas 2 and 3 should be monitored for maritime cultural heritage to ensure that any relics exposed would be assessed by a maritime archaeologist, and an appropriate management strategy put in place.

Recommendation 4

Should maritime heritage relics be unexpectedly found during the dredging works, works in the area of the relics should cease and the Heritage Council of NSW should be notified, in accordance with Section 146 of the NSW Heritage Act.

Recommendation 5

To mitigate against the potential for an unexpected discovery of relics delaying the works program, existing side scan data of the north-western section of the dredge footprint in Area 1 (Turning Circle and its approaches) should be reviewed by a maritime archaeologist prior to works. If this data is not available, a remote sensing survey should be undertaken by a maritime archaeologist prior to works. In addition, works in Areas 2 and 3 should be monitored for maritime cultural heritage to ensure that any relics exposed would be assessed by a maritime archaeologist, and an appropriate management strategy put in place.

9 Management and Mitigation Measures

Caltex have included the following management and mitigation measures in the EIS for the proposed works to address impacts on the significance of existing and potential heritage items, places and archaeological sites affected by the works:

- A photographic record of the existing fabric and operation of Kurnell Wharf would be prepared prior to the proposed works. This would focus in particular on the existing infrastructure at Fixed Berth 1. This record would become part of the history of the place and would be maintained for the appreciation of present and future generations.

- A management control would be included in the *Dredge and Spoil Disposal Management Plan* (DSDMP) and the *Construction Environmental Management Plan* (CEMP) for the works' contractor to monitor for heritage items or relics during dredging. If relics were to be discovered in the dredging areas, the works would immediately cease at that location and the relics would be reported to NSW Heritage Council (in accordance with Section 146 of the Heritage Act 1977). Further assessment by a maritime archaeologist and development of an appropriate management strategy may also be required.

Bibliography

'Secret Instructions to Captain Cook, 30 June 1768', http://foundingdocs.gov.au/resources/transcripts/nsw1_doc_1768.pdf, accessed 4 September 2012.

Albani, AD & Rickwood, PC 1998, 'The Botany Basin: its bedrock morphology and recent geological history', pp190-196. In McNally, GH & Jancowski, J (Eds), *Collected Case Studies in Engineering Geology, Hydrogeology and Environmental Geology, Geological Society of Australia*. http://www.precisioninfo.com/rivers_org/au/archive/?doc_id=26, accessed 13 September 2012.

Attenbrow, V 1981, *Mangrove Creek Dam – Salvage Excavation Project*, Report to NSW National Parks and Wildlife Service for the Department of Public Works.

Attenbrow, V 2004, *What's Changing: Population Size or Land-Use Patterns? The Archaeology of Upper Mangrove Creek, Sydney Basin*, Pandanus Books, Australian National University, Canberra.

Attenbrow, V 2010, *Sydney's Aboriginal Past*, 2nd edition, University of New South Wales Press Ltd, Sydney.

Australia ICOMOS 1999, *The Burra Charter: The Australia ICOMOS charter for places of cultural significance*, Burwood.

Australian Museum Business Services (AMBS) 2011, *Kurnell B Line Upgrade: Heritage Impact Assessment*, Report prepared for URS on behalf of Caltex.

Benson, D & Eldershaw, G 2007, 'Backdrop to encounter: the 1770 landscape of Botany Bay, the plants collected by Banks and Solander and rehabilitation of natural vegetation at Kurnell', *Cunninghamia,* 10(1), pp 113–137.

Benson, D & Howell, J 1990, *Taken for Granted: The bushland of Sydney and its suburbs*, Kangaroo Press Pty Ltd and The Royal Botanic Gardens Sydney, Kenthurst.

Caltex 1984, *Boiling the Oil*.

Collins, D 2003 [1798], *An Account of the English Colony in New South Wales. Vol. 1*, University of Sydney, Sydney. http://setis.library.usyd.edu.au/ozlit/pdf/colacc1.pdf, accessed 6 September 2012.

Cook, J 2004 [1770], *James Cook's Journal of Remarkable Occurrences aboard His Majesty's Bark Endeavour, 1768-1771*, National Library of Australia, Manuscript 1 page 228 [Electronic transcript], South Seas. http://nla.gov.au/nla.cs-ss-jrnl-cook-17700429, accessed 3 September 2012.

Cook, J 2010 [1768-1770], *Selections from A Journal of the Proceedings of His Majesty's Bark Endeavour on a Voyage round the World, by Lieutenant James Cook, Commander, commencing the 25th of May 1768 - 23 Oct. 1770*. Manuscript Safe 1/71 [Electronic transcript], State Library of New South Wales. http://www.sl.nsw.gov.au/discover_collections/history_nation/voyages/discovery/endeavour/cook/index.html, accessed 6 February 2012.

Cook, J 1821, *The Three Voyages of Captain James Cook Round the World Vol II. Being the Second of the First Voyage*, Longman, Hurst, Rees, Orme and Brown, London.

Context Pty Ltd 2008, *Meeting Place Precinct: Botany Bay National Park – Kurnell. Conservation Management Plan*, Report for Parks and Wildlife Group, Department of Environment, Climate Change (NSW).

Cosmos Archaeology Pty Ltd 2011, *Ichthys Gas Field Development Project:nearshore development 2011 area – assessment of marine heritage survey methods*, Report prepared for INPEX Browse Ltd, Perth, WA.

Dallas, M 1996, *Cronulla Sewage Treatment Plant Upgrade and Additional Effluent Transfer Pipeline Archaeological Study*, Report to Sydney Water.

Department of the Environment, Water, Heritage and the Arts 2009, *Matters of National Environmental Significance: Significant Impact guidelines 1.1*, Commonwealth of Australia.

Design 5 2006, *The Meeting Place Precinct, Botany Bay National Park, Kurnell, Heritage Assessment*, Report prepared for Parks and Wildlife Division, Department of Environment and Conservation (NSW).

ExxonMobil 2008, 'Mobil History', http://www.exxonmobil.com.au/Australia-English/PA/about_who_history_mobil.aspx, accessed 3 September 2012.

Frost, A 1994 *Botany Bay Mirages: Illusions of Australia's Convict Beginnings, Melbourne University Press,* Carlton.

Frost, G 2011, *Review of Coastal Processes and Evaluation of the Impact of the Constructed Groynes along Lady Robinsons Beach, Botany Bay, New South Wales, Australia*, Unpublished Honours Thesis for Bachelor of Environmental Science (Honours), University of Wollongong. http://ro.uow.edu.au/thsci/17, accessed 14 September 2012.

Geoscience Australia 2008, *Australian Stratigraphic Units Database: Hawkesbury Sandstone*, http://dbforms.ga.gov.au/www/geodx.strat_units.int, accessed 13 October 2008.

Hawkins, CA 1947, 'The Formation of Port Jackson', *Port of Sydney Journal* (July):140-143.

Hazelton PA & Tille PJ 1990, *Soil Landscapes of the Wollongong-Port Hacking 1:100 000 Sheet*, Soil Conservation Service, Sydney.

Heritage Branch 2009, *Assessing Significance For Historical Archaeological Sites and 'Relics.'*

Hill and Knowlton Pty Ltd c1960, *The Kurnell Story*, Australian Oil Refining Pty Ltd, Sydney.

Hunter, J 2003 [1793], *An Historical Journal of the Transactions at Port Jackson and Norfolk Island: With the Discoveries which have been made in New South Wales and in the Southern Ocean, since the publication of Phillip's Voyage, compiled from the Official Papers; Including the Journals of Governor Phillip and King, and of Lieut. Ball; and the Voyages from the first Sailing of the Sirius in 1787, to the Return of the Ship's Company to England in 1792*, University of Sydney, Sydney, http://adc.library.usyd.edu.au/data-2/hunhist.pdf, accessed 6 September 2012.

Irish, P 2007a, *Draft Methodology for Aboriginal Archaeological Monitoring and Limited Salvage Excavation: Meeting Place Precinct, Botany Bay National Park, Kurnell, NSW*, Report to the La Perouse Aboriginal Community.

Irish, P 2007b, *Final Report on Aboriginal Archaeological Test Excavations Meeting Place Precinct, Botany Bay National Park, Kurnell, NSW*, Report to the DECC and the Government Architects Office.

Irish, P 2009, *Additional Monitoring at the Meeting Place: Addendum to Final Report on Aboriginal Archaeological Monitoring and Salvage Excavations: Meeting Place Precinct, Kamay Botany Bay National Park, Kurnell, NSW*, Report to Design Landscapes Pty Ltd and the DECCW.

Irish, P 2010, *Final Report on Aboriginal Archaeological Monitoring and Salvage Excavations Meeting Place Precinct, Botany Bay National Park, Kurnell, NSW*, Australian Archaeological Consultancy Monograph Series 3, Australian Association of Consulting Archaeologists Inc., Armadale.

Jones, G 1981, 'Effects of dredging and reclamation on the sediments of Botany Bay', *Australian Journal of Marine and Freshwater Research,* 32 (3), pp 369-377.

Keith, D 2006, *Ocean Shores to Desert Dunes: the native vegetation of New South Wales and the ACT*, Department of Environment and Conservation (NSW), Hurstville.

Kirkby, DR 1973, *From Sails to Atoms: First fifty years of Sutherland Shire, 1906-1956*, Sutherland Shire Council.

Kohen, J 1986, *Prehistoric Settlement in the Western Cumberland Plain: Resources, Environment and Technology*, Unpublished PhD Thesis, School of Earth Sciences, Macquarie University, Sydney.

Kohen, JL, Stockton, ED & Williams, MA 1984, 'Shaws Creek KII rockshelter, a prehistoric occupation site in the Blue Mountains piedmont, eastern New South Wales', *Archaeology in Oceania* 19(2), pp 57-72.

Lampert, RJ 1971, *Burrill Lake and Currarong; Coastal Sites in Southern New South Wales*, Terra Australis 1, Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.

Larkin, M 1998, *Sutherland Shire: A history to 1939*, Sutherland History Press, Janali.

McDonald, J 2008, *Dreamtime superhighway : an analysis of Sydney Basin rock art and prehistoric information exchange*, Terra Australis 27, ANU E Press, Australian National University, Canberra.

McDonald, J & Rich, E 1993, *Archaeological Investigations for Rouse Hill Infrastructure Project [Stage 1] Works along Caddies, Smalls and Second Ponds Creek, Rouse Hill and Parklea, NSW. Final Report on Test Excavation Program. Volumes I and II*, Report to the Rouse Hill Joint Venture.

Maritime Services Board 1959, *Sailing Directions: New South Wales Coast*, Sydney.

Maritime Services Board 1971, *Birth of a Port – Botany Bay Stage One*, Sydney.

Maritime Services Board 1983, *Sailing Directions: New South Wales Coast*, Tenth Edition, Sydney.

Martin, ARH 1994, 'Kurnell Fen: an eastern Australian coastal wetland, its Holocene vegetation, relevant to sea-level change and aboriginal land use', *Review of Palaeobotany and Palynology,* 80, pp 311-332.

Megaw JVS 1997, 'Aboriginal archaeology of the Sutherland Shire', *Sutherland Shire Studies,* 3, pp 9-12.

Muckelroy, K 1978, *Maritime Archaeology*, New Studies in Archaeology, Cambridge University Press, London.

Murray, R 2001, *Go Well: One Hundred Years of Shell in Australia*, Hargreen Publishing Company, Melbourne.

Nanson, GC, Young, RW & Stockton, E 1987, 'Chronology and Paleoenvironment of the Cranebrook Terrace [near Sydney] Containing Artefacts more than 40,000 Years Old', *Archaeology in Oceania,* 22(2), pp 72-78.

Navin Officer 2006, *Botany Bay 132kV Electricity Cable Project: Cultural Heritage Assessment*, Report to Molino Stewart Pty Ltd.

Navin Officer 2003, *Cultural Heritage Assessment of the Proposed Port Botany – an assessment of maritime and terrestrial archaeological potential*, Report to Sydney Ports Corporation.

Navin Officer 2007, *Subtransmission Substation Kurnell, NSW: Indigenous Cultural Heritage Assessment*, Report to Energy Australia.

NSW Heritage Office and Department of Urban Affairs & Planning 1996, *NSW Heritage Manual*, Sydney.

NSW Heritage Office1996, *Underwater Heritage: Principles and Guidelines*, Sydney.

NSW Heritage Office 2001, *Assessing Heritage Significance: a NSW Heritage Manual update*.

Nugent, M 2005, *A Contextual History of Botany Bay National Park (Kurnell Section*).

Office of Environment & Heritage (OEH) 2011, *Shell Middens*. http://www.environment.nsw.gov.au/nswcultureheritage/ShellMiddens.htm, accessed 7 February 2012.

Roy, PS & Crawford, EA 1981, 'Holocene geological evolution of the southern Botany Bay – Kurnell region, central New South Wales coast', *Records of the Geological Survey of NSW,* 20(2), pp 159-250.

Salt, DF 2000, *Kurnell: Birthplace of Modern Australia. A Pictorial History*, Clarion House, Como West.

Smith L, Rich E & Hesp P 1990, *Aboriginal Sites on Kurnell Peninsula: A Management Study,* Report to NPWS & Australian Heritage Commission.

Smith T, 1992, 'The barque Fame – Sydney Harbour reveals another causality', *Bulletin of the Australasian Institute for Maritime Archaeology*, 16(2), pp 1-8.

Stockton, E 1993, 'Archaeology of the Blue Mountains', in E Stockton (Ed), *Blue Mountains Dreaming: Aboriginal Heritage*, Three Sisters Productions, Springwood, pp 23-52.

Stockton, E & Holland, W 1974, 'Cultural sites and their environment in the Blue Mountains', *Archaeology and Physical Anthropology in Oceania*, 9(1), pp 36-65.

Sweetman, KW 1955, 'Botany Bay: The Growth of a Sea Port', *Port of Sydney Journal* 5(2).

URS 2003, *Port Botany Expansion Environmental Impact Statement – Volume 1*, Report to Sydney Ports Corporation.

URS 2012, *Environmental Assessment Scoping and Approvals Report Proposed Port and Berthing Project, Botany Bay*, Report to Caltex Australia Petroleum Pty Ltd.

Ward, AM, 1951, 'The Entrance Channels Port Jackson', *Port of Sydney Journal* 3(3-4) pp 82-85; 3(5), pp 114-118.

Wilkinson, R 2004, *Once Upon A Wildcat: Images from Australia's petroleum story*, Media Dynamics, Ascot.

Newspapers

Australian Town and Country Journal 21 July 1877, p 31, 'Wreck of the Cutter George in Botany Bay', http://nla.gov.au/nla.news-article70607541

The Advertiser 15 August 1930, p 23, 'Dredge Capsizes', http://nla.gov.au/nla.news-article30501702

Sydney Herald 21 March 1836, p 2 'Ship News', http://nla.gov.au/nla.news-article28654730

Sydney Morning Herald (SMH) 1 November 1870, p 3, 'The Navigation of Cook's River', http://nla.gov.au/nla.news-article28418469

SMH 1 February 1881, p 4, 'Exports', http://nla.gov.au/nla.news-article13478807

SMH 27 June 1907, p 7, 'The Late Storm. Shipwreck on the Coast. An Unknown Ketch Founders off Botany. Probably with all Hands. Fears for the Arab', http://nla.gov.au/nla.news-article14844792

SMH 15 August 1930, p 12, 'Dredge Sunk. Plant Valued at £4000', http://nla.gov.au/nla.news-article16665074

SMH 26 December 1934, p 9, 'Race for Beach after Boat Springs a Leak', http://nla.gov.au/nla.news-article17133564

SMH 19 March 1949, p 4, 'Dredge Ashore in Southerly', http://nla.gov.au/nla.news-article18107803

SMH 25 July 1951, p 3, 'Company's Move to Build Big Oil Refinery', http://nla.gov.au/nla.news-article18212568, accessed 3 September 2012.

SMH 31 August 1951, p 11, 'Refinery to be Larger', http://nla.gov.au/nla.news-article18213813, accessed 3 September 2012.

SMH 15 September 1951, p 11, 'Refinery Plan', http://nla.gov.au/nla.news-article18230755, accessed 3 September 2012.

SMH 28 March 1952, p 1, Refinery Plan Rejected', http://nla.gov.au/nla.news-article18251109, accessed 3 September 2012.

SMH 7 May 1952, p 3, 'Big Railway Projects', http://nla.gov.au/nla.news-article18263793

SMH 11 June 1952, p 3, 'Kurnell Site For Caltex Refinery', http://nla.gov.au/nla.news-article18268449, accessed 3 September 2012.

SMH 5 December 1953, p 14 'Advertising. Notice to Shipping. Sunken Shell-Grit Dredge, Botany Bay', http://nla.gov.au/nla.news-article18399735

SMH 17 February 1954, p 9, 'Small Dredge Sunk In Botany Bay', http://nla.gov.au/nla.news-article18410383

Registers of Shipping

British Register, Port of Sydney, 20/1849

British Register, Port of Sydney 37/1884

Websites

The Australian National Shipwrecks Database
http://www.environment.gov.au/heritage/shipwrecks/database.html

National Library of Australia, Trove: Pictures, photos, objects
http://trove.nla.gov.au/picture

National Library of Australia, Trove: Digitised newspapers
http://trove.nla.gov.au/newspaper

NSW Maritime Heritage Shipwreck Database
http://www.environment.nsw.gov.au/maritimeheritageapp/SearchAdvance.aspx

SEWPaC, Australian Heritage Database
http://www.environment.gov.au/cgi-bin/ahdb/search.pl

NSW State Heritage Inventory
http://www.environment.nsw.gov.au/heritageapp/heritagesearch.aspx

State Library of NSW, Manuscripts, oral history and pictures
http://acms.sl.nsw.gov.au/search/SimpleSearch.aspx

Sutherland Shire Library, Picture Sutherland Shire
http://www.photosau.com.au/sutherlandhist/scripts/home.asp

Sutherland Shire Maps
https://mapping.ssc.nsw.gov.au/Sutherland/

Appendix A

Aboriginal Sites Previously Recorded in the vicinity of the Study Area

Site ID	Site Name	Datum	Zone	Easting	Northing	Site Type
45-5-2587	Frenchmans Bay Foredune	AGD	56	336500	6238000	Midden
45-6-0292	Yarra Point;Botany Bay	AGD	56	336280	6238150	Midden
45-6-0556	La Perouse;BBNP Proposal	AGD	56	337300	6236800	Midden
45-6-0561	Congwong Beach	AGD	56	336900	6237400	Midden
45-6-0648	Site 1, La Perouse	AGD	56	336300	6237350	Rock Engraving
45-6-0649	Site 2, La Perouse	AGD	56	336572	6237358	Rock Engraving
45-6-0650	Site 3, La Perouse	AGD	56	336572	6237358	Rock Engraving
45-6-0651	Site 4, La Perouse	AGD	56	336572	6237358	Rock Engraving
45-6-0652	Site 5, La Perouse	AGD	56	336375	6237400	Rock Engraving
45-6-0653	Site 6, La Perouse	AGD	56	336400	6237600	Rock Engraving
45-6-0659	La Perouse	AGD	56	337011	6238281	Rock Engraving
45-6-0873	La Perouse Reserve	AGD	56	336702	6238068	Rock Engraving
45-6-0886	Bare Island;Yarra Bay;	AGD	56	336400	6238500	Shelter with Midden
45-6-1144	La Perouse;	AGD	56	336570	6237449	Midden
45-6-1145	La Perouse;	AGD	56	336800	6237400	Midden
45-6-1146	Congwong Cave, La Perouse	AGD	56	336846	6237363	Shelter with Art
45-6-1403	La Perouse,	AGD	56	336477	6237539	Rock Engraving
45-6-1762	Congwong Beach;	AGD	56	336900	6237400	Midden
45-6-2752	Restriction applied. Please contact ahims@environment.nsw.gov.au.	-	-	-	-	Restricted
45-6-2753	Restriction applied. Please contact ahims@environment.nsw.gov.au.	-	-	-	-	Restricted
52-3-0209	Cronulla Beach;Kurnell Peninsula;	AGD	56	332356	6232840	Midden
52-3-0210	Quibray Bay;Cronulla Beach;	AGD	56	332196	6233310	Midden
52-3-0211	Quibray Bay Cronulla Beach Quibray Complex	AGD	56	332336	6233460	Midden
52-3-0212	Kurnell Peninsula;Captain Cook Drive;	AGD	56	334196	6234560	Midden
52-3-0213	Boat Harbour;Cronulla Beach;	AGD	56	333929	6232185	Midden
52-3-0214	Kurnell Peninsula;	AGD	56	333996	6232910	Midden
52-3-0215	BH 1;Boat Harbour;Cronulla Beach;	AGD	56	333896	6231960	Midden
52-3-0216	Boat Harbour;BH 2;	AGD	56	334090	6231900	Midden
52-3-0217	Kurnell Peninsula;	AGD	56	334246	6233310	Midden
52-3-0218	Potter Point;Kurnell;	AGD	56	335132	6231845	Midden
52-3-0219	Captain Cook's Landing Place.	AGD	56	335496	6235960	Burial/s,Midden
52-3-0220	Restriction applied. Please contact ahims@environment.nsw.gov.au.	-	-	-	-	Restricted
52-3-0221	Captain Cook's Landing Place,	AGD	56	335646	6235660	Rock Engraving
52-3-0258	Abbot Site;Botany Bay;	AGD	56	333396	6233610	Midden
52-3-0370	Joseph Banks 1-	AGD	56	334496	6233410	Open Camp Site

Site ID	Site Name	Datum	Zone	Easting	Northing	Site Type
52-3-0371	Boat Harbour Reserve;	AGD	56	334500	6231900	Midden
52-3-0525	Tasman St-	AGD	56	333746	6234710	Burial/s,Midden
52-3-0687	TG1, Tabbigai Gap 1-	AGD	56	336136	6233270	Midden
52-3-0688	TG2, Tabbigai Gap 2-	AGD	56	336206	6233170	Open Camp Site
52-3-0689	CS1, Cape Solander 1-	AGD	56	336366	6234320	Open Camp Site
52-3-0690	Botany Cone Swamps 1; BCS1-	AGD	56	334356	6231910	Midden
52-3-0692	Botany Cone Swamps 3; BCS3-	AGD	56	334236	6232050	Open Camp Site
52-3-0694	Botany Cone Swamps 5;BCS5;	AGD	56	334220	6231900	Midden,Open Camp Site
52-3-0695	Botany Cone Swamps 6; BCS6-	AGD	56	334186	6231820	Open Camp Site
52-3-0698	Boat Harbour 3;BH3;	AGD	56	333950	6232150	Midden
52-3-0699	Boat Harbour 4;BH4;	AGD	56	334070	6232010	Midden
52-3-0700	Boat Harbour 5; BH5-	AGD	56	334036	6231910	Midden,Open Camp Site
52-3-0701	Besmaw 1; B1-	AGD	56	333846	6232660	Midden
52-3-0702	B2; Eastside	AGD	56	333626	6232310	Midden,Open Camp Site
52-3-0703	Boat Harbour; NT 1	AGD	56	334046	6232190	Open Camp Site
52-3-0706	Potter Point 1; PP1-	AGD	56	335276	6231930	Open Camp Site
52-3-0708	Potter Point 3; PP3-	AGD	56	335246	6232010	Open Camp Site
52-3-0709	Potter Point 4; PP4-	AGD	56	335236	6231960	Open Camp Site
52-3-0710	Joseph Banks Drive 1; JBD1-	AGD	56	334546	6232660	Open Camp Site
52-3-0722	Pimple Midden Relics;Kurnell Peninsula;	AGD	56	333870	6232620	Midden
52-3-0723	BH TRACK; Kurnell Peninsula-	AGD	56	333776	6232310	Midden
52-3-0724	BH W Kurnell Peninsula-	AGD	56	333546	6231960	Midden
52-3-0725	Big Middens;Kurnell Peninsula;	AGD	56	333730	6232250	Midden
52-3-0726	W2; Kurnell Peninsula-	AGD	56	332346	6232870	Midden
52-3-0727	W3; Kurnell Peninsula-	AGD	56	332376	6232880	Midden
52-3-0728	W4; Kurnell Peninsula-	AGD	56	332366	6232890	Midden
52-3-0729	W5; Kurnell Peninsula-	AGD	56	332366	6232970	Midden
52-3-0730	S1; Kurnell Peninsula-	AGD	56	332316	6232850	Open Camp Site
52-3-0731	S2; Kurnell Peninsula-	AGD	56	332396	6232870	Open Camp Site
52-3-0732	E1; Kurnell Peninsula-	AGD	56	333596	6232350	Midden
52-3-0733	E2; Kurnell Peninsula-	AGD	56	333556	6232340	Midden
52-3-0734	E3; Kurnell Peninsula-	AGD	56	333526	6232430	Midden
52-3-1110	McCue Midden-	AGD	56	332896	6233310	Midden,PAD
52-3-1220	Kurnell PAD	AGD	56	333950	6233920	PAD
52-3-1223	Kurnell Meeting Place Precinct	AGD	56	335900	6235900	PAD

Site ID	Site Name	Datum	Zone	Easting	Northing	Site Type
52-3-1232	Kurnell Lot 101 Captain Cook Drive#1	AGD	56	334260	6234096	Artefact Scatter
52-3-1271	Kurnell Lot 101 Captain Cook Drive #1	GDA	56	334260	6234096	Artefact Scatter
52-3-1366	Kurnell Potential Archaeological Deposit 1 (K PAD 1)	AGD	56	335100	6235525	PAD
52-3-1381	Cundlemongs grave	AGD	56	335596	6235910	Burial
52-3-1804	LR1	GDA	56	332299	6233363	Midden

Appendix B

Historic Heritage Inventories

National Heritage List

Kurnell Peninsula Headland

Sutherland Shire Heritage Study

Australian Oil Refinery

Crown Land, Boatshed

Silver Beach and roadway

Commonwealth of Australia Gazette

No. S 38, Monday, 28 February 2005

SPECIAL

Published by the Commonwealth of Australia

Environment Protection and Biodiversity Conservation Act 1999

DECISION ABOUT INCLUSION OF A PLACE IN THE NATIONAL HERITAGE LIST

I, Ian Gordon Campbell, Minister for the Environment and Heritage, having considered, in relation to Kurnell Peninsula (the place), included in the National Heritage List on 20 September 2004 under section 324F (Emergency Listing) of the *Environment Protection and Biodiversity Conservation Act 1999* (the Act)–

(a) the Australian Heritage Council's assessment whether the place meets any of the National Heritage criteria; and

(b) the comments given to the Council under section 324G of the Act;

alter the boundary, pursuant to subsection 324J(5) of the Act, of the listed place described in the National Heritage List to that described in the Schedule below, and remove from the List for the place the National Heritage value that caused it to meet criterion (e) as prescribed by the regulations for the purposes of section 324D of the Act.

The descriptions of the values under criteria (a), (b), (g) and (h) are varied, including: removal of the natural National Heritage values ascribed to the place under criterion (a); and removal of the historic National Heritage values ascribed to the place with respect to La Perouse under criterion (a).

The entry for this place in the National Heritage List is now as set out in the Schedule.

Dated this 24th day of February 2005

Ian Gordon Campbell
Minister for the Environment
and Heritage

Cat. No. S3805
ISSN 1032-2345

SCHEDULE

STATE
Local Government Area
Name:
Location
Values:

NEW SOUTH WALES

Sutherland Shire

Kurnell Peninsula Headland:

About 400ha, at Kurnell, comprising Botany Bay National Park, Lot 1 DP91704, the road reserve extending from Cape Baily Lighthouse in the east to the Park boundary in the west and the area between the seaward boundaries of the National Park and Lot 1 DP91704 and the Low Water Mark.

Criterion	**Values**
(a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history.	The Meeting Place Precinct, Kurnell Peninsula, was the site of first recorded contact between Indigenous people and Britain in eastern Australia, and symbolically represents the birthplace of a nation, and the dispossession of Indigenous people. This symbolism is reinforced by its proximity to Sydney, the site of the first British settlement, as well as its accessibility. The discovery of Botany Bay, including Kurnell Peninsula, in April 1770 by Lt. James Cook, Commander of the Endeavour, was a precursor to the colonization of Australia by Britain. The association of Cook's visit with the place is clear and well substantiated and has been celebrated since 1822. The Meeting Place Precinct, including Captain Cook's Landing Place, includes memorials and landscape plantings commemorating the events of 1770. Place names such as Inscription Point and Point Solander, the remnant watercourse, the memorials to explorers and Indigenous inhabitants, and Cook's maps of the Peninsula, in conjunction with Cooks Journal, and those of officers and scientists, clearly illustrate the events of 1770. Attributes specifically associated with its Indigenous values include the watering point and immediate surrounds, and the physical evidence of Aboriginal occupation in the area broadly encompassed by the watering place and the landing stage. Kurnell Peninsula, Botany Bay, was the first site on the east coast of the Australian continent explored by scientists from Britain, with many of the first type-specimens of flora and fauna collected near the landing site by both Banks and Solander. Of particular note in 1770 was the naming of the *Banksia* genus after Joseph Banks. Cook's naming of 'Botany Bay' in 1770 would result in its adoption as an emotive term

	for a destination, which came to be associated with convictism for much of the nineteenth century. Although Cooks' mapping of the east coast of Australia in 1770 did not appreciate the extent and importance of Port Jackson, nor the existence of Bass Strait, his running surveys were an outstanding achievement, which enabled the continental characteristics of Terra Australis, and its relationship to Papua New Guinea and New Zealand, to be defined fully for the first time. Cook's survey of Botany Bay in 1770, and clear description of the headlands at its entrance, provided information about a safe harbour with fresh water for British ships which followed. The headland area of Kurnell Peninsula, in its landmark role bounding the entrance to Botany Bay, is significant to the nation as the destination for the First Fleet under Captain Arthur Phillip in 1787. Although first settlement occurred at Sydney Cove in January 1788, Cook's first voyage, with his first landfall in Australia at Kurnell Peninsula, Botany Bay, informed the subsequent British declaration of terra nullius through his reports, and, as the destination of the First Fleet, began the process that would lead to British possession of the Australian continent by 1830.
(b) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.	Kurnell Peninsula was the first landfall made by Cook on continental Australia during his successful mapping of the eastern coastline, and is the point of first recorded contact between the British and Indigenous Australians in eastern Australia. The impact of the event and the events themselves are well described. The association of the events with the place is clear and well substantiated. The place possesses rare aspects of Australia's cultural heritage and is of outstanding heritage value to the nation. For Attributes refer to the first entry for Criterion (a).
(g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.	'Captain Cook's Landing Place' at Kurnell Peninsula is considered by many to be of outstanding heritage value to the nation for its association with the 'the birth of the nation'. The events hold a different meaning for Indigenous Australians, marking the commencement of colonization of Australia, and dispossession, underpinned by the doctrine of *terra nullius.* The story of Cook's first landing on the east coast of Australia is nationally important, and Captain Cook's Landing Place has become a symbolic place representing an important national story.

The story of Cook's voyage, including Cook's landing place at Kurnell and first contact between the British and Indigenous Australians on the eastern seaboard, has become an integral part of Australian folk-lore and our collective psyche. There are 'Captain Cook' stories in many parts of Aboriginal Australia, including remote areas such as Central Australia and the Victoria River Downs, Northern Territory. The events have been well documented by many authors, acknowledging the place's important association with Indigenous Australian's at a national level.

Captain Cook's Landing Place is within the Meeting Place Precinct and part of the reserve set aside in 1899. For Attributes refer to the first entry for Criterion (a).

(h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history

The Meeting Place Precinct, Kurnell Peninsula, is significant to the nation as the first landfall of Captain James Cook during his successful mapping of Australia's eastern coastline in 1770. This event has been celebrated by the placing of memorials since 1822 and through commemorations such as the bicentenary in 1970.

On this, Cook's first of three voyages in the Pacific, Joseph Banks was botanist, assisted by Daniel Solander and the artists Sydney Parkinson, Alexander Buchan and Herman Sporing. The artists were to produce botanical, zoological and ethnographic drawings. Banks and Solander collected 83 specimens, many of which are now the type specimens of species and genera, including Banksia. Both Banks and Solander as scientists on Cook's crew are remembered by local geographical place names; Cape Banks and Point Solander have defined the entrance to Botany Bay since 1770.

Attributes clearly associated with the landing are included within the Meeting Place Precinct. Although the location of botanical specimens collected by Banks and Solander was referred to generically as 'Botany Bay', the landing place, as the site of first exposure to the environment, was a key source of botanical specimens and species types. A number of species, including *Angophora costata* woodland on the adjacent headland areas and a native violet at the watering place, named after Banks, occur in close proximity to the landing site.

Present name
Australian Oil Refinery

Other name(s)

Location
PORT HACKING, 9129-4-N, 1:25,000, 334050-335800E, 623510-623350N

Locality
Sir Joseph Banks Drive,
Kurnell.

Present owner
Australian Oil Refinery Pty. Ltd.

Address
Sir Joseph Banks Drive
Kurnell

Category
Other work

Sub category
Oil refinery

Reference number
38

Date inspected
20/7/92

Survey by
Kirsty Altenburg

Property description

Site area

Existing zoning

Photograph Film / negative nos:L / 17

Caption Australian Oil Refinery, Kurnell, from South.

Reference number	38
Present name	Australian Oil Refinery
Date of construction	1953-1956
Architect	
Builder	
Materials exterior	
Materials interior	
Other physical details	Principal contractor E.B Badger and Sons Pty. Ltd., subsidiary of Stone and Webster Corporation of United States. Fletcher- Merritt-Raymond Construction Company of New Zealand constructed 1,200m. wharf. they also laid four 0.15mm (6 inch) submarine pipelines across Botany Bay to Banksmeadow. Chicago Bridge and Iron Company built the 54 tanks for crude oil and product storage. There are nine separate production areas:1. petrol storage areas. 2. Fuel oil and intermediate product tankage. 3. Distillate storage. 4. Process plant. 5. Power plant. 6. Storehouse yard. 7. Bass Strait complex. 8. Crude tankage. 9. Australian Lubricating Oil Refinery.
Site condition	Intact structure
Modifications	

Listings

SHIP themes	24. Industrialisation or deindustrialisation. 12. The growth and dominance of Sydney.
Local themes	Work.
Historical period	1951-1975 Post 1975
Other historical notes	See additional notes.
Information sources	Aird, The Water Supply, Sewerage and Drainage of Sydney 1788-1960, 193, 276 .

Historic	Representative State
Aesthetic	Representative State
Social	
Scientific	Representative State
Other	
Statement of Significance	Australian Oil Refinery is significant as being one of only two refineries in the Sydney area.
Recommendations	This site should be conserved. A conservation plan should be prepared prior to disturbance.

Reference number 38

Present name Australian Oil Refinery

Additional notes

Other physical details

Extra historical notes

Residents of Kurnell agitated for piped water supply, but cost had been too great. In 1953 AOR paid 56,901 pounds to Water Board for construction of 5.25 miles of water pipeline from Cronulla to Kurnell. Completed 29 Oct. 1954. Refinery capacity at completion of construction just over one million tons of crude oil per year on daily throughput of 22,000 barrels. Phase two of refinery expansion began in 1961. Refinery capacity increased to 90,000 barrels per day. Further expansion completed in 1973. At time of construction refinery was largest petroleum installation built in New South Wales, and largest industrial plant built at one time by private enterprise in the State.

SUTHERLAND FORESHORE HERITAGE STUDY

Address: Crown Land – Prince Charles Parade Kurnell 2231 DEMOLISHED			
Name: BOATSHED		Owner:	
Feature Type:	Structure Type: Boatshed / Site Feature Type: Wharf	Dating:	1926-1950
		Author:	P Davies
		Survey Date:	July 1997
		Style:	
		Title Ref:	
Indication of Significance:	Probable Significance	Theme:	8 Fishing
Material:	Timber / AC sheet	Listings:	
Condition:	Deteriorated	Inventory No:	
Integrity:	Disturbed or damaged	Zoning:	
Criteria:	Historic Local; Social Local; Aesthetic; Representativeness Local; Research; Rarity Local	Photograph Index:	02: 09-10
		Risk:	Development: ☐ Vandalism: ☐

Site Description + History:

A large timber boatshed located in the sand dunes with a timber deck on the water side and remnants of ramping. The building is of timber contruction with timber siding double hung windows, 6 pane to the top and two pane to the lower section. It has sliding timber doors to the water frontage. It has a gabled roof clad in A/C sheet and is of substantial size. It is no longer used and is in poor condition. A short timber wharf projects from the front, and is currently (late 1997) piled with misc. bits and pieces.

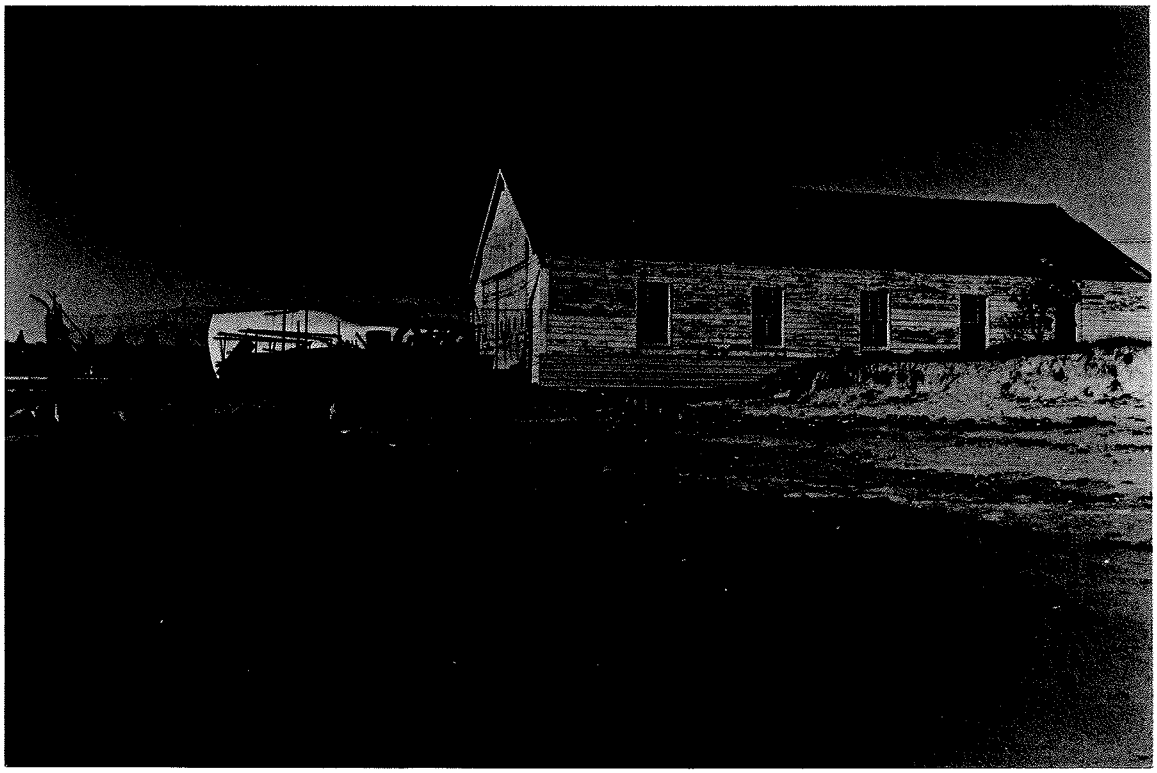
It appears to be the sole surviving structure on the waterfront and appears to be one of a number of strutures that once would have occupied the foreshore.

Comments:

A very rare surviving commercial boatshed on a waterfront that has been rebuilt substantially in an attempt to prevent erosion from changes in other parts of the waterway. It is representative of typical commercial boatsheds from the war period in their robust construction with some attention to detail. Although

Bibliography + Previous Studies:

Curby, P & Kass, T., 1993, *A Thematic History of Sutherland Shire - Final Report*, Sutherland: Sutherland Shire Council;
Curby, P., 1997, *Sutherland Shire Foreshore Study: History*, Rozelle: Paul Davies Pty Ltd
Perumal, Murphy, Wu Pty Ltd, 1993, *Sutherland Shire Heritage Study, Final Report*, Sutherland: Sutherland Shire Council;



BOATSHED	Photograph Index: 02: 09-10
Prince Charles Parade Kurnell 2231	

SUTHERLAND SHIRE HERITAGE STUDY

Prepared by Perumal Murphy Wu Pty Ltd for
Sutherland Shire Council and the NSW Department of Planning

Reference No: L12

Present Name: Silver Beach and roadway	Date Inspected: 30.9.92 Survey By: WA
Location: Prince Charles Parade Town/Suburb: KURNELL Postcode: 2231 Locality Real Description	Category Sub Category
Present Owner: Town/Suburb Postcode	Site Area Existing Zoning

Evaluation Criteria:

Historic	Rare ☐	Associative ☐	Representative ☐
Aesthetic	Rare ☐	Associative ☐	Representative ☑
Social	Rare ☐	Associative ☐	Representative ☐
Scientific	Rare ☐	Associative ☐	Representative ☑
Other	Rare ☑	Associative ☐	Representative ☐

Date

Architect/Designer

Builder

Significance: Beach with remnant native vegetation in important setting on Botany Bay, affording dramatic views over Botany Bay. Combined with a series of rare stone groynes, set along beach to protect sandy beach from storms. Local significance.

Location Plan

Physical Characteristics:

Description: Narrow series of curving white sandy beaches along south eastern edge of Botany Bay. Remnant native vegetation such as Wattles and Spinifex grass. Affording extensive views of Botany Bay, Kurnell peninsula and the city skyline. Stone groynes constructed in repetitive lines, jutting into bay to conserve sand on beach rarely found in Sydney area. Recent introduction of Norfolk Island pines not sympathetic with the indigenous vegetation of Boona Reserve, or the recommended regeneration of patches of remnant native vegetation from the bay.

Historical Period:

	Built	Used
Pre 1800	☐	☐
1800 - 1825	☐	☐
1826 - 1850	☐	☐
1851 - 1875	☐	☐
1876 - 1900	☐	☐
1901 - 1925	☐	☐
1926 - 1950	☐	☐
1951 - 1975	☐	☐
Post 1975	☐	☐

Historical Themes:

SHIP EA

Local

Heritage Listings:

- ☐ Register of the National Estate (AHC) - Registered
- ☐ Register of the National Estate of Aust (AHC) - Interim
- ☐ Register of the National Trust (NSW)
- ☐ Register of Significant Twentieth Cent. Architecture (RAIA)
- ☐ Department of Public Works Heritage and Cons. Register
- ☐ Heritage Council Register - Permanent Cons. Order
- ☐ Heritage Council Register - Interim Cons. Order
- ☐ Heritage Council Register - Section 130 Order
- ☐ Heritage Council Register - Nomination
- ☐ NSW Govt Dept Heritage Register (S.170 Heritage Act)
- ☐ NP&WS Historic Sites Register
- ☐ NP&WS Aboriginal Sites Register (Contact Sites)
- ☐ Institution of Engineers (NSW) Heritage Register
- ☐ Existing Heritage Study
- ☐ Regional Environmental Plan Heritage Schedule
- ☐ Local Environmental Plan Heritage Schedule
- ☐ Other

Sources

Appendix G

Noise and Vibration

Technical Appendix G

The Kurnell Port and Berthing Project

Noise and Vibration Assessment

JANUARY 2013

Prepared for

Caltex Australia Limited

Level 24
2 Market Street
Sydney, NSW 2000

43177815

URS

Project Manager:

.....
Chris Fay
Associate Environmental Consultant

URS Australia Pty Ltd

Level 4, 407 Pacific Highway
Artarmon NSW 2064
Australia
T: 61 2 8925 5500
F: 61 2 8925 5555

Principal-In-Charge:

.....
Michael Chilcott
Principal Consultant

Author:

.....
Miguel de la Mata
Acoustics Engineer

Reviewer:

.....
Ashley Bird
Principal Environmental Scientist

Date: **16 January 2013**
Reference: 43177815/REP/3
Status: Draft

Document delivery

URS Australia provides this document in either printed format, electronic format or both. URS considers the printed version to be binding. The electronic format is provided for the client's convenience and URS requests that the client ensures the integrity of this electronic information is maintained. Storage of this electronic information should at a minimum comply with the requirements of the Commonwealth Electronic Transactions Act (ETA) 2000.

Where an electronic only version is provided to the client, a signed hard copy of this document is held on file by URS and a copy will be provided if requested.

Table of Contents

Table of Contents

Tables

Table of Contents

Figures

Appendices

Abbreviations

Abbreviation	Description
dB	decibels
dB(A)	decibels, A–weighted
DECC	Department of Environment and Climate Change (Now DECCW)
DECCW	Department of Environment, Climate Change and Water
DP&I	Department of Planning and Infrastructure
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
DGRs	Director General's Environmental Assessment Requirements
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environmental Protection Licence
Hz	Hertz
ICNG	Interim Construction Noise Guidelines (NSW EPA 2009)
INP	NSW Industrial Noise Policy
$L_{A10,t}$	statistical noise level exceeded 10% of the time period t, representing the typical upper noise level
$L_{A90,t}$	statistical level exceeded 90% of the time period t, representing the background noise level
$L_{Aeq,t}$	time averaged A-weighted sound pressure level, over time period t
NSW	New South Wales
POEO	Protection of the Environment Operations Act
RBL	Rating Background Level
WHO	World Health Organization
BHD	Backhoe Dredger
GPS	Global Positioning System
QRH	Quick Release Hooks
SWL	Sound Power Level
SPL	Sound Pressure Level

1

Introduction

This assessment forms a technical appendix to the main environmental impact statement (EIS). It includes an assessment and supporting data in relation to the potential noise and vibration impacts resulting from the proposed upgrade to the Kurnell port and berthing facility.

The scope of this assessment has been informed through the Director General's Requirements (DGRs) for the proposed works, comments raised by statutory agencies and requirements included in noise and vibration assessment Guidance, Acts, Regulation and Statute.

The assessment of the potential noise and vibration impacts on surrounding noise sensitive receptor locations has been carried out in accordance with the relevant NSW Guidelines.

2

Scope of Assessment

2.1 Director General's Requirements

The DGRs requested that the EIS considers:

- noise and vibration from all activities and sources on and offsite, and impacts to adjoining sensitive receptors; and
- changes to operational impacts including noise.

Further comment with regard to the assessment of noise and vibration has been received from the NSW Environment Protection Authority (EPA), as the principal agency controlling and regulating noise. These are set out below.

Table 2-1 Scoping Comments

Issue	Addressed in
Noise and Vibration: The goal of the proposed works should be to minimise adverse impacts due to noise from the proposed works.	See Mitigation **Section 9**
The assessment must clearly outline the noise mitigation, monitoring and management measures the proponent intends to apply to the proposed works to minimise noise pollution. The assessment should include, but need not be limited to: identification and assessment of all potential noise sources associated with the development, the location of all sensitive receptors, proposed hours of operation and proposed noise mitigation measures.	See **Sections 3.3, 5.1, 7.2, 8** and **9** for proposed hours, sensitive receptors, identified noise sources, impact assessment and mitigation, respectively.
Depending on the timeframe for the proposed dredging works, the noise assessment may need to consider the cumulative impacts of the dredging activities as well as the Jet Fuel Pipeline activities being undertaken around the Kurnell area.	The proposed works would follow the Jet Fuel Pipeline proposed works therefore this aspect has been excluded from consideration in this assessment.
Construction noise and operational noise associated with the proposed works should be assessed in accordance with the attached guidelines (Interim Construction Noise Guideline).	See Criteria **Section 6.1 and Assessment Section 8.1**
The EIS should consider the potential for any cumulative impacts to occur as a result of the proposed dredging activities, Where necessary, the EIS should consider how operational activities of the proposed works could be coordinated with the proponents of other projects occurring in the vicinity to minimise impacts arising from the development including water quality, noise impacts, construction traffic, dust impacts, aquatic ecology and waste management.	See **Section 3.2.**

2.2 Methodology

This noise and vibration assessment has involved the following steps:

- identify the study area applicable to the assessment;
- review of the applicable criteria, legislation and general requirements;
- understand the existing acoustic environment of the study area;
- identify noise sensitive receptors;
- set project specific criteria;
- predict construction noise and comparison with the nominated noise criteria; and
- recommend necessary mitigation measures to achieve satisfactory criteria performance.

4 Scope of Assessment

A detailed assessment of groundborne vibration has not been performed due to the large separation distance between the potential vibration sources and nearest receptors. At 100 m, vibration from piling is predicted to be less than 0.14 mms^{-1}, which is considered to be 'just perceptible' by the British Standard (BS-5228-2)[1] commonly used in Australia to assess vibration in the absence of any local standard. The nearest residential receptors are approximately 700 m from any works-generated vibration sources; hence, any impacts relating to vibration would be considered negligible and have therefore not been considered further.

[1] British Standard (BS) 5228-2:(2009) *Codes of Practice for Noise and Vibration Controls on Construction and Open Sites*

3

Proposed Works Description

3.1 Location

The Kurnell port and berthing facility is located in Botany Bay, approximately 10 km south of Sydney's City Business District.

The main features in the surrounds of the project site are:

- the Port of Botany Bay, located approximately 2.5 km to the north, directly across the Botany Bay harbour, and its associated shipping channel to the east and north;
- Sydney (Kingsford Smith) Airport's 'north-south' and 'third' runways, approximately 3.5 km to the north-west across Botany Bay harbour, and the associated aircraft flight paths directly above Kurnell;
- the suburb of Kurnell and Silver Beach approximately 800 m to the south;
- the Kamay Botany Bay National Park, approximately 800 m to the east;
- Towra Point Aquatic and Nature Reserve, Bare Island, Cape Banks Aquatic Reserve, Dolls Point and Taren Point; and
- the Kurnell Refinery, south of Kurnell.

3.2 Works Overview

The assessment has taken into account the following noise generating activities.

- Dredging of the two fixed berths, sub berth, turning circle and approaches (the dredge footprint).
- Reusing a proportion of the dredged material to cover two exposed sections of the submarine fuel pipelines that are located west of the dredge footprint behind the sub berth, and a former anchor point at the approach to the sub berth.
- Disposing of the remaining dredged material offshore.
- Increasing the footprint of both fixed berths.
- Constructing a rock revetment along the southern boundary of the fixed berth #1.
- Upgrading the infrastructure associated with fixed berth #1 and sub berth.
- A range of ancillary improvements to the Wharf.

Figure 1-1 of the main EIS shows the location of the berths and the project site relative to Botany Bay. The dredge footprint is shown in **Figure 4-2** of the main EIS.

The anticipated construction program estimates that the duration of the works to be two years, with peak activity occurring during the 18 months between Q4 2013 and Q1 2014. The indicative construction program is presented in **Table 3-1**.

3 Proposed Works Description

Table 3-1 Anticipated Construction Program

Works	Duration of Works	Total Works Period	2013			2014				2015	
			Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Dredging											
Dredging Works (including 1 week's Mobilisation/ Demobilisation)	25 Weeks	6 Months									
Reuse Works	1 Week										
Fixed berth #1 Infrastructure											
Superstructure works (Loadings Arms, Manifold, Quick Release Hooks)											
Loading Arms Installation (and manifold installation)	12 weeks	24 Months (peak activity 18 months)									
Mechanical Loading Arm Removal and New Tie-Ins	12 weeks										
Quick Release Hooks	16 weeks										
Rock Revetment Works	6 Weeks										
Sheet Piling	8 weeks										
Fire System	8 weeks										
Installation of the Dolphins, Moorings and Piling	20 Weeks (approx.)										
Sub Berth											
Upgrade Works	20 Weeks (approx.)	4-6 Months									

It is clear from the above schedule that certain of the proposed works would coincide. These interactions have been considered in the noise assessment as the cumulative impacts of the proposed works.

3.3 Proposed Working Hours

It is proposed that:

- all works would be undertaken within the standard working hours specified by the *Interim Construction Noise Guideline (ICNG) 2009* (Monday to Friday: 0700-1800 and Saturday: 0800-1300), with the exception of;
  - — the upgrade to the sub berth, which would additionally take place on Saturday afternoon (1300-1800) and Sunday (0800-1800); and
  - — the dredging works, which would take place 24-hours a day for approximately 23 weeks with the exception of short periods that are required for maintenance etc. (as discussed below).

3.3.1 Dredging Works Schedule

It is anticipated that the dredging would take place continuously with the requirement for short breaks for refuelling, maintenance, servicing, taking on supplies and to accommodate the continued berthing at the facility as discussed below.

Whilst the objective of the approximate 23-week schedule would be to continually dredge, the works would need to remain flexible to allow continued operation of the port and berthing facility. This may result in short periods when the works would stop or the dredger shifts its operations to another unaffected part of the footprint. It would be unlikely that continuous dredging would be achieved across any specific area of the footprint prior to achieving the required depth and profile.

3.4 Dredging

The objective of the proposed dredging works would be to remove sediment accumulated over the past 40 years at specific locations within the dredge footprint. This would increase overall navigability, allowing the continued use of the berthing facility in to the future.

It is proposed that the dredging would be carried out using a single backhoe dredger (BHD), which will load the dredged materials onto split hopper barges working rotation. Following loading, the materials would be transported to an offshore disposal ground located in Commonwealth waters with the exception of approximately 6,000 m^3 of dredging materials that would be reused within Botany Bay.

3.5 Wharf Upgrades

In summary, the upgrade works of fixed berth #1 and the sub berth would include:

- installation of new loading arms;
- installation of new breasting dolphins;
- installation of new bow mooring dolphins;
- construction of a rock revetment and installation of a sheet piled wall;
- upgrade of the existing fire system;
- installation of quick release hooks;
- removal of the existing preventer lines at the sub berth; and
- replacement of various mooring chains at the sub berth.

The construction would involve piling the foundations for the new bowing dolphins and a new proposed platform. It would also require the installation of a sheet piled wall at the back of fixed berth #1 to prevent undermining of the Wharf piles located nearby, scour and erosion and turbidity. The sheet piled wall would be additionally reinforced with a rock revetment. In all instances the piling would take the form of vibratory piling to the point of refusal, after which percussive piling will be used to embed the pile into the clay.

Other typical construction activities would be undertaken during the upgrade works. Details of the proposed works are included in **EIS Chapter 4, Proposed Works Description.**

4

Legislation, Standards and Guidelines

The following policy and guideline are relevant to undertaking the noise and vibration assessment.

4.1 Industrial Noise Policy

The Industrial Noise Policy (INP) provides the framework for deriving noise limits for consents and licences. It enables the NSW EPA to regulate premises that are scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act). This policy seeks to promote environmental wellbeing through preventing and minimising noise.

The policy sets out noise criteria to assess the potential noise impacts resulting from industrial operational activity. It includes a criterion to control short-term intrusive noise and its impacts on residences and a criterion to maintain noise level amenity for particular land uses including residences.

The scope of the policy covers operational noise from industrial premises, extractive industries, commercial premises, maintenance, repair activities, and individual industrial sources such as air conditioning units or rotating machinery. The policy does not deal with new or upgraded transportation corridors, motor sport facilities, construction activities and neighbourhood or domestic noise.

The INP is relevant to the proposed works as it defines the concept of using the Rating Background Level (RBL) to assess the impact on the noise-sensitive receptors.

4.2 Interim Construction Noise Guideline

This was prepared to provide guidance on applying feasible and reasonable work practices to minimise noise impacts from construction activities. It is generally accepted that higher noise levels will be accepted by the community for shorter amounts of times, and that it is not always feasible to achieve the guidelines limits, particularly where activities must be performed at night for safety or operational reasons.

These guidelines advise ‘standard hours’ for construction works (excluding blasting) as follows:

- Monday to Friday 0700-1800;
- Saturday 0800-1300; and
- No work on Sundays or public holidays.

Section 2.3 of this guideline elaborates on the reasoning for construction work outside the recommended standard hours. It mentions the five categories of works that might be undertaken outside recommended standard hours, these being:

- delivery of oversized plant or structures;
- emergency work;
- maintenance and repair of public infrastructure where disruption to services during standard hours would not be acceptable;
- public infrastructure works that shorten the length of the proposed works and are supported by the affected community; and
- works where the proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Any noise assessment must therefore identify why construction outside the recommended standard hours would be necessary.

4 Legislation, Standards and Guidelines

As discussed in Section 3.3, dredging and the upgrade of the sub berth would occur outside of the recommended standard hours set by these guidelines. The criteria or 'management levels' provided by the guideline are discussed in **Section 6.1**.

5

Existing Environment

5.1 Noise Sensitive Receptors

Noise sensitive receptors have been identified by considering the location of the proposed works site relative to the surrounding environment, whilst considering the classification given by the ICNG.

The following groups of noise sensitive receptors and their approximate distances to the proposed works were identified:

- Silver Beach (600 m);
- Rangers House located towards the northern end of Kamay Botany Bay National Park (700 m);
- residential dwellings located along Prince Charles Parade (No. 2 – 174) (800 - 850 m);
- Kamay Botany Bay National Park recreational park (800 m); and
- Botany Bay Environmental Education Centre (900 m).

Figure 5-1 (overleaf) shows the locations of the noise sensitive receptors.

5.2 Existing Noise Environment

The noise environment of the Kurnell Peninsula and this part of Botany Bay is characterised by a number of industrial noise sources, particularly the ongoing operations at the existing Kurnell Refinery. Other industrial, commercial and marine activities across the Bay, along with the aircraft noise associated with Sydney (Kingsford Smith) Airport also form part of the existing noise environment. However comparatively, this area of the Bay is quieter than the western and northern shorelines. Other noise sources include local vehicle movements and natural sounds such as wave action and fauna. Various noise studies have been performed in the area in recent years. Backed by further monitoring at the Rangers House (see **Appendix D**), these data have been used to determine representative ambient and background noise levels. The following references have been reviewed.

- Botany Bay Cable Crossing (Wilkinson Murray (2006)).
- 2011 Community Noise Evaluation (HFP (2011)).
- Kurnell B-Line Jet Fuels Project (Construction and Vibration Noise Assessment) (Renzo Tonin (2011)).
- Kurnell B-Line Jet Fuels Project (Construction Management) (URS (2012)).
- Kurnell Port and Berthing Facility (Background Noise Monitoring) (URS (2012)).

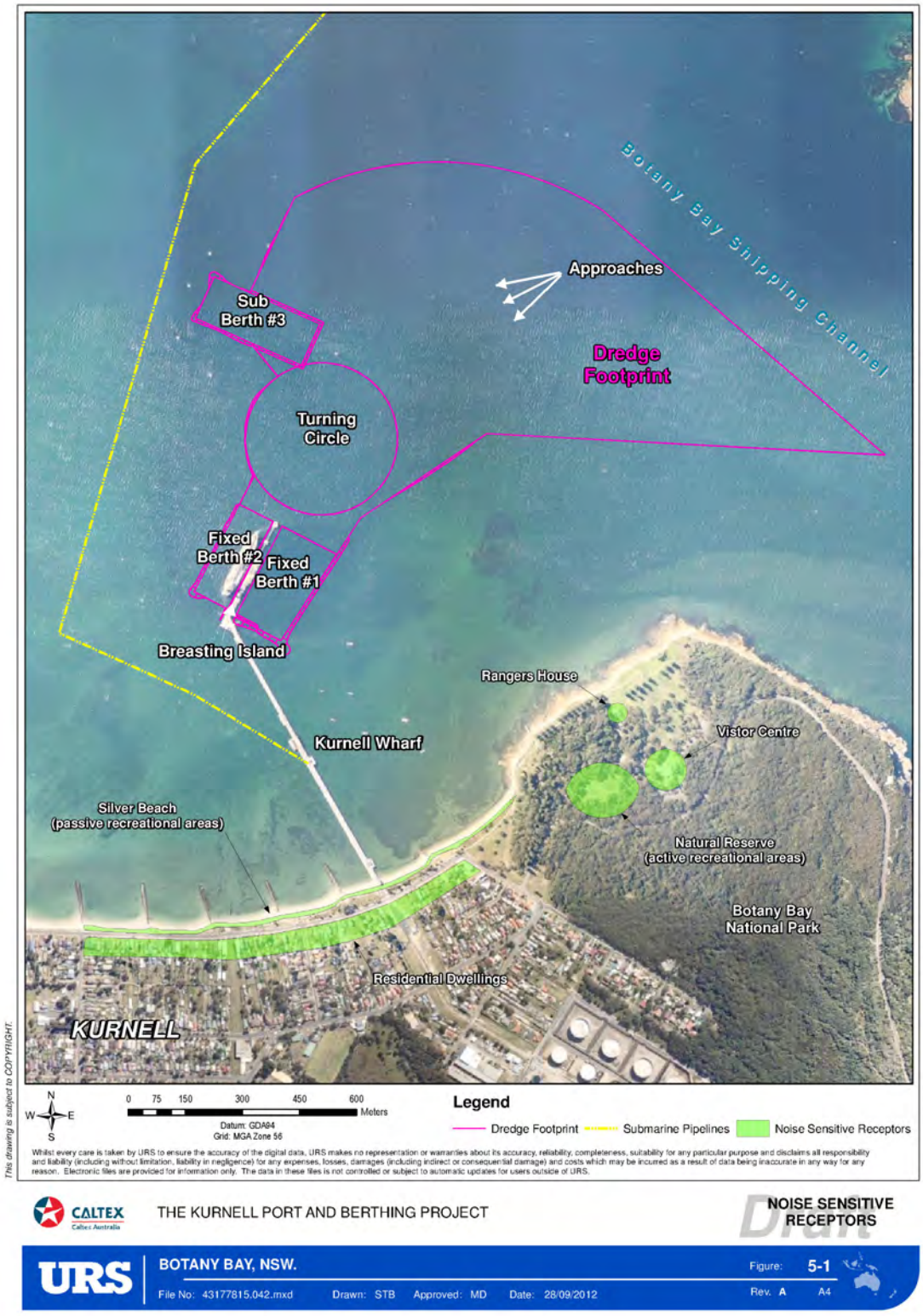
The relevant monitoring locations from the above reports are those in proximity to the residential dwellings on Prince Charles Parade, shown in **Figure 5-1**. Monitoring undertaken in different areas of Kurnell would not be relevant since the noise profile at these locations may be significantly different; in particular those closer to the Refinery, south of Prince Charles Parade.

For the Rangers House (sometimes referred to as Alpha Farm) located in Kamay Botany Bay National Park, there was a requirement to obtain 7-day continuous noise data to calculate a RBL. These data were collected between 18 and 27 December 2012. The monitoring method is described in **Appendix D**.

Due to the Refinery operations, Port Botany expansion and increasing road traffic noise, it is expected that background and ambient noise levels have marginally increased in comparison to 2006. This can be observed particularly during the evening and night-time periods. Overall, the data available confirm this expectation. **Table 5-1** summarises the relevant information extracted from the referenced reports. The baseline noise levels are presented in the form of a Rating Background Level (RBL), which is defined in the INP.

5 Existing Environment

Figure 5-1 Noise Sensitive Receptors



5 Existing Environment

Table 5-1 Rating Background Noise Levels at Kurnell, L_{A90}

Reference	Monitoring Type	Location	Day 0700-1800h	Evening 1800-2200h	Night 2200-0700h
Botany Bay Cable Project (Jul 2006)	Long-term noise logging	10 Prince Charles Parade	41 dB(A)	42 dB(A)	40 dB(A)
Jet Fuel Pipeline Assessment (Apr 2006)	Long-term noise logging	15 Cook Street *	41 dB(A)	43 dB(A)	39 dB(A)
Jet Fuel Pipeline Construction (Nov 2011 – May 2012)	Short-term daytime noise measurements	48 Prince Charles Parade	44-49 dB(A) **	-	-
Community Noise Assessment (Sep 2011)	Long-term noise logging	48 Prince Charles Parade	41dB(A)	46 dB(A)	41 dB(A)
Baseline Noise Monitoring (Dec 2012)	Long-term noise logging	Rangers House (Kamay Botany Bay National Park)	41 dB(A)	43 dB(A)	41 dB(A)

* This location was considered to be representative of other sensitive locations within Kurnell.
** The noise level range represents a collection of measurements over four different site visits.

The measurements from **Table 5-1** show that highest background noise levels occur during the evening; the reports state that this is principally due to fauna and aircraft traffic generated noise over industrial activities. Field notes from the short-term measurements undertaken during the Jet Fuel Pipeline construction indicate that daytime background noise levels near Prince Charles Parade were controlled by industrial noise from the Refinery, Botany Bay shipping activity and road noise.

The 2011 monitoring notes considerable noise from the overhead passage of aircraft as they take off or come in to land at the Airport. The 2012 measurements taken at the Rangers House indicate that background noise in this location is controlled by waves breaking on the shore.

The monitoring considered in this assessment includes measurements undertaken at various times throughout the year. There is no indication of any significant seasonal background noise variability.

The RBLs assumed at the noise sensitive receptors are set out in

Table 5-2 These are based principally on the long-term measurements undertaken in 2011 and 2012.

Table 5-2 Rating Background Noise Levels, L_{A90}

Sensitive Receptors	Day 0700-1800h	Evening 1800-2200h	Night 2200-0700h
Residential Dwellings at No. 2-174 Prince Charles Parade	41 dB(A)	46 dB(A)	41 dB(A)
Rangers House	41 dB(A)	43 dB(A)	41 dB(A)

5 Existing Environment

It can be observed that RBLs are consistent throughout the day and night-time at Prince Charles Parade and Rangers House. Evening RBLs tend to be somewhat higher, mainly due to fauna and an increasing number of aircraft flyovers, short-term high-noise events, occurring over the four hours of the evening.

6

Criteria

6.1 Interim Construction Noise Guideline

The ICNG provides criteria in the form of 'management levels' that relate to the potential community response to noise. They have been used in the quantitative assessment to define the need for mitigation, noting that the objectives of the ICNG are to 'mitigate as far as practicable'.

Table 6-1 defines the management levels, and includes the accompanying notes from the ICNG on how to apply these levels. Management levels include both absolute values, and values relative to the ambient environment (i.e. a 'background plus' limit). Management noise levels apply at the most affected property boundary, or the most affected location within 30 metres of a residence where the building is more than 30 metres from the property boundary.

Table 6-1 Construction Noise Criteria – Noise at Residences

Time of Day	Management Level $L_{Aeq, 15min}$	How to apply
Recommended standard hours: Monday to Friday: 7.00am to 6.00pm Saturday: 8.00am to 1.00pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise: • Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Additional criteria are provided for other sensitive land uses, as listed in **Table 6-2**.

Table 6-2 Construction Noise Criteria – Noise at Other Sensitive Land Uses

Land Use	Management Level, $L_{Aeq,15min}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level: 45 dB
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level: 65 dB
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level: 60 dB
Commercial premises (offices, retail outlets, etc.)	External noise level: 70 dB
Industrial premises	External noise level: 75 dB

Noise sources with audible characteristics such as tonality or impulsivity have 5 dB added to their predicted or measured noise level. This addition penalty is for noise with a character that has a perceived higher degree of annoyance to humans. Further detail is provided in section 4.5 of the ICNG.

6.2 Underwater Noise

Currently, there is no regulation or guideline available in NSW to set objective noise limits to protect underwater species. The NSW *National Parks and Wildlife Amendment (Marine Mammals) Regulation 2006* aims to protect certain marine mammals under the *National Parks and Wildlife Act 1974*. This regulation mentions in regards to noise that vessels in proximity to cetaceans must be operated *'at a constant slow speed and in a manner that consistently minimises noise'*.

The identified sensitive species are:

- Cetaceans:
  - Baleen Whales
  - Toothed Whales
- Fish.

A number of studies indicates that acute damage to fish caused by sound does not occur below 160 dB (re 1 µPa), nor is disturbance of cetaceans likely at levels below that.

Of the proposed works, dredging, pile driving and rock placement have the potential to impact on cetaceans and fish. Currently, it may only be possible to make generalisations about the vulnerability of species groups based on behavioural observations of responses to anthropogenic sounds, habits and what is known about a species' auditory sensitivity or vocal range.

When evaluating likely impacts, consideration should also be given to differences in local conditions that will affect sound propagation. Some anthropogenic noise sources generate significant amounts of energy at low frequencies, thereby leading to potential disturbance, physiological damage or disturbance to vulnerable fauna.

The impact assessment was based on audibility and reported disturbance noise levels of the species against typical noise from the proposed works.

Appendix C presents a detailed underwater noise assessment for the proposed works.

6.3 Project Specific Noise Limits

Noise limits for construction activities are usually more permissive than for operational activities on the basis that higher noise levels will generally be tolerated for shorter periods of time.

Management levels from the ICNG for the works are detailed in **Table 6-3.**

Table 6-3 Project Specific Noise Limits $L_{Aeq(15min)}$

Sensitive Receptors	Standard Hours (Mon-Fri: 0700-1800, Sat: 0800-1300)		Outside Standard Hours
	Noise Affected Management Level $L_{Aeq(15min)}$	Highly Noise Affected Level $L_{Aeq(15min)}$	Noise Affected Management Level $L_{Aeq(15min)}$
Residential Dwellings at No. 2-174 Prince Charles Parade	51 dB	75 dB	46 dB
Rangers House	51 dB	75 dB	46 dB
Silver Beach (Passive recreational area)	60 dB (when facilities are being used)		
Botany Bay Natural Reserve Oval (Active recreational area)	65 dB (when facilities are being used)		
Botany Bay Environmental Education Centre (Educational institutions)	55 dB* (when facilities are being used)		

* A 10 dB indoor/outdoor was assumed for typical building materials and windows open.

7

Acoustics Modelling

7.1 Introduction

Acoustics modelling software has been used to predict construction noise levels at sensitive receptors. The noise model was constructed to enable the prediction of noise levels from the various construction and dredging activities. This was achieved by combining the contribution from each noise source. The noise model takes into account:

- sound power levels of each source;
- receptor locations;
- meteorological effects and attenuation due to distance; and
- ground and atmospheric absorption.

Table 7-1 lists the key model parameters that have been chosen to provide a conservative representation of actual conditions.

Table 7-1 Model settings

Parameter	Setting / Source
Software	SoundPLAN V7.1
Algorithm	ISO 9613-2
Temperature / humidity	10 degrees C / 70% humidity
Order of reflections	0
Search radius	5 km
Parameter	$L_{Aeq(15\ min)}$
Ground absorption	Water - 0 (reflective) All other areas - 0.4 (40% soft ground)
Receiver height	1.5 m
Sound contour grid	1.5 m height, 2 m resolution

7.2 Equipment and Modelling Scenarios

Table 7-2 summarises the noise sources linked to the activities likely to represent the most conservative scenarios in terms of noise emissions from the proposed works.

Table 7-2 Construction Noise Sources

Source	Sound Power Levels dB(A)
Backhoe dredger (BHD) [1]	110
Mobile crane [1]	95
Tugboat [2]	100
Piling * [1]	117
Grinding and cutting * [1]	108
Rock transfer noise* [1]	111
Miscellaneous manual tools [3]	100
Diesel power generator [4]	102

* These activities entail a penalty of 5 dB applied to the predicted noise levels at the receptors
[1] Noise data source: BS 5228-1
[2] Noise data source: Port Botany Expansion EIS report (Wilkinson Murray, Jan 2009)
[3] Sound power levels assumed

7 Acoustics Modelling

[4] Noise data source: SoundPLAN 7.1 library

Table 7-3 presents the identified modelling scenarios based on the proposed works description and the engineering details as confirmed with Caltex in December 2012. The scenarios assume that all plant operates at the same time, at nominal loads and constantly for the 15-minute assessment period.

The modelling has focussed on representing the construction works, potential overlapping of activities and locations of those activities. It has aimed to test the sensitivity of the receptors to worst-case noise generating scenarios. As such, it assumes the operation of all the equipment that would be required for the activities forming the assessment scenario. For this reason the modelling is conservative in its output.

Based on the predicted noise level from each modelling scenario, reasonable and feasible mitigation and management measures have been defined in accordance with the ICNG. Operations that would additionally take place outside of the standard working hours are shown in grey. As noted above, the sub berth works would take place during the daytime at the weekend with the dredging taking place continuously over a 23-week period.

Table 7-3 Construction Noise Scenarios

No	Description	Activity	Noise Source	Qty
1	2013 Q3: Dredging works. All the potential critical locations within the dredging footprint have been considered. Reuse works (one week) would not have material influence in noise emissions. Installation of sheet piled wall within fixed berth #1.	Dredging (including loading)	BHD	1
			Tug Boat	2
		SP: Sheet Piling	Piling	1
			Rig Power Pack	1
			Water Jet Pump	2
2	2013 Q4: Dredging works coinciding with the installation of quick release hooks (QRH) loading arms and a new manifold and Rock Revetment.	Dredging (including loading)	BHD	1
			Tug Boat	2
		QRH: Preventer line replacement and QRH installation	Grinding and cutting	2
			Auxiliary Boats	3
		LAR: Installation of loading arms and manifold	Mobile crane	2
			Tug Boats	4
			Miscellaneous manual tools	1
		RR: Rock revetment construction	BHD	1
			Tug boat	2
			Impact rock transfer	1
3	2014 Q1: Dredging works coinciding with the loading arms and a new manifold installation, bollard replacement, sub berth upgrade works and rock revetment installation.	Dredging (including loading)	BHD	1
			Tug Boat	2
		Replacement of existing bollards	Grinding and cutting	2
			Power generator	2
		LAR: Installation of loading arms and manifold	Mobile crane	2
			Tug Boats	4
			Miscellaneous manual tools	1

7 Acoustics Modelling

No	Description	Activity	Noise Source	Qty
		RR: Rock revetment construction	BHD	1
			Tug boat	2
			Impact rock transfer	1
		Sub berth upgrade	Tug boat	1
			Barge Power Generators (Compressors/Generators)	2
			Miscellaneous manual tools	1
			Grinding and cutting	2
4	2014 Q2: Sub berth upgrade works.	Sub berth upgrade	Tug boat	1
			Barge Power Generators (Compressors/Generators)	2
			Miscellaneous manual tools	1
			Grinding and cutting	2
5	2014 Q3: Installation of new mooring dolphins/platform foundations, installation of a new fire system.	DOL: New platform foundation installation	Piling	1
			Mobile crane	1
			Grinding and cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to support jack up barge)	2
		FS: Fire system installation	Mobile crane	1
			Tug Boats	2
			Grinding and cutting	2
6	2014 Q4: Installation of new bowing dolphins, installation of a new fire system and decommissioning of hydraulic loading arms.	DOL: New platform foundation installation	Piling	1
			Mobile crane	1
			Grinding and cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to support jack up barge)	2
		FS: Fire system installation	Mobile crane	1
			Tug Boats	2
			Miscellaneous manual tools	1
		LAR: Decommissioning of the hydraulic loading arms	Mobile crane	1
			Tug Boats	2
7	2015 Q1: Installation of new bowing dolphins, and decommissioning of hydraulic loading arms.	DOL: New platform foundation installation	Piling	1
			Mobile crane	1
			Grinding and cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to support jack up barge)	2
		LAR: Decommissioning of the hydraulic loading arms	Mobile crane	1
			Tug Boats	2
8	2015 Q2: Installation of new	DOL: New platform	Piling	1

No	Description	Activity	Noise Source	Qty
	bowing dolphins.	foundation installation	Tug Boat	2
			Grinding and cutting	2
			Rig Power Pack	1
			Water Jet Pump	1
			Tug Boats (to support jack up barge)	2

Works occurring both within and outside of the standard working hours are shaded grey.

The location of noise sources in the acoustics model have been selected to represent the minimum separation distances from the project site to the noise sensitive receptors. Since there are a number of noise-sensitive receptors at multiple locations, and several noise sources, the modelling has included a series of variants to cover all situations; the results in some instances showing a range of construction noise levels.

7.3 Results

The predicted noise levels at the receptors are summarised in **Tables 7-4** and

Table 7-5**,** for the *Standard Working Hours* and *Outside Standard Working Hours*, respectively as defined by the ICNG. As activities include impact piling, rock impact and grinding or cutting, all scenarios in

Table 7-4 include a 5 dB penalty for special audible characteristics such as tonality or impulsiveness, in accordance with the ICNG.

Predictions in

Table 7-5 exclude any tonal or impulsive noise sources, and therefore do not include the 5 dB penalty. Noise from dredging activities is of a broadband nature and does not have special audible characteristics, and no penalty is required. It has been assumed that beeping or movement alarms of mobile plant or vehicles would not be used during these activities.

Noise contour plots for each modelling scenario showing the maximum predicted construction noise level are included in **Appendix B.**

Table 7-4 Predicted Construction Noise Levels $L_{Aeq(15min)}$ – Standard Working Hours

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Residential Dwellings at No. 2-174 Prince Charles Parade	51	53-55	51-54	50-54	37-38	52-53	50-52	50-52	50-52
Rangers House	51	47-49	46-47	46-48	34	48	48	48	47

7 Acoustics Modelling

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Silver Beach (Passive recreational area)	60	56-57	54-56	54-56	40	55	55	54	54
Botany Bay Natural Reserve Oval (Active recreational area)	65	52-53	50-52	50-52	37	52	51	51	51
Botany Bay Environmental Education Centre (Educational institutions)	55	45-47	44-46	44-46	32	46	46	46	45

The highest noise levels are predicted for construction activities that include piling (Scenarios 1, 5, 6, 7 and 8). Under these scenarios, noise management measures could focus on reducing piling noise as this activity dominates the overall levels.

Construction of the rock revetment in combination with dredging generates similar overall noise levels (Scenarios 2 and 3) to those during piling. However, a combination of several non-static noise sources distributed over a large area is more difficult to control.

Further analysis of noise mitigation and recommendations is presented in **Section 9**.

Table 7-5 Predicted Construction Noise Levels $L_{Aeq(15min)}$ - Outside of Standard Working Hours

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8*
Residential Dwellings at No. 2-174 Prince Charles Parade	46	34-44	34-44	36-44	32-33	N/A	N/A	N/A	N/A
Rangers House	46	35-38	35-38	36-39	29	N/A	N/A	N/A	N/A
Silver Beach (Passive recreational area)	60	42-46	42-46	43-47	35	N/A	N/A	N/A	N/A
Botany Bay Natural Reserve Oval (Active recreational area)	65	36-42	36-42	38-42	32	N/A	N/A	N/A	N/A

7 Acoustics Modelling

Receptor	Noise Criteria Management Levels (dB(A))	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Standard Hours	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8*
Botany Bay Environmental Education Centre (Educational institutions)	55	33-36	33-36	34-37	27	N/A	N/A	N/A	N/A

Predicted noise levels outside of standard working hours are considerably lower than those during standard hours. Other than under Scenario 4, the noise levels are attributed to dredging at various locations. Scenario 4 presents noise levels of the Sub berth upgrade works. These activities are considerably more distant to all the sensitive receptors and they may not be audible at receptor locations.

It is noted that dredging at various points across the dredging footprint would generate a range of noise levels at sensitive receptors. Dredging noise levels may range from 34 dB(A) to 44 dB(A) when considering the furthest and closest locations.

Section 8 presents a discussion of the predicted impacts at the noise sensitive receptors.

8

Impact Assessment

8.1 Construction Noise

8.1.1 Standard Hours

Table 8-1 identifies where predicted construction noise levels exceed the project criteria during standard hours.

Table 8-1 Predicted Exceedances during Standard Hours

Receptor	Exceedance Levels dB(A) $L_{Aeq(15min)}$							
	Scenario 1	Scenario 2*	Scenario 3*	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Residences on Prince Charles Parade	2-4	0-3	0-3	-	1-2	0-1	0-1	0-1
Rangers House	-	-	-	-	-	-	-	-
Silver Beach	-	-	-	-	-	-	-	-
Botany Bay Natural Reserve Oval	-	-	-	-	-	-	-	-
Environmental Education Centre	-	-	-	-	-	-	-	-

**Rock Revetment Works*

Piling noise triggers exceedances across all stages of the proposed works at residential receptors on Prince Charles Parade. The worst case 4 dB exceedance occurs during piling along the rock revetment alignment (Scenario 1) (i.e. the sheet piled wall works). Of all the considered construction activities, this has the shortest distance to the sensitive receptors.

Other piling occurring further north, during the proposed new mooring and bowing points installations (Scenarios 5-8), would generate up to a 2 dB exceedance at the most affected sensitive receptor.

However, it must be noted that piling does not generate exceedances at every receptor.

During the rock revetment construction (Scenarios 2 and 3), rock placement and overlapping dredging activity would generate up to a 3 dB exceedances at the most affected receptors. Other ancillary construction equipment contributes to the exceedances to a lesser extent.

8.1.2 Outside of Standard Hours

Table 8-2 identifies where predicted construction noise levels exceed the project criteria outside of standard hours.

Table 8-2 Predicted Exceedance Outside Of Standard Hours

Receptor	Construction Noise Levels dB(A) $L_{Aeq(15min)}$							
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5*	Scenario 6*	Scenario 7*	Scenario 8*
Residences on Prince Charles Parade	-	-	-	-	N/A	N/A	N/A	N/A
Rangers House	-	-	-	-	N/A	N/A	N/A	N/A
Silver Beach	-	-	-	-	N/A	N/A	N/A	N/A
Botany Bay Natural Reserve Oval	-	-	-	-	N/A	N/A	N/A	N/A
Environmental Education Centre	-	-	-	-	N/A	N/A	N/A	N/A

** No Outside of Standard Hours working associated with these scenarios*

No exceedances are predicted outside of standard hours for the proposed activities. It is anticipated that dredging activities may not be audible or just audible outside the boundary of all noise sensitive receptors. No impulsive or intermittent noise character would be engaged during this period that could risk a comfortable sleep amenity.

8.1.3 Summary

These following activities could result in an exceedance of the ICNG Noise Affected Management Level:

- up to 4 dB(A) at 2-174 Prince Charles Parade under Scenario 1 when sheet piling works were taking place, lasting approximately 3 weeks;
- up to 3 dB(A) at 2-174 Prince Charles Parade under Scenarios 2 & 3 when the rock revetment works were taking place, lasting approximately 4 weeks; and
- up to 1-2 dB(A) at 2-174 Prince Charles Parade under Scenarios 5-8 when the tubular piling works were taking place, lasting approximately 9 weeks.

8.1.3.1 Standard Working Hours

Construction activities during standard working hours are not considered to have a detrimental effect on the acoustic amenity of the noise sensitive receptors. The most sensitive receptors during this period of working are residential dwellings on Prince Charles Parade, in particular those located towards the east. The activities identified as the key noise sources are piling and the rock revetment works. Exceedances up to 4 dB were predicted due to piling during the construction of the sheet piled wall, and up to 3 dB due to rock placement noise during the rock revetment's erection.

Other piling events located further north during the installation of the proposed new platform and mooring/bowing foundations generate exceedances of less than 2 dB. The construction activities assessed reflect the worst-case scenarios where concurrent noise-generating activities coincide during a 15 minute period. Such scenarios are unlikely to regularly occur and when they do they will be of limited duration; therefore, noise levels in general would be below the predicted noise levels for the majority of the time.

8.1.3.2 Outside Standard Working Hours

Outside of standard working hours, dredging noise may on occasion be just audible, otherwise it will be barely audible-to-inaudible for the majority of the time (when measured outdoors along the boundary of the residential dwellings). Indoors, night-time sleeping would not be disturbed as dredging noise would not be audible and impulsive or intermittent activity would not take place during these hours.

The proposed dredging works are anticipated to run for approximately two-years therefore it is considered reasonable to propose activities that would not exceed a very stringent noise limit, such as the one used in this assessment, to take place outside standard working hours.

Dredging is a key activity within the proposed construction scheduling and it is considered that a 24-hour operation would minimise the duration of the construction works, whilst preserving the acoustic amenity of the sensitive receptors.

Caltex would limit piling, grinding and cutting activities to the Standard Hours of working set by the ICNG since the magnitude and character of noise from these activities (i.e. tonality and impulsiveness) has the potential to cause disturbance (as shown by the modelling results).

8.2 Impact on Marine Animals

8.2.1.1 Baleen Whales

It is likely that noise generated from these proposed works will be within the hearing ranges of baleen whales. However, as these whales have minimal presence in Botany Bay there is unlikely to be any significant risk.

8.2.1.2 Toothed Whales

Noise generated from these proposed works may be audible to toothed whales (including dolphins), although at frequencies below their optimal hearing ranges. While dolphins do occur in the project area, this is understood not to be considered as an area of critical or important habitat. Effects upon dolphins, if any, are likely to be behavioural and most likely confined to the period of pile driving and localised.

8.2.1.3 Fish

Fish present within the area will be able to detect the low frequency noises generated by the construction activities, particularly the pile driving. However, any acoustic-induced impact is likely to be short-term and non-persistent.

See **Appendix C** for more details of the underwater noise impact assessment.

9

Mitigation

9.1 Airborne Noise

The assessment confirms the potential for impacts associated with the proposed works that would lead to exceedances of the ICNG limits.

These exceedances occur due to piling/rock placement works (undertaken during standard working hours). The following mitigation would be provided for each activity.

9.1.1 Piling

There would be a responsibility on the works' contractor to validate the noise levels of its piling operations ahead of commencing the works in order that the following noise values are achieved.

- Calculated 15-minute sound power levels $L_{w,eq,15min} \leq 113$ dB(A).
- Measured 15-minute sound pressure levels $L_{p,eq,15min} \leq 85$ dB(A) measured at 10 m from the source in-situ or in a similar location where the works are to be carried out.

The above measurements would need to be carried out by a qualified acoustics consultant, member of the Australian Acoustical Society (AAS) or the Association of Australian Acoustical Consultants (AAAC), and they must be undertaken in accordance with relevant Australian Standards for acoustic measurement of equipment in the field.

The above ratings are set to validate the noise predictions and to readily achieve the ICNG noise criteria. A 4 dB(A) exceedance attributed to piling was predicted in the assessment, where a piling SWL of 117 dB(A) was used. A SWL of 113 dB(A) would reduce the noise levels to achieve the noise criteria.

It is considered unlikely that the target piling SWL of 113 dB(A) can be achieved without mitigation. Reasonable and feasible noise mitigation controls to achieve the noise criteria could include physical measures such as the use of dampening non-metallic dollies between the hammer and the driving helmet, or acoustic shielding of the piling equipment, or measures to reduce the overall noise level by introducing periodic breaks in the works.

- Piling for 12 minutes and stopping 3 minutes would give an overall reduction of 1 dB(A) when measured as $L_{Aeq,15min}$.
- Piling for 10 minutes and stopping for 5 minutes would reduce the noise levels by circa 2 dB(A).

A combination of these measures would ensure the works' contractor would reduce noise to a feasible and reasonable level in accordance with the ICNG.

It should be noted that *'the adoption of a quieter method might prolong the piling operation; the net result being that the overall disturbance to the community, not only caused by noise, will not necessarily be reduced'* [2].

9.1.2 Rock Placement

Upon initiation of these works, noise monitoring at representative locations of the receptors would be required to ensure that noise levels will be within the predictions. Near-field noise measurements may not be practical in this case since other equipment running simultaneously could prevent a correct field reading. The 3 dB(A) exceedance predicted by the modelling during rock placement is not entirely attributed to such activity, as other noise sources also contribute to the exceedance.

[2] British Standard (BS) 5228-1:2009 *Codes of Practice for Noise and Vibration Control on Construction and Open Sites*

Reductions in noise could be achieved by implementing similar respite periods as for the piling. However for such a short program (4 weeks) introducing breaks every few minutes would be impractical only serving to extend the duration of these works. Also the achieved reductions would not reliably meet the noise management levels with some level of exceedance remaining.

Therefore, a combination of dredging noise mitigation with the implementation of best work practices may be feasible and reasonable strategies to minimise noise during rock handling.

9.1.3 Dredging

As part of the terms of contract established with the works' contractor there would be a requirement to confirm the noise levels of the dredger and its consistency with the SWL used in the modelling undertaken to inform this EIS. The SWL could be confirmed with manufacturer's data or by means of field measurements during the initiation of the dredging works. A greater SWL would require additional modelling and consideration of the mitigation requirements set out below.

Dredging outside standard working hours could take place without need for mitigation.

9.1.4 General Noise Management

In addition to the above mitigation the following management controls would be implemented.

- For works taking place outside the standard working hours, monthly-attended noise monitoring would be undertaken to verify levels along Prince Charles Parade. Any persistent exceedances (although unlikely with the above mitigation included) would require Caltex to include additional noise management controls in line with the ICNG.
- The proposed works would be incorporated into Caltex's current procedures for handling and managing complaints. This would involve handling complaints through an advertised 24-hour hotline, keeping a complaints register, and making a response within 48-hours.
- Caltex is proposing to keep the local community regularly informed of the proposed works. This would include specific communications with regard to scheduling noise-generating activities. Specific consultation would take place ahead of the piling, dredging and rock placement works. It would also set out the proposals for daytime working at the weekend and the night-time dredging.
- Works' contractors would be bound to Caltex's internal management procedures requiring appropriate training and awareness of all staff on the appropriate use and maintenance of equipment, including the routine use of provided shielding/screening etc.

9.2 Underwater Noise

The following procedures would be put in place to manage underwater noise impacts. These would be controlled through the fauna management plan (see **EIS Chapter 11, Ecology**).

- During the proposed works, contact would be made with the whale migratory team within NSW OEH during June and October to confirm any reported whale sightings.
- During the proposed works observations would be made up to a distance of 420 m from the active working area (whilst dredging, piling or rock placement works were taking place). The observations would be made using the Whale and Dolphin Sighting Log[3] and be trained in the identification of sighting cetaceans, pinnipeds or dugongs. The checks would also include any noted instances of shoaling fish in this area.

[3] Fulton., F (2008)

- Slow start up measures would be used for all submarine noise generating activities to ensure any noise-sensitive marine fauna would move away from the source of the noise if required. Works would not commence if cetaceans, pinnipeds or dugongs were sighted within 150 m of the dredging, piling or rock placement works.
- If, during the dredging, piling or rock placement works, cetaceans, pinnipeds or dugongs were to come within 420 m, the works' contractor would be put on standby to stop any associated underwater noise-generating works from taking place.
- If, during the dredging, piling or rock placement works, cetaceans, pinniped or dugongs were to come within 150 m, the works' contractor would stop any associated underwater noise-generating works until the sensitive marine fauna were to move more than 150 m away. Activities would not recommence until 30 minutes following the mammal leaving this 'exclusion' zone.

9.3 Residual Impacts and Effects

An objective measure of residual impact would largely depend on the validation of the SWL used in the assessment. Assuming these SWLs are confirmed with the works' contractor then there would be a limited residual impact, restricted to:

- a short-term exceedance of up to 3 dB(A) against the noise management criteria set by ICNG when the rock revetment works would be taking place during the standard working hours, lasting for approximately 4 weeks.

10

Conclusions

URS was engaged by Caltex to undertake a noise and vibration impact assessment of the proposed dredging and wharf upgrade in Kurnell, New South Wales. The proposed activities were assessed in accordance with the Interim Construction Noise Guidelines and other relevant noise and vibration policies, as required by the Director General's Environmental Assessment Requirements. Construction noise levels were predicted using acoustics modelling software for eight different scenarios that cover all the proposed construction activities over the duration of the works. A further qualitative assessment was made of underwater noise.

Noise during the proposed construction activities are expected to be within acceptable levels. Temporal exceedances predicted for key noise sources such as piling, rock placement and dredging may be managed in line with mitigation measures recommended in **Section 9**, to provide a reduction of at least 1-3 dB(A). All feasible and reasonable measures have been considered to minimise any potential impact on noise sensitive receptors. The acoustic amenity of all the sensitive receptors would not be compromised by the proposed works.

No impact from road traffic noise is anticipated given the small volume of vehicles required by the proposed activities. No vibration impact is anticipated due to the large distances between the proposed works footprint and the sensitive receptors.

The proposed works are unlikely to trigger any long-term impact upon marine fauna in the area due to the expected low levels of underwater noise, the temporary nature of the acoustic disturbance, the absence of identified critical habitat in the project area for dugongs, turtles or cetaceans, and the availability for nearby alternative areas for refuge.

The residual noise impact of the proposed works is considered to be acceptable, particularly given the existing noise environment and industrial activities in the area. Notwithstanding this, active community consultation is proposed as a key management measure to ensure a diligent environmental protection of the acoustic amenity in accordance with the NSW EPA requirements.

11

References

- *Industrial Noise Policy*, NSW Environment Protection Authority, 1999
- *Interim Construction Noise Guideline*, NSW Department of Environment and Climate Change, 2009
- *Road Noise Policy*, NSW Department of Environment Climate Change and Water, 2011
- *Guidelines for Community Noise*, World Health Organisation (WHO), 1999
- AS 3671-1989: Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction
- Australian Standard 2004, *Electroacoustics – Sound level meters – Specifications*, AS IEC 61672.1:2004
- Australian Standard 1997, *Acoustics – Description and Measurement of Environmental Noise*, AS 1055:1997
- British Standard 5228: 2009, Codes of Practice for Noise and Vibration Control on Construction and Open Sites
- International Standard ISO 9613-2 First Edition 1996, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.
- *National Parks and Wildlife Amendment (Marine Mammals) Regulation 2006,* NSW Government, 2006.

12

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Caltex.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal contract.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between August 2010 and January 2013 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Except as required by law, no third party may use or rely on this Report unless otherwise agreed by URS in writing. Where such agreement is provided, URS will provide a letter of reliance to the agreed third party in the form required by URS.

To the extent permitted by law, URS expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. URS does not admit that any action, liability or claim may exist or be available to any third party.

It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

A

Appendix A Glossary of Acoustics Terminology

A wide range of acoustic parameters and technical terms are used in this report. To assist in understanding the technical contents, a brief description of the acoustic terms is provided in this section.

Typical Noise Levels: Compared to the static air pressure (10^5 Pa), the audible sound pressure variations are very small ranging from about 20 µPa ($20x10^{-6}$ Pa), which is called "threshold of hearing" to 100 Pa. A sound pressure of approximately 100 Pa is so loud that it causes pain and is therefore called "threshold of pain".

dB (Decibel): A unit of sound level measurement. The human ear responds to sound logarithmically rather than linearly, so it is convenient to deal in logarithmic units in expressing sound levels. To avoid a scale which is too compressed, a factor of 10 is introduced, giving rise to the decibel. It is equivalent to 10 times the logarithm (to base 10) of the square of the ratio of a given sound pressure to a reference pressure.

Perception of Sound: The number of sound pressure variations per second is called the frequency of sound, and is measured in Hertz (Hz). The normal hearing for a healthy young person ranges from approximately 20 Hz to 20 kHz. In terms of sound pressure levels, audible sound ranges from the threshold of hearing at 0 dB to the threshold of pain at 130 dB and over. A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to small but noticeable change in loudness. An increase of about 8 – 10 dB is required before the sound subjectively appears to be significantly louder.

Sound Pressure (SPL): Sound pressure is the measure of the level or loudness of sound. Like sound power level, it is measured in logarithmic units. The symbol used for sound pressure level is SPL, and it is generally specified in dB. 0 dB is taken as the threshold of human hearing.

Table Appendix A-1 Sound Pressure Levels of Some Common Sources

Sound Pressure Level (dB)	Sound Source	Typical Subjective Description
140	Propeller aircraft; artillery fire, gunner's position	Intolerable
120	Riveter; rock concert, close to speakers; ship's engine room	
110	Grinding; sawing	
100	Punch press and wood planers, at operator's position; pneumatic hammer or drilling (at 2 m)	Very noisy
80	Kerbside of busy highway; shouting; Loud radio or TV	Noisy
70	Kerbside of busy traffic	
60	Department store, restaurant, conversational speech	
50	General office	Moderate
40	Private office; Quiet residential area	Quiet
30	Unoccupied theatre; quiet bedroom at night	
20	Unoccupied recording studio; Leaves rustling	Very quiet
10	Hearing threshold, good ears at frequency of maximum sensitivity	
0	Hearing threshold, excellent ears at frequency maximum response	

Appendix A - Glossary of Acoustics Terminology

Sound Power Level (SWL): Sound power is the energy radiated from a sound source. This power is essentially independent of the surroundings, while the sound pressure depends on the surroundings (e.g. reflecting surfaces) and distance to the receptor. If the sound power is known, the sound pressure at a point can be calculated. Sound power is also measured in logarithmic units, 0 dB sound power level corresponding to 1 pW (10^{-12} W). The symbol used for sound power level is SWL or Lw, and it is specified in dB.

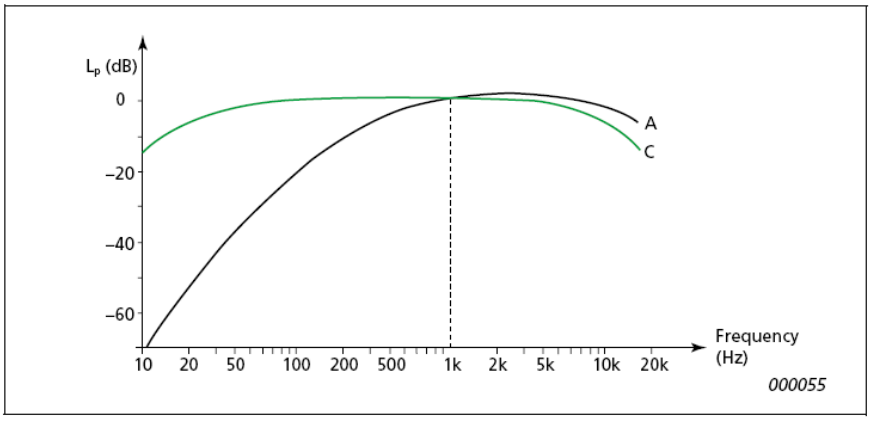
Frequency: Frequency is synonymous to pitch and is measured in units of Hz.

Frequency Spectrum: In environmental noise investigations, it is often found that the single-number indices, such as L_{Aeq}, do not fully represent the characteristics of the noise. If the source generates noise with distinct frequency components, then it is useful to measure the frequency content in octave or one-third octave frequency bands. For calculating noise levels, octave spectra are often used to account for the frequency characteristics of propagation.

"A" Frequency Weighting: The method of frequency weighting the electrical signal with a noise measuring instrument to simulate the way the human ear responds to a range of acoustic frequencies. It is based on the 40 phon equal loudness contour. The symbols for the noise parameters often include the letter "A" (e.g. L_{Aeq}) to indicate that frequency weighting has been included in the measurement. See the graph below.

"C" Frequency Weighting: The response of the human ear varies with the sound level. At higher levels, 100 dB and above, the ear's response is flatter, as shown in the C-Weighted Response below.

Although the A-Weighted response is used for most applications, C-Weighting is also available on many sound level meters. C-Weighting is usually used for Peak measurements and also in some industrial and entertainment noise measurement, where the transmission of low frequency noise can be a problem. C-weighted measurements are expressed as dBC or dB(C).



Adverse Weather: Weather effects (wind and temperature inversions) that enhance noise. The prescribed conditions are for wind occurring more than 30 % of the time in any assessment period in any season and/or for temperature inversions occurring more than 30 % of the nights in winter.

Assessment Period: The period in a day over which assessments are made: Standard construction hours (Monday to Friday from 7 am to 6 pm and Saturdays from 8 am to 1pm) and outside standard construction hours (any time outside the standard construction hours).

Ambient Noise: The all-encompassing sound at a site comprising all sources such as industry, traffic,

Appendix A - Glossary of Acoustics Terminology

domestic, and natural noises. This is represented as the L_{Aeq} noise level in environmental noise assessment. (See also L_{Aeq})

Background Noise: Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is measured statistically as the A-weighted noise level exceeded for ninety per cent of a sample period. This is represented as the L_{A90} noise level (See also L_{A90}).

Free Field: An environment in which a sound wave may propagate in all directions without obstructions or reflections. Free field noise measurements are carried out outdoors at least 3.5 m from any acoustic reflecting structures other than the ground.

Extraneous Noise: Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

Impulsive Noise: Noise having a high peak of short duration or a sequence of such peaks. Noise from impacts or explosions, e.g., from a pile driver, punch press or gunshot, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of the sound pressure level.

Intermittent Noise: Noise with a level that abruptly drops to the level of or below the background noise several times during the period of observation. The time during which the level remains at a constant value different from that of the ambient being of the order of 1 s or more.

Meteorological Conditions/Effects: Wind and temperature inversion conditions.

Noise Barrier: Solid walls or partitions, solid fences, earth mounds, earth berms, buildings. etc used to reduce noise without eliminating it.

Temperature Inversion: An atmospheric condition in which temperature increases with height above the ground.

Tonality: Noise containing a prominent frequency and characterised by a definite pitch.

L_{Aeq}: A-weighted equivalent continuous noise level. This parameter is widely used and is the constant level of noise that would have the same energy content as the varying noise signal being measured. The letter “A” denotes that the A-weighting has been included and “eq” indicates that an equivalent level has been calculated. This is referred to as the ambient noise level. (See Ambient Noise)

L_{A90}: The A-weighted sound pressure level which is exceeded for 90 % of the measurement period. It is determined by calculating the 90^{th} percentile (lowest 10 %) noise level of the period. This is referred to as the background noise level. (See Background Noise)

L_{A10}: The A-weighted sound pressure level which is exceeded for 10 % of the measurement period.

L_{A1}: The A-weighted sound pressure level which is exceeded for 1 % of the measurement period.

L_{Amax}: The A-weighted maximum Root Mean Square (RMS) sound pressure level measured during the sample period**.**

B

Appendix B Noise contour plots

C

Appendix C Underwater Noise Assessment

Appendix C - Underwater Noise Assessment

Introduction

This section considers potential effects upon cetaceans and fish of noise sources related to the proposed works, namely from dredging, piledriving and rock placement.

It is difficult to predict which species will be most vulnerable to man-made noise because of the wide range of individual and population sensitivities as well as differences in wariness or motivation. Currently, it may only be possible to make generalisations about the vulnerability of species groups based on behavioural observations of responses to anthropogenic sounds, habits and what is known about a species' auditory sensitivity or vocal range.

When evaluating likely impacts, consideration should also be given to differences in local conditions that will affect sound propagation, e.g. depth and bathymetric profile, bottom type, intensity, persistence and type of source. Some anthropogenic noise sources may generate significant amounts of energy at low frequencies, thereby leading to potential disturbance, physiological damage or disturbance to vulnerable fauna.

It is acknowledged that a range of significant and/or conservation dependent marine fauna are known to occur or potentially occur in the project area, as detailed in Section LLL. These fauna are potentially susceptible to various extents to project-related underwater noise. It is also justifiable to conclude that species-specific exposure evaluations yield the same general results, and on this basis, it is illustrative and valid to base risk assessments and associated management measures on appropriate indicator species. Noting their conservation significance and documented potential susceptibilities to underwater noise of anthropogenic origin, and acting as conservative surrogates for all marine fauna, suitable indicator taxa are considered to be cetaceans, and to a lesser extent fish. This approach is consistent with that approved for Sydney Ports Corporation for the nearby Port Botany expansion (Maunsell/AECOM 2006), where marine noise management efforts focused upon cetaceans.

Noise Sources

Dredging

Reported source levels for general marine dredging operations range from 160 to 180 dB (re 1 µPa @ 1 m) for 1/3 octave bands with peak intensity between 50 and 500 Hz (Greene and Moore 1995). One study of dredging in Cook Inlet, Alaska (Dickerson et. al. 2001) examined the underwater noise generated by a bucket (grab) dredging operation. Measurements showed that the bucket striking coarse gravels on the seabed generated the most noise with a recorded peak of 124 dB (re 1 µPa) at 150 m from the dredge site. The dredging operation was characterised by a grinding noise with a recorded peak of 113.2 dB (re 1 µPa) at 150 m from the dredging site. It is reasonable to expect that backhoe dredges should be expected to generate similar noise profiles to grab dredges.

Information from a number of studies indicates that acute damage to fish caused by sound does not occur below about 160 dB (re 1 µPa), nor is disturbance of cetaceans likely at levels below that (Southall et al. 2007). During grab dredging (or backhoe) activities, this noise level is unlikely to be generated, even when dredging through partially consolidated rock. Underwater noise transmission loss in the near field is typically of the spherical spreading type (Nedwell & Howell 2004). Therefore, for the source measurements for the grab dredge provided above, a noise level of 160 dB (re 1 µPa)

or greater would only occur within a few metres of the working site. It has also been calculated that the majority of fish species would not be able to detect the noise made by dredging activity at a distance greater than 1 km from the activity (Henderson 2003).

Dredging noise varies through time, periodically ceasing during non-work periods and whilst dredged material is taken away for disposal. This creates periods during which marine fauna would not be subject to noise-induced disturbance.

Pile Driving

Nedwell et. al. (2003) reports on monitoring measurements of the waterborne noise resulting from impact piling and vibropiling at Town Quay, Southampton, UK, during construction of a ferry terminal. Underwater noise levels were monitored during the vibropiling operation at a location 417 m from the actual site of piling. The recorded levels showed that there was no discernible increase in the background noise signal at this point during the vibropiling operation (with recorded background levels periodically reaching 150 dB (re 1 µPa), but typically in the region of 110-120 dB [re 1 µPa]). Caged brown trout (Salmo trutta) placed at 25 m from vibropiling locations reportedly showed no discernible behavioural reaction to the works (Nedwell et. al. 2003).

Nedwell and Edwards (2002) also report on underwater noise measurements obtained during vibropiling operations for a wharf extension at Littlehampton, UK. The recorded noise levels from a number of points showed a considerable degree of scatter indicating that the level of sound generated by the source varied. They attributed this variation to differing propagation conditions caused by variations in sediment density near the piles.

Higher noise levels are generated during piledriving operations using the impact piling technique. An assessment of the effect of impact pile driving noise on fish species predominant near Rødsand, Denmark has been made by Engell-Sørensen (2000). This work assessed the potential behavioural and physical effects of the noise levels of pile driving associated with construction of offshore wind turbines. Sound Exposure Levels for four measurement positions between 30 m to 720 m from the activity gave levels ranging from 166 dB to 188 dB (re 1 µPa), with a calculated Source Level of 210 dB (re 1 µPa @ 1 m). Engell-Sørensen (2000) concluded that: avoidance reactions would be likely to occur up to 30 m from the source, especially for species with swim bladders; the measured noise levels could harm the hearing ability of clupeids such as herring (Clupea harengus) and sprat (Sprattus sprattus), but this may regenerate over time; and, other than those already mentioned, the noise from pile driving is unlikely to cause any other physical effect.

The data from this and other studies demonstrate that the noise generated by impact piling works in the marine environment has the potential to cause acute damage and even mortality to fish in very close proximity to the pile. For pelagic fish and cetaceans, physiological damage is less likely, with the most likely behavioural response during piling would be avoidance of the area in which the noise signals reach a threshold at which discomfort or annoyance is reached.

Pile driving is likely to be undertaken over a period of a few weeks with noise generated to be periodically persistent, with pauses such as while pile sections are being added and the work shifted to new piles. It is also anticipated that pile driving will only be conducted during normal working hours. Noise levels will also vary depending on the substrate and the pile driving method used. Pile driving is arguably the most noise intensive activity in the proposed package of works, with its inherent repetitive, impulsive nature possibly accentuating its ability to startle or lead to avoidance behaviour by

marine fauna. Any startle effects arising from pile driving would most likely be more acute during the initial start-up phase. Any potential for cumulative, long-term effects would be minimised by the lack of persistence of the activity, providing periods of respite for any vulnerable fauna

Rock Placement

Minimal information is available regarding noise generated from rock placement activities; however, it is reasonable to expect that any noise will be dominated by the turbulence of the rock fall and grinding of rocks, possibly associated with mechanical transients generated by the operating gear and fallpipes. Given the normal pattern of rock placement activities, it may be anticipated that any noise will be intermittent and of relatively short duration.

It is reasonable to assume that noises associated with the placement, movement and settling of the rocks themselves would be low frequency broadband. Intensity and period of the noise event would be influenced by factors such as the amount, size and mass of rocks placed, the depth of water in which they were placed and the type of surface upon which they landed and settled. In any event, it is unlikely that the noise levels attained would be of any great significance.

Depending upon the method of rock placement employed, the operation would also be the source of mechanical transients. These would be due to the operation of bottom hopper doors, for example. Although no data are available, it is illustrative to consider the noise associated with the operation of a clamshell dredge as a useful surrogate. Richardson et al. (1995) described noise from a clamshell dredge as variable depending on the operating status. Richardson et al. (1995) also noted that noise from the tug and barge used to transfer dredged material was greater than that produced by the dredge itself. On this basis, no tangible adverse noise-induced effects should be expected from the planned rock placement activities.

Assessment of Risk to Marine Fauna

Cetaceans

Baleen Whales

It is likely that noise generated from this proposed works will be within the hearing ranges of baleen whales. However, as these whales have minimal presence in Botany Bay, generally limited to periodic incursions in the bay, there is unlikely to be any significant risk.

Toothed Whales

Noise generated from this proposed works may be audible to toothed whales (including dolphins), although at frequencies below their optimal hearing ranges. While dolphins do occur in the project area, this is understood not to be considered as an area of critical or important habitat. Effects upon dolphins, if any, are likely to be behavioural and most likely confined to the period of pile driving and localised.

Dugongs

Although their presence is unlikely, project-generated underwater noise would most likely be audible

to any dugongs present within the project area. Any acoustic-induced effects upon dugongs would be expected to be similar to that anticipated for dolphins, and also limited in both temporal and scale scales.

Fish

Fish present within the area will be able to detect the low frequency noises generated by the construction activities, particularly the pile driving. However, any acoustic-induced impact is likely to be short-term and non-persistent.

Conclusions

Some noise, generally low frequency broadband, will be generated from the proposed activity, particularly during the construction phase. It may be concluded that this should be considered as unlikely to trigger any long-term, persistent, deleterious impact upon marine fauna in the area. This conclusion is founded upon several key points, namely:

- the relatively low levels of noise expected to be generated;
- the temporary nature and periodicity of the predicted acoustic disturbance; and
- the absence of any identified critical or important habitat in the project area for dugongs, turtles or cetaceans, and the availability of nearby alternative areas for temporary refuge.

It is quite likely that the proposed activities, particularly the pile driving, will elicit some short-term behavioural changes. These are likely to be confined to startle responses, possible changes to feeding patterns and temporary avoidance of the project area. None of these are considered likely to result in long-term harm to either individuals or populations of any of the marine fauna considered. These potential impacts can be managed by the adoption of procedures similar to those employed for the recent expansion of Port Botany, as detailed in Maunsell/AECOM (2006).

References

Anderson, PK, & Barclay, RMR 1995, Acoustic signals of solitary dugongs: physical characteristics and behavioural correlates. Journal of Mammalogy 76: 1226-1237.

Dickerson, C., Reine, K. J., & Clarke, D. G. 2001, Characterisation of underwater sounds produced by bucket dredging operations. DOER Technical Notes Collection (ERDC TN-DOER-E14), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Engell-Sørensen, K. et al. 2000, Evaluation of the Effect of Noise from Offshore Pile-Driving on Marine Fish, Bio/consult as, Johs. Ewaldsvej 42-44, DK-8230. Åbyhøj, Tech Rep. 1980-1-03-1- rev. 2. to: SEAS, Slagterivej 25, DK-4690, Haslev.

Greene, CRJ & Moore SE 1995, Man-made Noise. Pp 101-158 in Marine Mammals and Noise. W. J. Richardson, C. R. J. Greene, C. I. Malme and D. H. Thomson (ed.), Academic Press, San Diego.

Henderson P (2003), Review of marine dredging effects on fish. In: Harbour Empowerment Order (HEO) for London Gateway. Environmental Impact Assessment. Faber Maunsell et. al., for P&O Developments Ltd.

Appendix C - Underwater Noise Assessment

Maunsell/AECOM (2006). Port Botany Expansion: Marine Mammal Management Plan. SPC 2006/03, prepared for Sydney Ports Corporation.

Nedwell J & Edwards B 2002, Measurements of underwater noise in the Arun River during piling at County Wharf, Littlehampton, UK. Subacoustech Ltd, Tech. Report 513 R 0108.

Nedwell, J et al. 2003, Measurements of underwater noise during piling at the Red Funnel Terminal, Southampton, and observations of its effect on caged fish. Subacoustech Ltd., Tech. Rep. 558 R0207.

Nedwell JR, Howell D 2004, 'A review of offshore windfarm related underwater noise sources'. Subacoustech Report Reference: 544R0308, November 2004.

Richardson WJ, Greene CR, Malme CI & Thomson DH 1995, Marine Mammals and Noise. Academic Press, San Diego.

Southall, BL, Bowles, AE, Ellison, WT, Finneran, JJ, Gentry, RL, Greene Jr, CR, Kastak, D, Ketten, DR, Miller, JH, Nachtingall, PE, Richardson, WJ, Thomas, JA & Tyack, PL 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 33 (4): 411 509.

D

Appendix D Unattended Noise Monitoring - Rangers House

WILKINSON MURRAY

4 January 2013

WM Project Number: 12362
Our Ref: URS_040112RH_Ltr_12362

Chris Fay
URS Australia Pty Ltd
Level 4, 407 Pacific Hwy
ARTARMON NSW 2064

Dear Chris

Re: Background Noise Monitoring Results

Introduction

URS Australia Pty Ltd (URS) prepared an assessment of potential noise and vibration impacts resulting from the proposed upgrade to the port and berthing facilities that form part of the Caltex Kurnell refinery. This assessment did not specifically measure background noise levels at the Ranger's House, located within the Botany Bay National Park.

WM has been commissioned by URS on behalf of Caltex, to undertake background noise monitoring at this location to confirm the appropriate background noise levels.

This letter report provides a summary of the noise monitoring procedures and results.

Noise Measurements & Analysis

A background noise survey was conducted by Wilkinson Murray Tuesday, 18 December to Thursday, 27 December 2012. The survey was carried out approximately 20m west of the Ranger's House as shown in Figure 1.

The noise monitoring equipment used for these measurements consisted of a NGARA environmental noise logger set to A-weighted and fast response. The NGARA noise monitoring system continuously records noise levels (CSV files) and audio recordings (WAV files) for the duration of the logging period. The audio recordings allow further aural review and spectral analysis if required. The equipment calibration was checked before and after the survey and no significant drift was noted.

Figure 1 – Monitoring Location

To describe background noise levels, the measure currently recommended by the *NSW Industrial Noise Policy* (INP) (Environment Protection Agency [EPA], 2000) is the Rating Background Level (RBL). This is based on the L_{A90} as defined in the INP. An RBL was established for each of the three assessment periods, namely the day, evening and night-time periods.

Meteorological data for the relevant periods were obtained from the nearest weather station at Kurnell (wind) and Sydney Airport (precipitation). Periods in which it was likely to be raining, or when wind speeds exceeded 5 metres per second (m/s) at microphone height, were excluded from analysis, in accordance with the INP.

Attended measurements were attempted in order to supplement the logger measurements on the day the logger was installed and when it was collected. On both occasions, weather conditions were not appropriate for monitoring due to excessive winds and therefore attended measurements were not possible.

Summary of Monitoring Results

The logger measurement results are summarised in Table 1. It is believed RBLs are dominated by ocean noise nearby.

Logger measurements are shown in graphical form in Appendix B. The graphs also include L_{A1}, L_{A10}, L_{Amin}, L_{Amax} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Appendix A for definitions).

Table 1 Summary of Logger Survey Results

Dwelling Name	Monitoring period	Measured Background Noise Levels (dBA)		
		Day	Evening	Night
Ranger's House	18 Dec – 27 Dec 2012	41	43	41

Notes:
Day: the period from 7.00 am to 6.00 pm.
Evening: the period from 6.00 pm to 10.00 pm.
Night: the remaining periods.

I trust this information is sufficient. Please contact us if you have any further queries.

Yours faithfully
WILKINSON MURRAY

Roman Haverkamp
Senior Engineer

APPENDIX A

GLOSSARY OF TERMS & DEFINITIONS

GLOSSARY OF TERMS & DEFINITIONS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

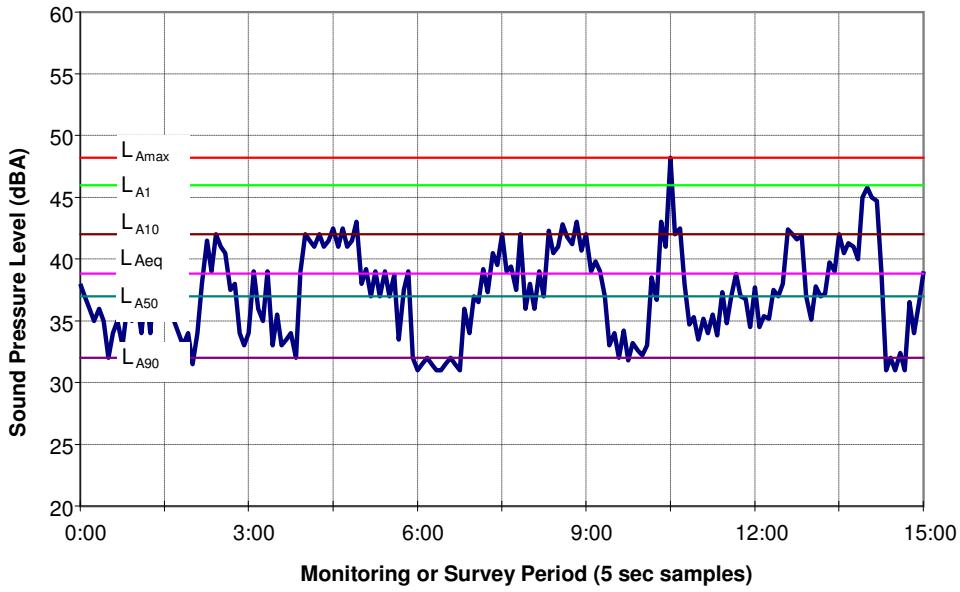
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

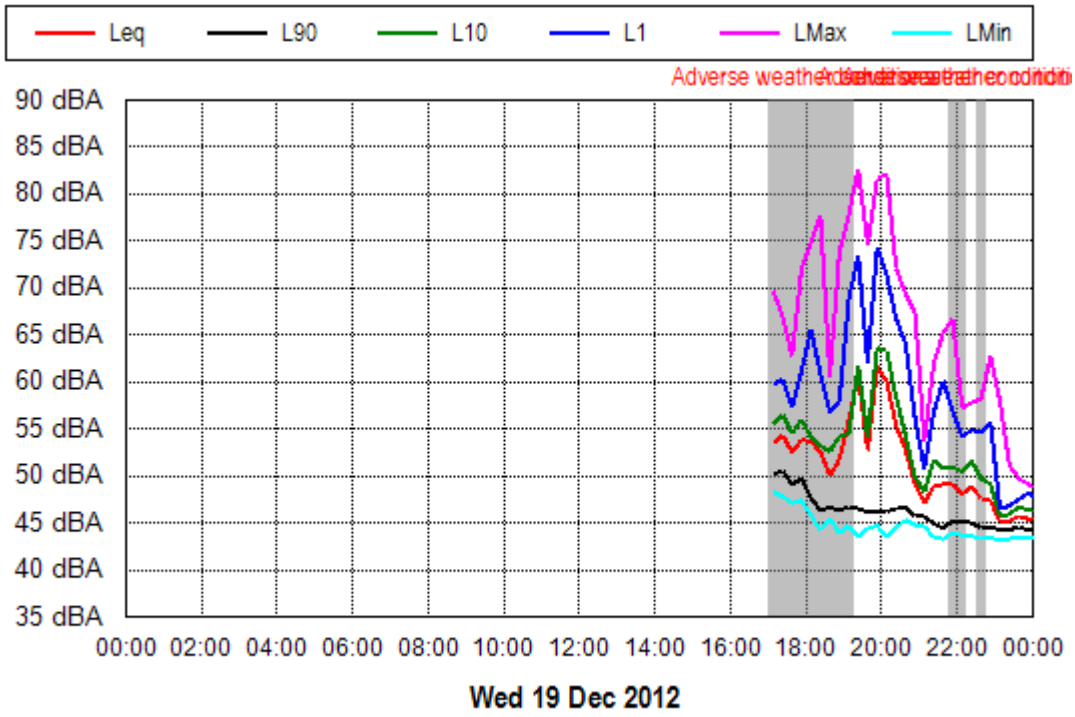
Typical Graph of Sound Pressure Level vs Time

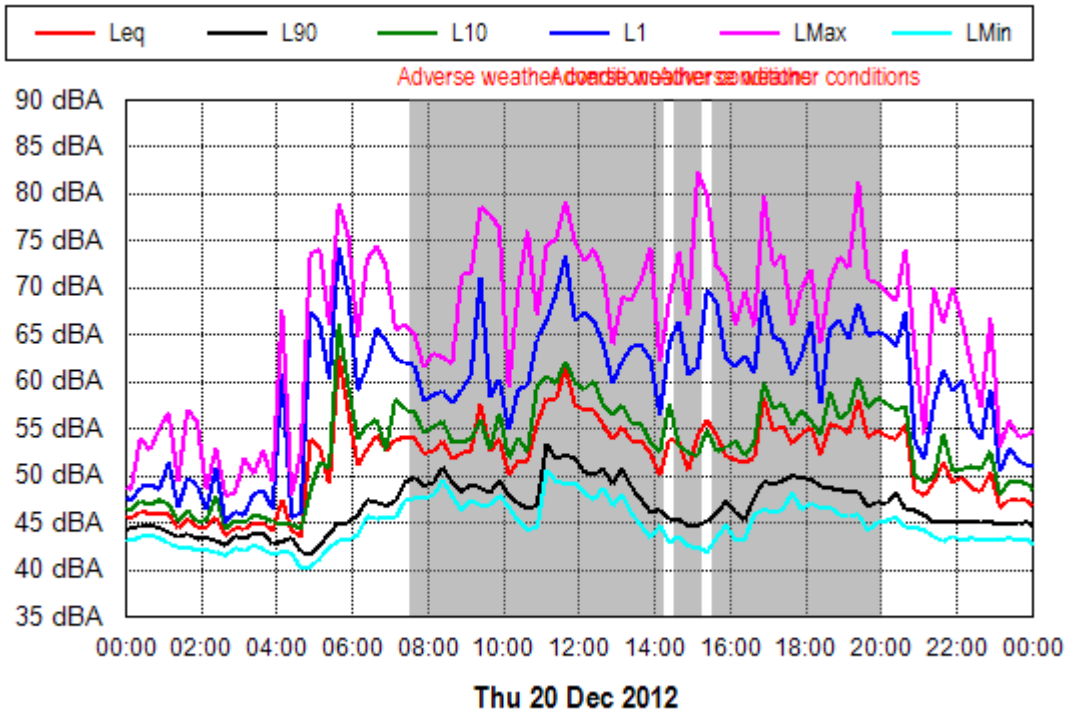


APPENDIX B

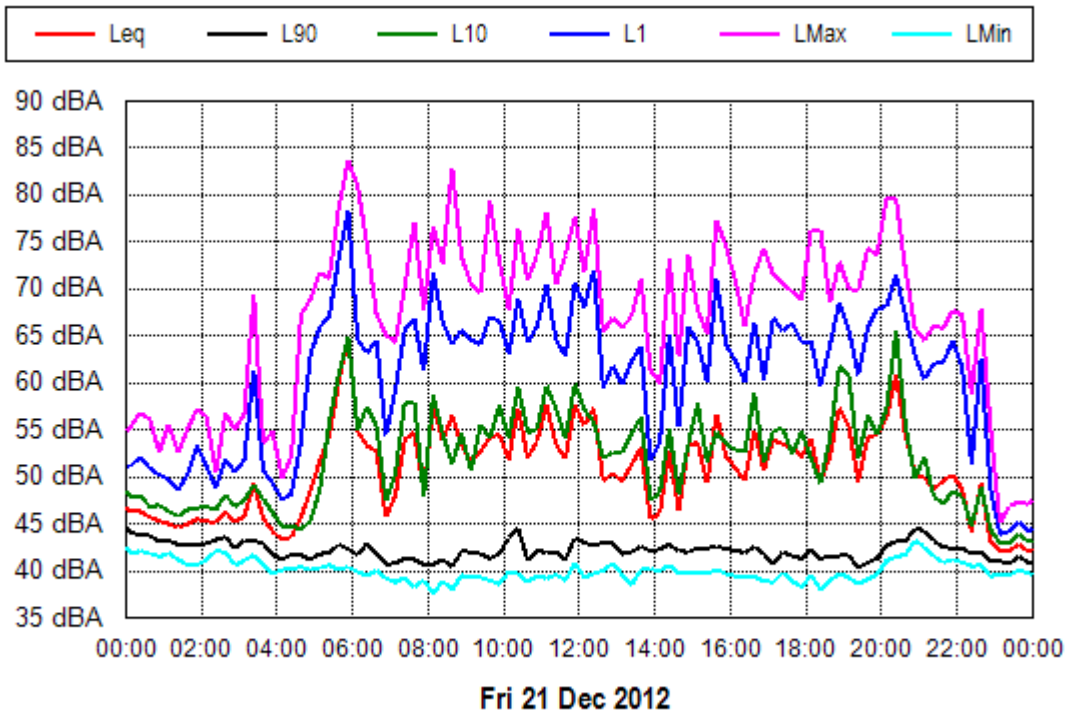
UNATTENDED NOISE MONITORING RESULTS

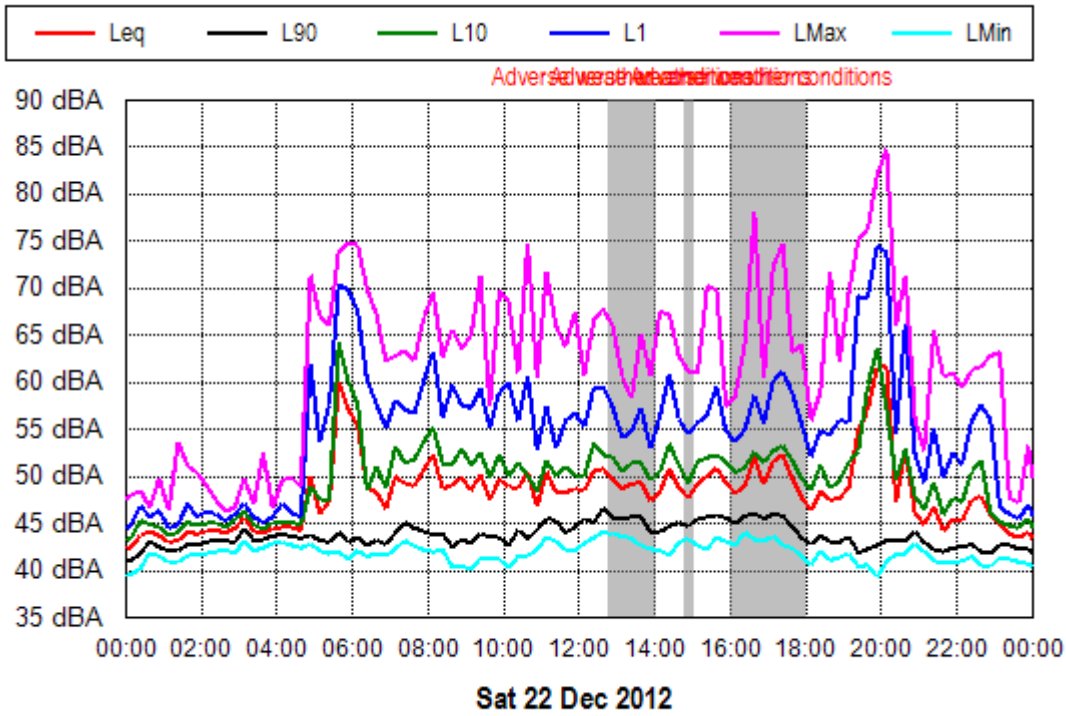
Project: Caltex Kurnell Refinery - Background Noise Monitoring
Location: Ranger's House
Filter: A



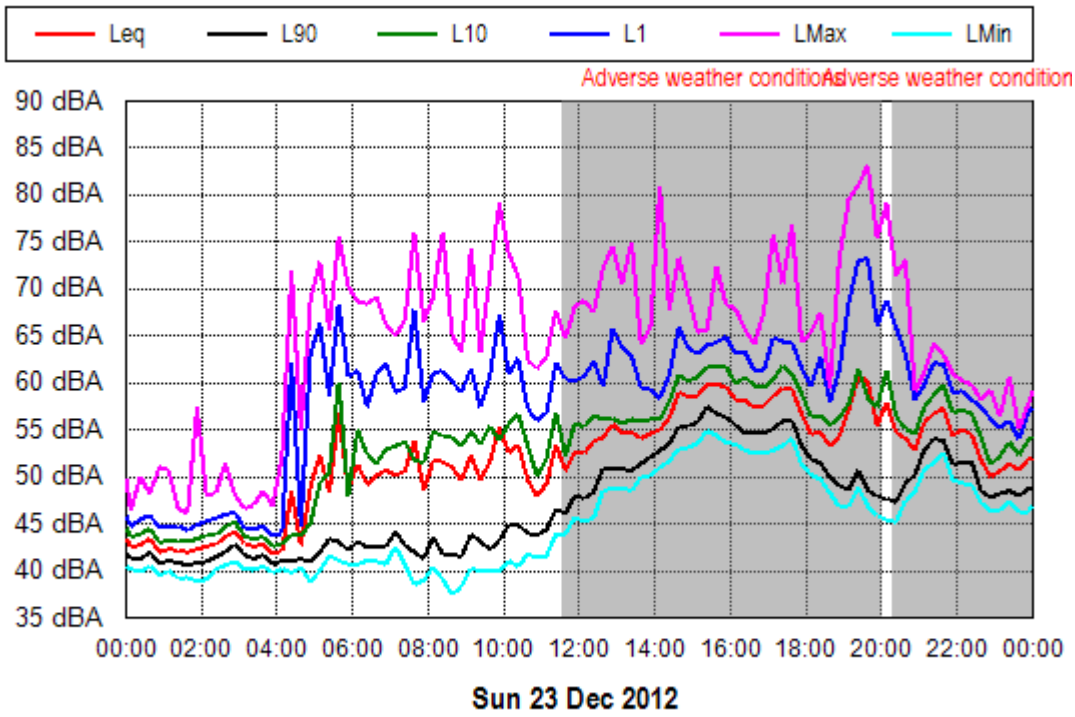


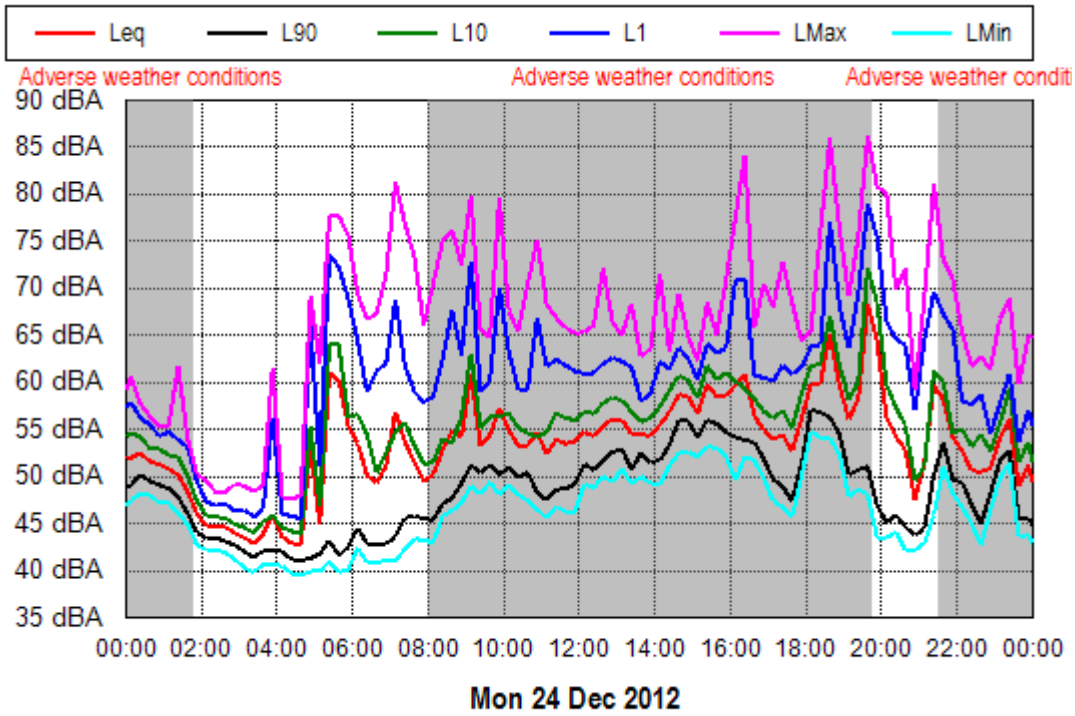
Project: Caltex Kurnell Refinery - Background Noise Monitoring
Location: Ranger's House
Filter: A



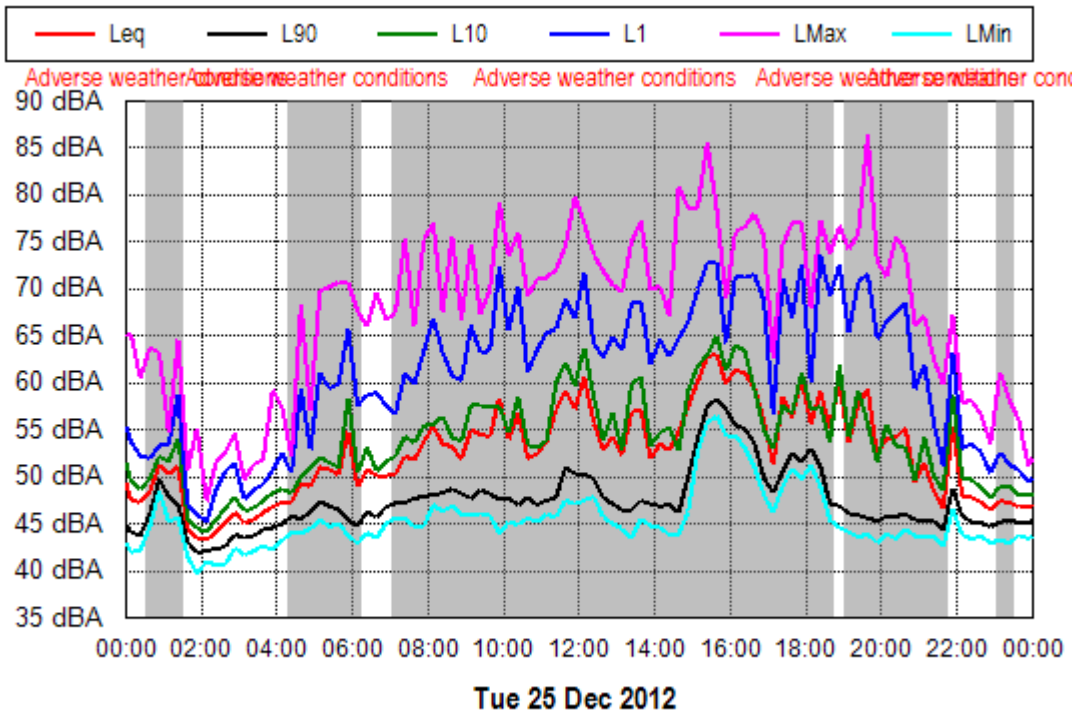


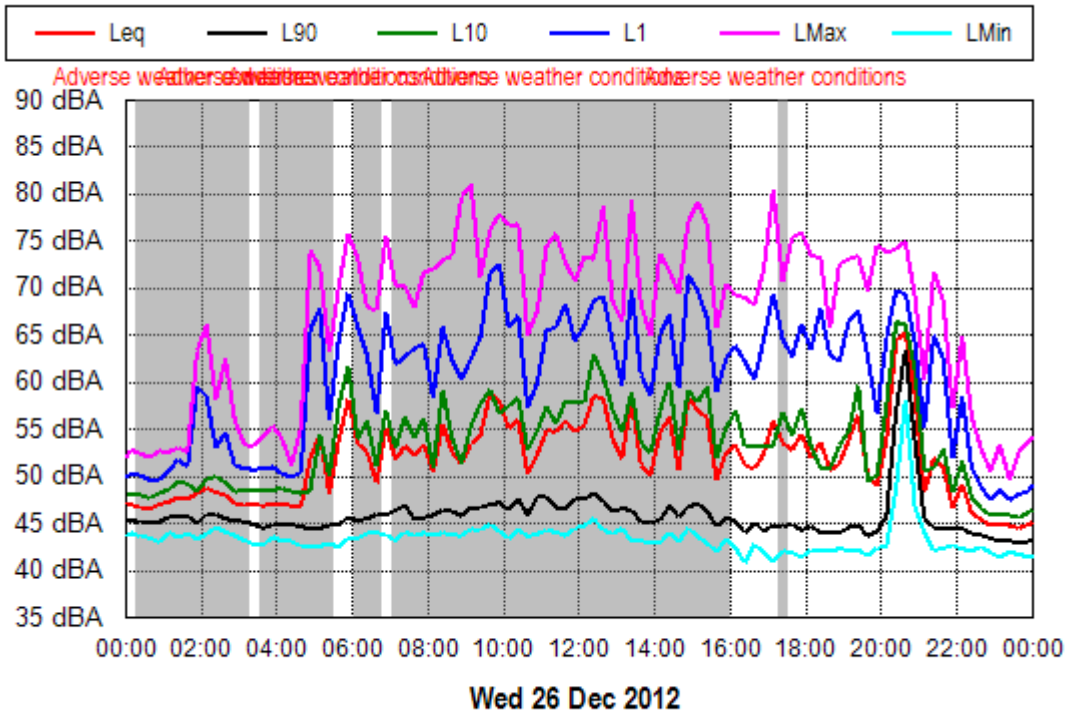
Project: Caltex Kurnell Refinery - Background Noise Monitoring
Location: Ranger's House
Filter: A



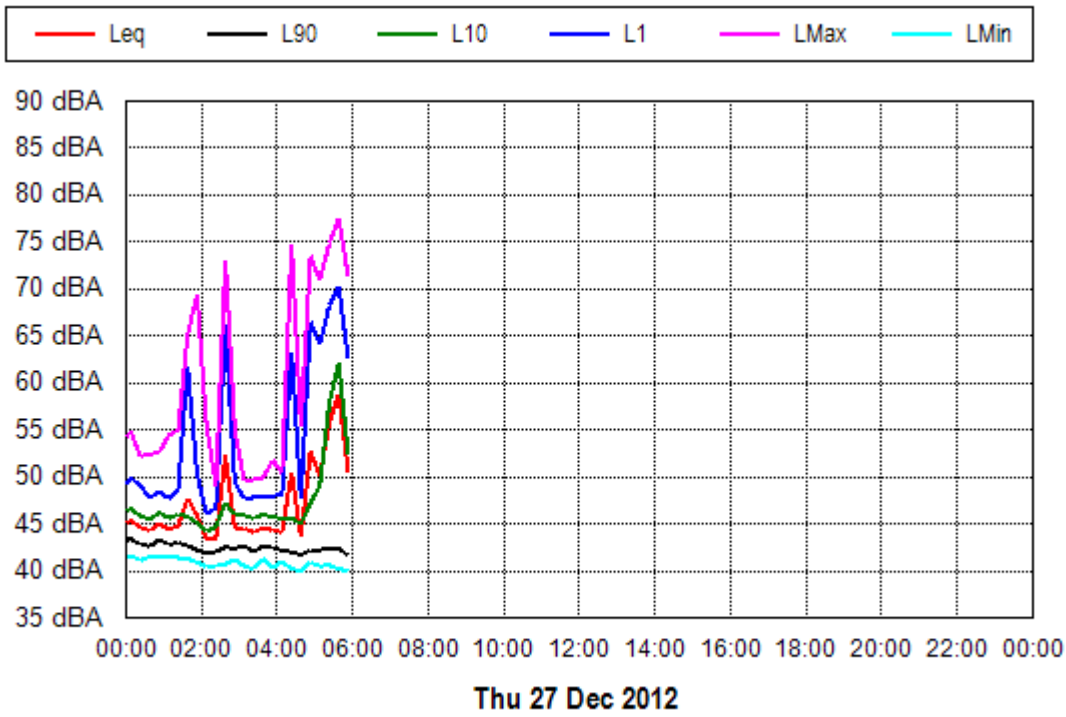


Project: Caltex Kurnell Refinery - Background Noise Monitoring
Location: Ranger's House
Filter: A





Project: Caltex Kurnell Refinery - Background Noise Monitoring
Location: Ranger's House
Filter: A



URS Australia Pty Ltd
Level 4, 407 Pacific Highway
Artarmon NSW 2064
Australia
T: 61 2 8925 5500
F: 61 2 8925 5555

www.ap.urscorp.com