Addendum

CDN/ID 18985299

Operational and Scientific Monitoring Plan

Offshore Victoria

Addendum 2: BassGas Operations

Rev	Date	Reason for issue	Reviewer/s	Consolidator	Approver
1	30/09/2020	Issued for NOPSEMA assessment (based on Artisan-1 Rev 4)	PW	Aventus	PW
0	30/07/2020	Issued for internal review	PW	Aventus	PW

Review due	Review frequency
Annually from date of acceptance	1 year

THE THREE WHATS
What can go wrong?
What could cause it to go wrong?
What can I do to prevent it?

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1 Introduction

1.1 Purpose

This document is an addendum to the Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) relevant to BassGas operations and provides a description of the following:

- Worst-case hydrocarbon spill scenarios;
- Matters of national environmental significance (MNES) within the environment that may be affected (EMBA) and predicted oil exposure from stochastic spill modelling;
- Environmental values and sensitivities of key areas within the EMBA and the operational and scientific monitoring studies that may be relevant to these areas;
- Priority planning areas for scientific studies; and
- Environmental monitoring implementation plan.

1.2 Timing

BassGas operations (the extraction and processing of gas at the Yolla-A platform) have been ongoing since 2006.

1.3 Environment that May Be Affected

The EMBA has been defined as an area where a change to ambient environmental conditions may potentially occur as a result of an unplanned hydrocarbon spill. A thorough description of the environmental sensitivities and values of the EMBA is presented in Chapter 5 of the BassGas Operations Environment Plan (EP) (CDN/ID 3972814).

It is noted that a change does not always imply that an adverse impact will occur; for example, a change may be required over a particular exposure value or over a consistent period of time for a subsequent impact to occur. The EMBA for BassGas operations, as defined in the BassGas Operations EP, is shown in Figure 1.1.

1.4 Spill Scenarios

Three credible worst-case spill scenarios were modelled for BassGas operations:

- A loss of well control (LoWC) at Yolla-A of 204,250 bbl/day for 86 days;
- A loss of containment (LoC) from the offshore raw gas pipeline of 3,144.9 bbl of gas condensate over 57.6 minutes at the 3 nm State/Commonwealth waters boundary; and
- A release of marine diesel oil (MDO) from a vessel fuel tank (300 m^3) over 6 hours as a result of a vessel collision at the 3 nm State/Commonwealth waters boundary.

A summary of the predicted exposure of MNES to hydrocarbons within the EMBA is provided in Section 2.1. For a summary of all other stochastic modelling outcomes, refer to Chapter 7 of the BassGas Operations EP. The spatial extent of predicted exposure from the stochastic modelling for the spill scenarios is shown in Figure 1.2, Figure 1.3 and Figure 1.4.

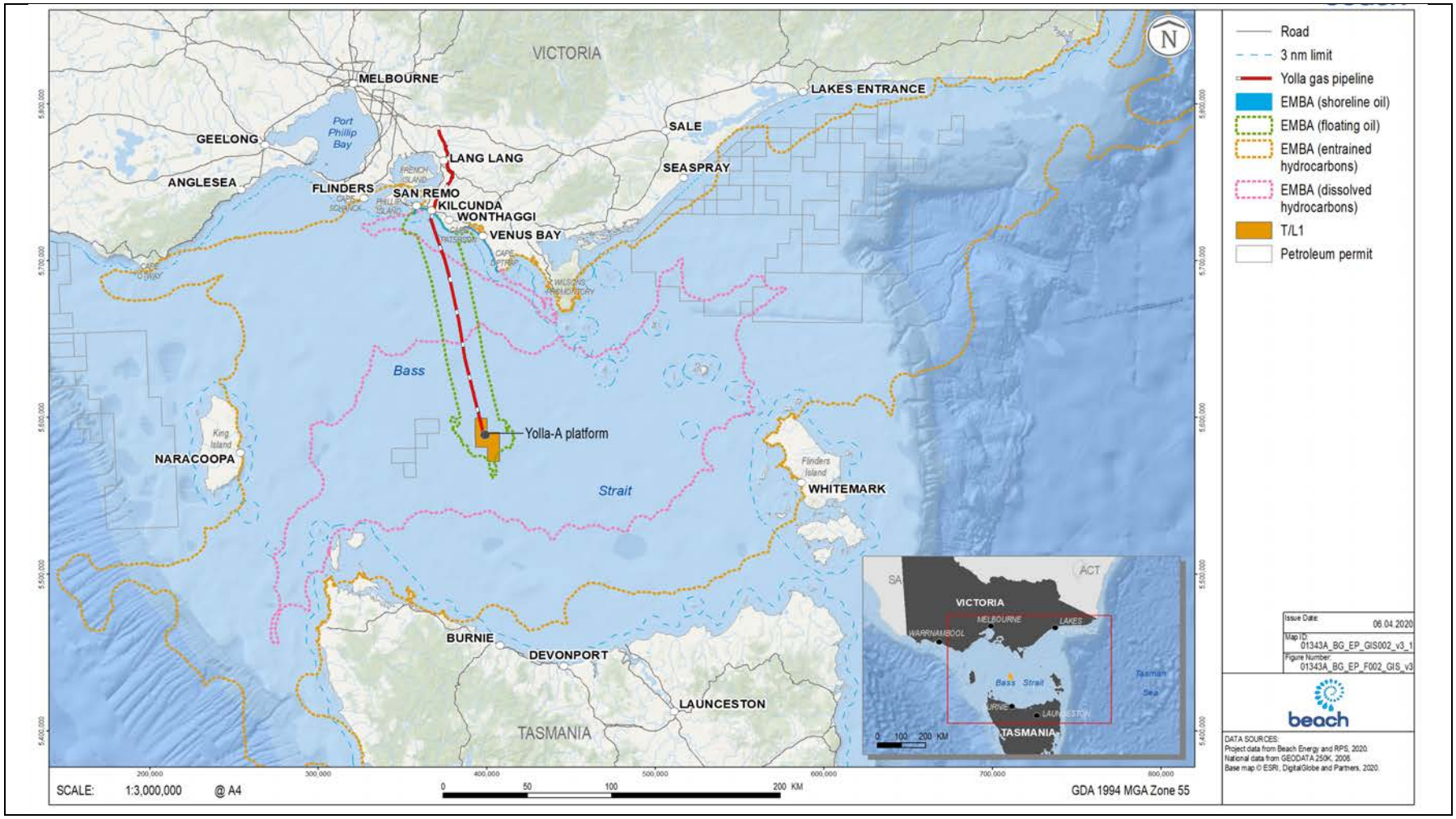
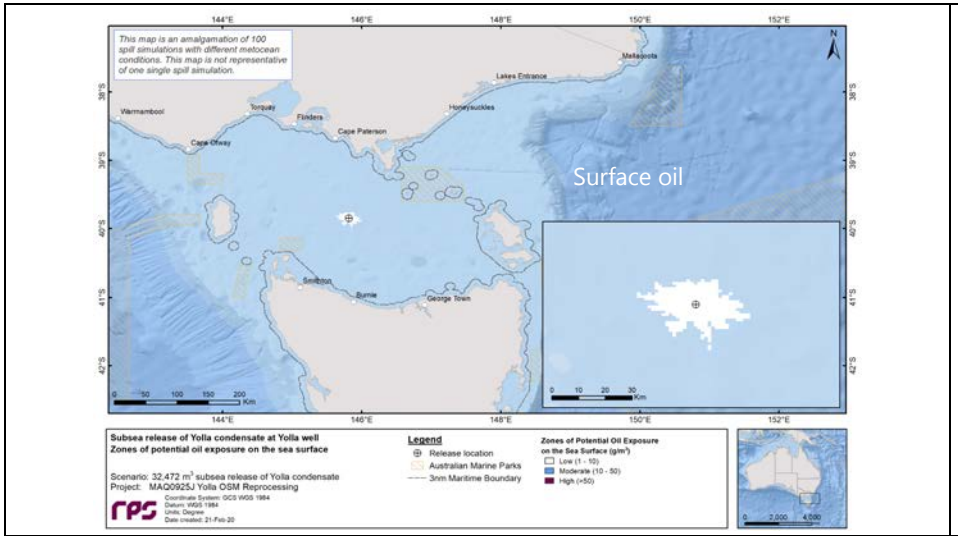


Figure 1.1. BassGas EMBA



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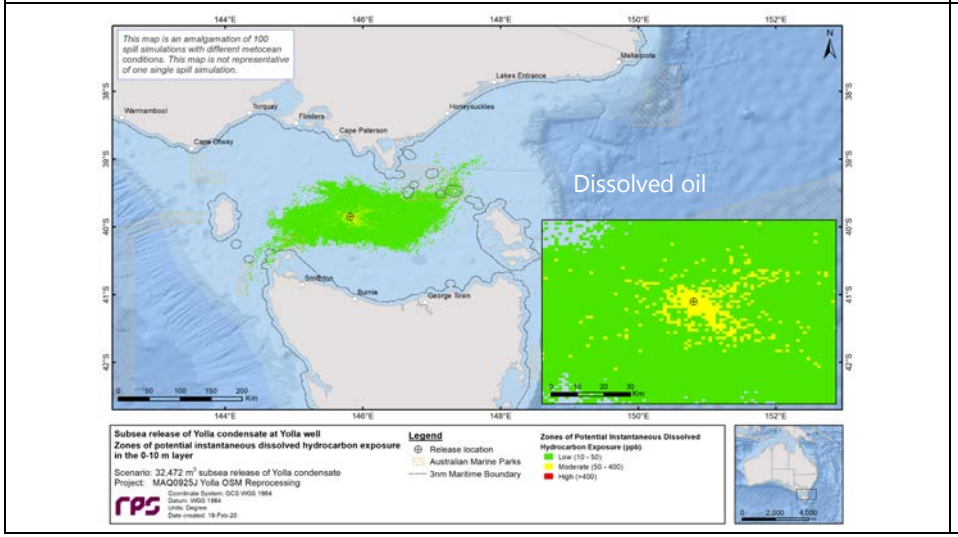

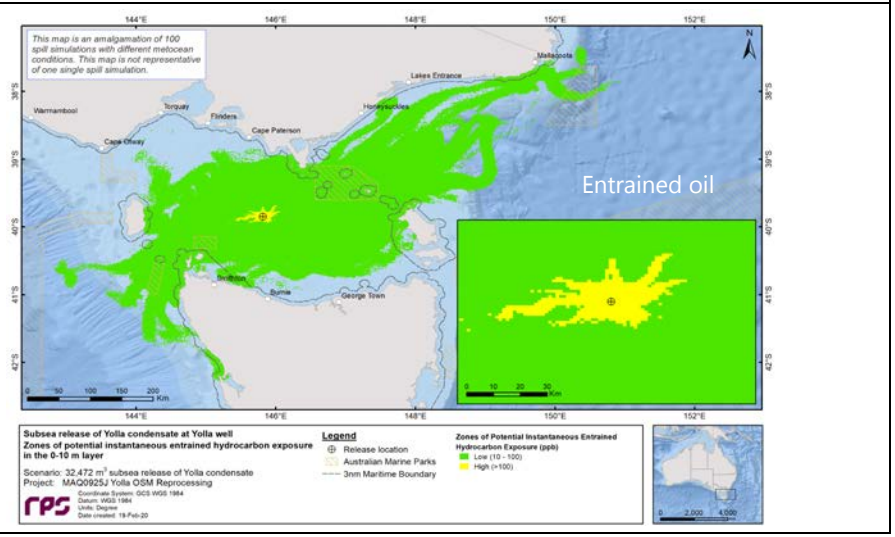

Figure 1.2. EMBA for LoWC

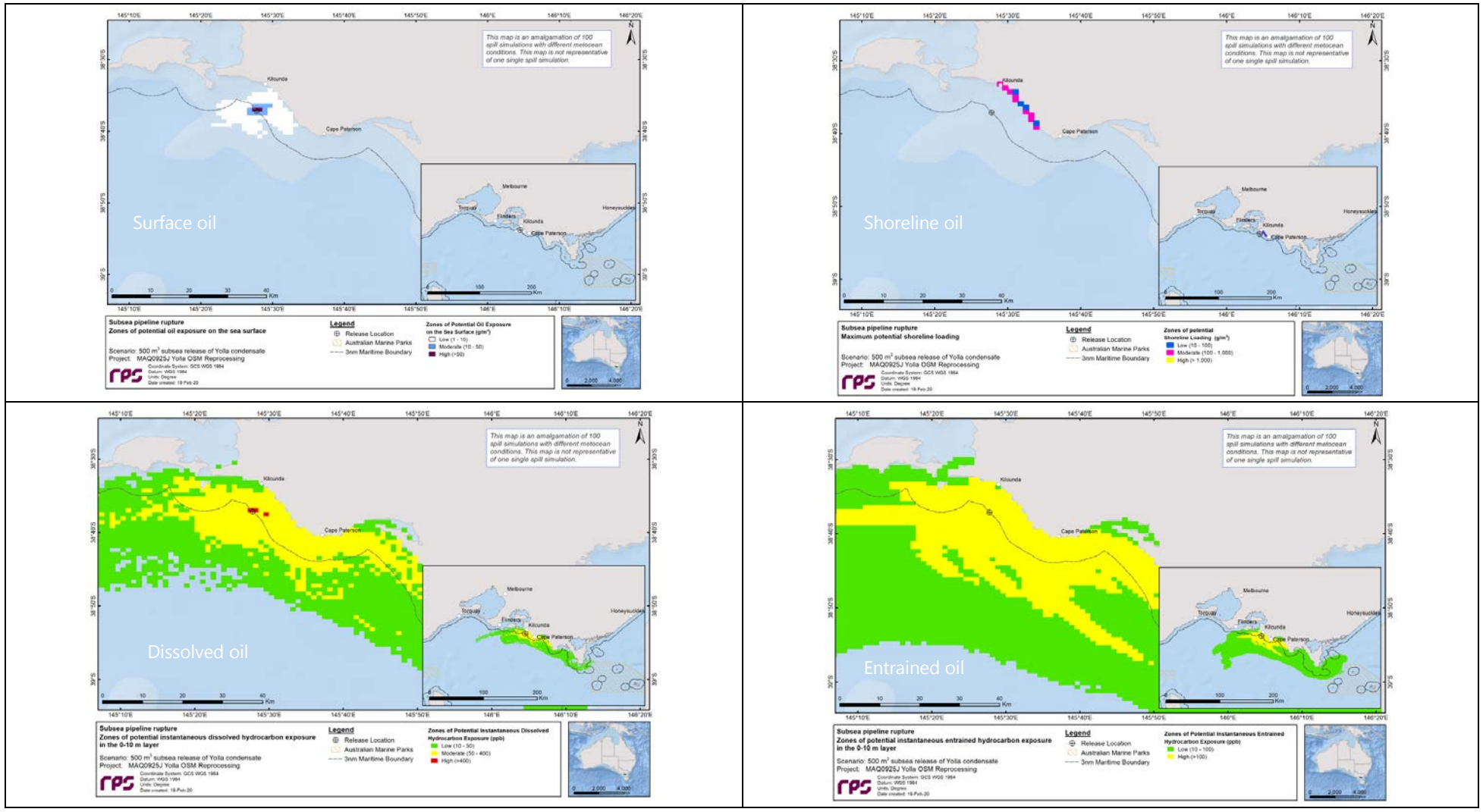

Figure 1.3. EMBA for LoC from the raw gas pipeline

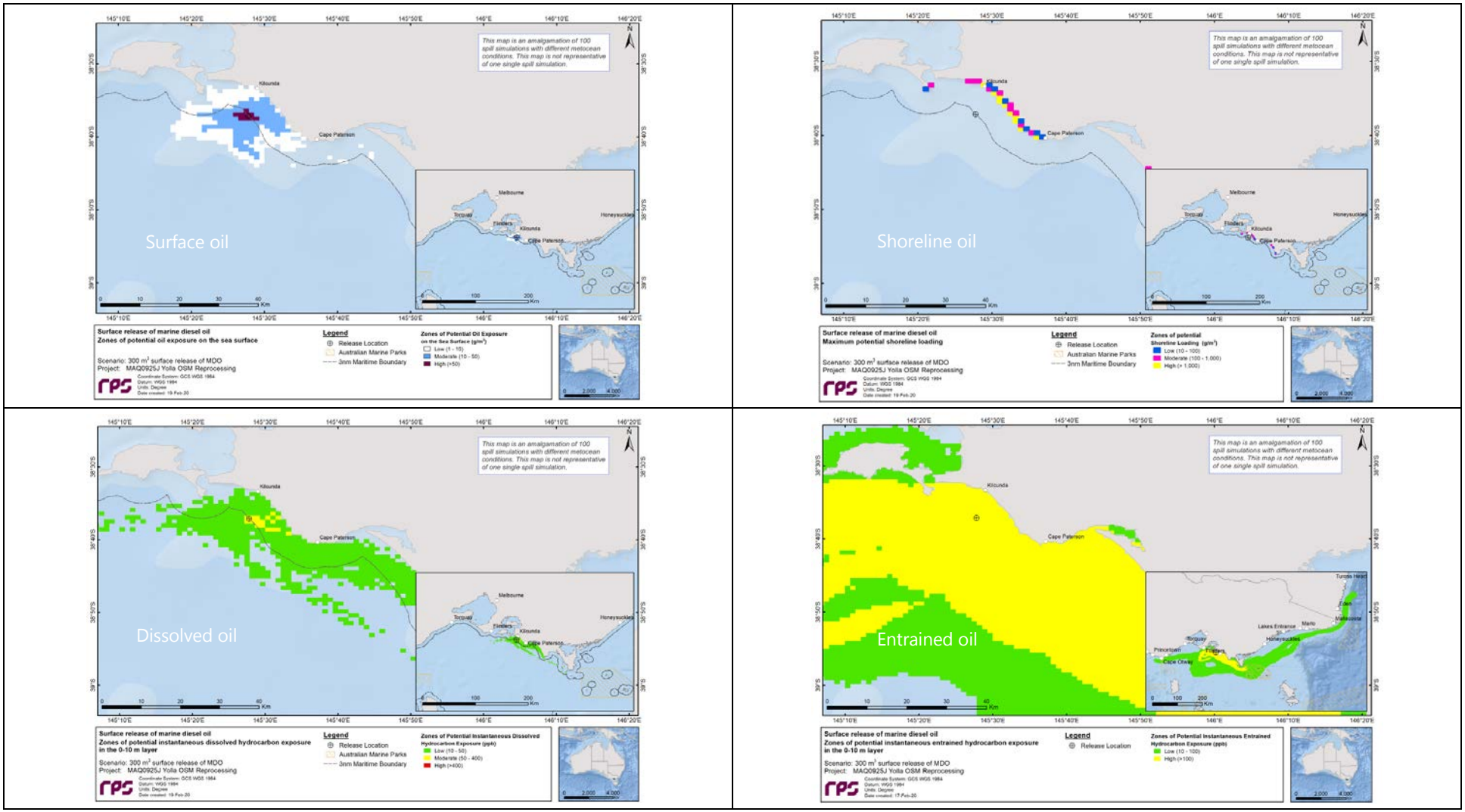

Figure 1.4. EMBA for MDO spill

2 Environmental Values and Sensitivities

The information presented in this section is based on spatial extents of stochastic spill modelling (Section 1.4) and/or the EMBA and the MNES and other environmental features identified within the BassGas Operations EP (Chapter 5). The information is presented here as context for spill monitoring awareness and planning. It does not restrict the implementation of any monitoring of MNES (or other) features that may be affected by an actual spill event that are beyond the area of predicted oil exposure (i.e., once the relevant initiation criteria are met for an operational and/or scientific study, these can be implemented irrespective of previous modelling outcomes).

2.1 Operational and Scientific Studies

Table 2.1 lists the operational and scientific studies that are described in detail in the Offshore Victoria OSMP.

Study	
Operational monitoring	
O1	Oil characterisation and behaviour
O2	Water quality
O3	Sediment quality
O4	Marine fauna surveillance
O5	Dispersant efficacy
O6	Fish tainting
Scientific monitoring	
S1	Water quality impact assessment
S2	Sediment quality impact assessment
S3	Subtidal habitats impact assessment
S4	Intertidal and coastal habitats impact assessment
S5	Marine fauna impact assessment
S6	Fisheries impact assessment
S7	Heritage and socioeconomic impact assessment

2.2 Predicted Hydrocarbon Exposure to MNES

Table 2.2 lists MNES that are known to occur within the EMBA and if there is predicted hydrocarbon exposure at or above low thresholds from the worst-case spill scenarios. It is noted that these low thresholds are not always relevant to levels associated with potential impacts, however, may represent a change in ambient environmental conditions.

Table 2.2. Matters of National Environmental Significance within the EMBA

MNES	Marine and/or coastal MNES features/species within the EMBA	Predicted MDO exposure				Predicted condensate exposure			
		Shoreline	Surface	Entrained	Dissolved	Shoreline	Surface	Entrained	Dissolved
World Heritage Properties	None present	–	–	–	–	–	–	–	–
National Heritage Places	The Western Tasmania Aboriginal Cultural Landscape	×	×	×	×	×	×	✓	×
Wetlands of International Importance (Ramsar wetlands)	Corner Inlet	×	×	✓	×	×	×	×	×
	Western Port	×	×	✓	×	×	×	✓	✓
	Gippsland Lakes	×	×	×	×	×	×	✓	×
	Lavinia (King Island)	×	×	×	×	×	×	✓	×
Threatened Ecological Communities (TECs)	Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	×	×	✓	✓	×	×	✓	✓
	Giant Kelp Marine Forests of South East Australia	×	×	✓	×	×	×	✓	✓
	Subtropical and Temperate Coastal Saltmarsh	×	×	✓	×	×	×	✓	×
Threatened Species	Various	✓	✓	✓	✓	✓	✓	✓	✓
Migratory Species	Various	✓	✓	✓	✓	✓	✓	✓	✓
Commonwealth Marine Areas	Apollo Australian Marine Park (AMP)	×	×	✓	×	×	×	×	×
	Boags AMP	×	×	×	×	×	×	✓	✓
	Beagle AMP	×	×	✓	×	×	×	✓	✓
	Franklin AMP	×	×	×	×	×	×	✓	✓
	East Gippsland AMP	×	×	×	×	×	×	✓	×
	Upwelling East of Eden Key Ecological Feature (KEF)	×	×	×	×	×	×	✓	×
	West Tasmanian Canyons KEF	×	×	×	×	×	×	✓	×

MNES	Marine and/or coastal MNES features/species within the EMBA	Predicted MDO exposure				Predicted condensate exposure			
		Shoreline	Surface	Entrained	Dissolved	Shoreline	Surface	Entrained	Dissolved
	Big Horseshoe Canyon KEF	×	×	×	×	×	×	✓	×
	Canyons of the eastern continental slope KEF	×	×	×	×	×	×	✓	×
Great Barrier Reef Marine Park	None present	–	–	–	–	–	–	–	–
Nuclear Actions	None present	–	–	–	–	–	–	–	–
Water Resources	None present	–	–	–	–	–	–	–	–

2.3 Monitoring studies relevant to key areas within the EMBA

Table 2.3 provides a summary of environmental values and sensitivities of identified key areas within the EMBA. Key areas are determined to be:

- AMPs;
- Wetlands of International Importance (Ramsar wetlands);
- TECs;
- Threatened or migratory species with a spatially defined biologically important area (BIA;
- KEFs; and
- Other protected areas, including State protected marine and terrestrial areas, nationally important wetlands and heritage sites.

The description of values and sensitivities is summarised from the Existing Environment (Chapter 5) of the BassGas Operations EP.

Table 2.3. Environmental values and sensitivities of key areas within the EMBA that may be exposed to oil

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Australian Marine Parks			
Apollo AMP	• Ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features: deep/hole/valley and shelf. • Important migration area for blue, fin, sei and humpback whales. • Important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. • Cultural and heritage site - wreck of the *MV City of Rayville*.	South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	O2: Water quality S1: Water quality impact assessment S5: Marine fauna impact assessment
Beagle AMP	• Ecosystems, habitats and communities associated with the Southeast Shelf Transition and associated with the seafloor features: basin, plateau, shelf and sill. • Important migration and resting areas for southern right whales. • It provides important foraging habitat for the Australian fur seal, killer whale, great white shark, shy albatross, Australasian gannet, short-tailed shearwater, Pacific and silver gulls, crested tern, common diving petrel, fairy prion, black-faced cormorant and little penguin. • Cultural and heritage sites including the wreck of the steamship *SS Cambridge* and the wreck of the ketch *Eliza Davies*.	South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	O2: Water quality O4: Marine fauna surveillance S1: Water quality impact assessment S5: Marine fauna impact assessment
Boags AMP	• Important foraging area for shy albatross, Australasian gannet, short-tailed shearwater, fairy prion, black-faced cormorant, common diving petrel and little penguins. • Located close to seabird breeding colonies on the nearby Hunter group of islands. • Ecosystems, habitats and communities associated with the IMCRA Bass Strait Shelf Province including sea floor plateau and tidal sandwave/sandbank.	South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S5: Marine fauna impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Franklin AMP	• Important feeding grounds for seabirds including species of albatross, petrel, shearwater and cormorant. • Located close to seabird breeding colonies on the nearby Hunter group of islands. • Great white sharks are known to forage in the reserve.	South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	O2: Water quality S1: Water quality impact assessment S5: Marine fauna impact assessment
East Gippsland AMP	• Mixing of warm and temperate waters in the reserve creates habitat for phytoplankton. • Oceanic birds including albatrosses, petrels and shearwaters are known to foraging in the AMP. • Humpback whales pass through the reserve during their north and south migration.	South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	O2: Water quality S1: Water quality impact assessment S5: Marine fauna impact assessment
State Marine Protected Areas			
Victoria (Marine National Parks)			
Bunurong Marine National Park (MNP)	• Extensive intertidal rock platforms and subtidal rocky reefs. • Abundant and diverse marine flora and fauna including over 22 species of marine flora and fauna recorded, or presumed to be, at their eastern or western distributional limits. • Highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone. • Important coastal habitat for several threatened species.	Bunurong MNP Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Churchill Island MNP	• Within the park are numerous marine habitats including mangroves, sheltered intertidal mudflats, seagrass beds, subtidal soft sediments and rocky intertidal shores. • This MNPis part of the Western Port Ramsar site.	N/A (refer to Western Port Ramsar Site Management Plan)	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
	• Churchill Island is an important habitat for many bird species. Migratory waders roost and feed within the Marine National Park including the bar-tailed Godwit and the red-necked stint. • The seagrass beds are major food sources for many commercially viable species such as King George whiting, black bream and yellow-eyed mullet.		S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Wilsons Promontory MNP	• Intertidal rocky shores, sandy beaches, seagrass and subtidal soft substrates. • Abundant and diverse marine flora and fauna, including hundreds of fish species and invertebrates such as sponges, ascidians, sea whips and bryozoans. • Important breeding sites for a significant colony of Australian fur seals. • Important habitat for several threatened shorebird species, including species listed under international migratory bird agreements. • Seascape, cultural places and objects of high traditional and cultural significance to Indigenous people. • Historic shipwrecks.	Wilsons Promontory MNP and Wilsons Promontory Marine Park Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Point Hicks MNP	• A diversity of habitats, including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches. • A very high diversity of fauna, including intertidal and subtidal invertebrates. • Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm eastern and cool southern waters. • Transient reptiles from northern waters, including turtles and sea snakes. • Threatened fauna, including whales and several bird species. • Outstanding landscapes, seascapes and underwater scenery. • Outstanding active coastal landforms, such as granite reefs and mobile sand dunes.	Point Hicks MNP Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Cape Howe MNP	• Diversity of habitats including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches. • Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm eastern and cool southern waters. • Marine mammals such as whales, dolphins, Australian fur-seals and New Zealand fur-seals. • Transient reptiles such as green turtles from northern waters. • Threatened fauna including whales and birds. • Foraging area for a significant breeding colony of Little Penguins from neighbouring Gabo Island. • Outstanding active coastal landforms within and adjoining the park, such as granite and sandstone reefs. • Victoria's most easterly MNP abutting one of only three wilderness zones on the Victorian coast. • Outstanding opportunities to build knowledge of marine protected areas and their management, and to further understand marine ecological function and changes over time.	Cape Howe MNP Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Victoria (Marine Sanctuaries)			
Marengo Reefs Marine Sanctuary	• Subtidal soft sediments, subtidal rocky reefs and intertidal reefs. high diversity of algal, invertebrate and fish species. • Australian fur-seal haul out area. • Evidence of a long history of Indigenous use. • Historic shipwrecks. • Tourism and recreational activities including snorkelling and seal watching.	Marengo Reefs Marine Sanctuary Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment
Mushroom Reef Marine Sanctuary	• Subtidal pools and boulders in the intertidal area that provide a high complexity of intertidal basalt substrates and a rich variety of microhabitats. • A range of reef habitats that support diverse and abundant flora including kelps, other brown, green and red algae; invertebrates including gorgonian fans, seastars, anemones, ascidians, barnacles and soft corals; and sedentary and migratory fish species.	Mushroom Reef Marine Sanctuary Management Plan	S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
	• Sandy bottoms habitats that support large beds of *Amphibolis* seagrass and patches of green algae. • Intertidal habitats that support resident and migratory shorebird species including threatened species. • Culturally important areas for the Boonwurrung people. • Recreational activities including diving and snorkelling.		
Tasmania (Marine Reserves)			
Arthur Bay Conservation Area	• Coastal and marine protected area on the west coast of Flinders Island. • Shallow marine area likely contains rocky reef sites and coastal interface used as habitat for marine fauna.	N/A	O2: Water quality S1: Water quality impact assessment S2: Sediment quality impact assessment S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Kent Group Marine Reserve	• Stronghold for fish species including violet roughy, mosaic leatherjacket, wilsons weedfish and maori wrasse. • Seagrass beds found at Murray Pass up to 20 m water depth. • Sponge gardens and stony coral found in 40 m water depths.	N/A	
State Terrestrial Protected Areas			
Victoria (National Parks)			
French Island National Park	• Land-based protected areas with a coastal interface that may be used as habitat for marine fauna (birds, pinnipeds, etc). • Where access is allowed, recreational activities may be present.	French Island National Park Management Plan	O3: Sediment quality O4: Marine fauna surveillance S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Great Otway National Park		Great Otway National Park and Otway Forest Park Management Plan	
Mornington Peninsula National Park		Mornington Peninsula National Park and Arthurs Seat State Park Management Plan	
Croajingolong National Park		Croajingolong National Park Management Plan	
Wilsons Promontory National Park		Wilsons Promontory National Park Management Plan	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Victoria (Conservation, Nature, Wildlife Reserves)			
Cape Liptrap Conservation Park	• Mainland-based protected areas with a coastal interface that may be used as habitat for marine fauna (birds, pinnipeds etc) • Where access is allowed, recreational activities may be present	Cape Liptrap Coastal Park Management Plan	O3: Sediment quality O4: Marine fauna surveillance S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Flinders Foreshore Coastal Reserve		Flinders Foreshore Coastal Reserve Management Plan	
Western Port Intertidal Reserve		N/A (refer to Western Port Ramsar Site Management Plan)	
San Remo Coastal Reserve		San Remo Coastal Reserve Management Plan	
Punchbowl Coastal Reserve		N/A	
Phillip Island Nature Park		Phillip Island Nature Parks Management Plan	
Kilcunda – Harmers-Haven Coastal Reserve		N/A (refer to Bunurong Marine National Park, Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve Management Plan)	
Reef Island and Bass River Mouth Nature Conservation Reserve		N/A	
Shallow Inlet Marine and Coastal Park		N/A	
Gippsland Lakes Coastal Park		Lakes National Park & Gippsland Lakes Coastal Park Management Plan	
Cape Conran Coastal Park		Cape Conran Coastal Park Management Plan	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Tasmania			
Councillor Island Nature Reserve	• Island-based protected areas with a coastal interface that may be used as habitat for marine fauna (birds, pinnipeds etc) • Where access is allowed, recreational activities may be present. However due to remoteness, recreation may be limited.	N/A	O3: Sediment quality O4: Marine fauna surveillance S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Albatross Island Nature Reserve		Small Bass Strait Islands Reserve Management Plan	
Petrel Islands Game Reserve		N/A	
Nares Rocks Conservation Area		N/A	
Three Hummock Island State Reserve		N/A	
Hunter Island Conservation Area		N/A	
Harbour Islets Conservation Area		N/A	
Henderson Islets Conservation Area		N/A	
Seacrow Islet Conservation Area		N/A	
Bird Island Game Reserve		N/A	
Stack Island Game Reserve		N/A	
The Doughboys Nature Reserve		N/A	
Bull Rock Conservation Area		N/A	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Boxen Island Conservation Area		N/A	
Goose Island Conservation Area		N/A	
Badger Island Indigenous Protection Area		N/A	
Mount Chappell Island Indigenous Protected Area		N/A	
Big Green Island Nature Reserve		N/A	
East Kangaroo Island Nature Reserve		N/A	
Chalky Island Conservation Area		N/A	
Isabella Island Nature Reserve		N/A	
Prime Seal Island Conservation Area		N/A	
Pasco Group Conservation Area		N/A	
Roydon Island Conservation Area		N/A	
Sentinel Island Conservation Area		N/A	
Sister Islands Conservation Area		N/A	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Curtis Island Nature Reserve		N/A	
Devils Tower Nature Reserve		N/A	
Craggy Island Conservation Area		N/A	
East Moncoeur Island Conservation Area		N/A	
West Moncoeur Island Nature Reserve		Small Bass Strait Islands Reserve Management Plan	
Hogan Group Conservation Area		N/A	
Cone Islet Conservation Area		N/A	
North East Islet Nature Reserve		N/A	
Rodondo Island Nature Reserve		Small Bass Strait Islands Reserve Management Plan	
Sugarloaf Rock Conservation Area		N/A	
Lavinia State Reserve	• Mainland-based (including King Island and Flinders Island) protected areas with a coastal interface that may be used as habitat for marine fauna (birds, pinnipeds etc) • Where access is allowed, recreational activities may be present	Lavinia State Reserve Management Plan	O3: Sediment quality O4: Marine fauna surveillance S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment
Sea Elephant Conservation Area		N/A	
City of Melbourne Bay Conservation Area		N/A	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Calm Bay State Reserve		N/A	S7: Heritage and socioeconomic impact assessment
Slaves Bay Conservation Area		N/A	
West Point State Reserve		N/A	
Arthur-Pieman Conservation Area		Arthur-Pieman Conservation Area Management Plan	
Four Mile Beach Regional Reserve		N/A	
Mount Heemskirk Regional Reserve		N/A	
Ocean Beach Conservation Area		N/A	
The Nut State Reserve		The Nut State Reserve Management Plan	
Tatlows Beach Conservation Area		N/A	
Rocky Cape National Park		Rocky Cape National Park Management Plan	
Fotheringate Bay Conservation Area		N/A	
Settlement Point Conservation Area		N/A	
Emita Nature Recreation Area		N/A	
Marshall Beach Conservation Area		N/A	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Mount Tanner Nature Recreation Area		N/A	
Bun Beetons Point Conservation Area		N/A	
Low Point Conservation Area		N/A	
Killiecrankie Nature Recreation Area		N/A	
Blyth Point Conservation Area		N/A	
Palana Beach Nature Recreation Area		N/A	
Jacksons Cove Conservation Area		N/A	
Internationally Important Wetlands (Ramsar Wetlands)			
Corner Inlet	• Represents the most southerly marine embayment and intertidal system of mainland Australia. • The site includes Corner Inlet and Nooramunga Marine and Coastal Parks, and the Corner Inlet MNP. • The major features of Corner Inlet are its large geographical area, the wetland types present (particularly the extensive subtidal seagrass beds), diversity of aquatic and semi-aquatic habitats and abundant flora and fauna, including significant proportions of the total global population of a number of waterbird species.	Corner Inlet Ramsar Site Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Gippsland Lakes	• Contains three main habitat types; permanent saline/brackish pools, coastal brackish/saline lagoons and permanent freshwater marshes. Threatened,	Gippsland Lakes Ramsar Site Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
	endangered, vulnerable or rare native fish communities, and mammal, amphibian and plant species exist within these habitats. • The lakes and their associated swamps and morasses regularly support an estimated 40,000 to 50,000 ducks, swans, coots and other waterfowl. Lake Reeve (at the western end of the lake system) is a site of international zoological significance, attracting up to 12,000 migratory waders and is one of the five most important areas for waders in Victoria. • The lakes support the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria, as well as up to 3,000 sharp-tailed sandpiper (*Calidris acuminata*) and up to 1,800 curlew sandpiper (*Calidris ferruginea*). Twenty-four (24) bird species listed under JAMBA and 26 species listed under CAMBA have been recorded at the lakes.		S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Lavinia	• The site is an important refuge for a collection of regional and nationally threatened species, including the nationally endangered orange-bellied parrot. • Other critical components of the site include wetland vegetation communities, regional and national rare plant species, regionally rare bird species, Kind Island scrubtit, water and sea birds, migratory birds, striped marsh frog and the green and gold frog • The site is currently used for conservation and recreation, including boating, fishing, camping and off-road driving. There are artefacts of Indigenous Australian occupation.	N/A (Plan is currently being revised)	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Western Port	• Western Port is valued for its terrestrial and marine flora and fauna, cultural heritage, recreational opportunities and science value. • The area has substantial intertidal areas supported by mangroves, saltmarsh, seagrass communities and unvegetated mudflats, which are significant for its shorebird habitat. • There are three marine parks within the Ramsar site (Yaringa, French Island and Churchill Island MNPs).	Western Port Ramsar Site Management Plan	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
			S7: Heritage and socioeconomic impact assessment
Nationally Important Wetlands			
Anderson Inlet	• Anderson Inlet is one of the largest estuaries on the Victorian coast. • The inlet is of high value for its fauna, including 23 waterbird species. • Popular for recreational fishing, camping, sailing, power-boating and water-skiing.	N/A	O2: Water quality O3: Sediment quality O4: Marine fauna surveillance S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment S5: Marine fauna impact assessment S7: Heritage and socioeconomic impact assessment
Lavinia Nature Reserve	• Lavinia Nature Reserve includes the Sea Elephant River Estuary and associated mudflats, areas of coastal swamp, lagoons and areas of drier marsh inland from the coast. • The wetland area supports species and communities which are threatened in both Tasmania and/or globally.	N/A (refer to Lavinia State Reserve Management Plan)	
Boullanger Bay – Robbins Passage	• Includes extensive area of tidal channels and intertidal mud and sand flats lying between the northwest channel coastline of Tasmania, and three offshore islands (Perkins, Robbins and Penguin Islands). • The site attracts the largest numbers of waders in Tasmania and represents significant habitat for non-migratory species.	N/A	
Rocky Cape Marine Area	• Area extends off the Rocky Cape National Park where the marine intertidal, tidal and deep waters, together with a range of wave exposures found in the area, result in particularly high biotic diversity. • Extensive fish fauna contains many warm and cool temperate species including cave dwelling species. • The area is commonly used for recreational activities such as scuba diving, snorkelling, fishing and boating.	N/A	
Thurra River	• Area of 2,920 ha and flows through State forest and Croajingolong National Park. • There are 29 threatened flora species and 37 threatened fauna species within the wetland.	N/A	

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Tamboon Inlet	• Located in east Gippsland and hosts a variety of wetland types that are affected by fresh and saline water, which supports a diversity of flora and fauna in estuarine habitat. • 96 plant taxa (including 38 introduced) have been recorded in the Tamboon Inlet area. The inlet is fringed by multiple vegetation classes including riparian scrub complex and coastal saltmarsh.	N/A	
Benedore River	• Occurs in east Gippsland in the Croajingolong National Park. The Benedore River has no introduced fish species and a natural assemblage of native species, which indicates pristine conditions. • There are 16 threatened flora species recorded in the wetland. There are 25 threatened fauna species including the little tern (*Sterna albifrons*).	N/A	
Powlett River Mouth	• The Powlett River Mouth provides valuable habitat for the endangered Orange-bellied Parrot. • The Powlett River Mouth area supports saltmarsh vegetation which is the required habitat of the Orange-bellied Parrot.	N/A	
Western Port	• Western Port is a large bay with extensive intertidal flats, mangroves, saltmarsh, seagrass beds, several small islands and two large islands. • Refer to description under Ramsar Wetlands.	N/A (refer to Western Port Ramsar Site Management Plan)	
Threatened Ecological Communities			
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	• This ecological community is the assemblage of native plants, animals and micro-organisms associated with the dynamic salt-wedge estuary systems that occur within the temperate climate, microtidal regime (<2 m), high wave energy coastline of western and central Victoria. The ecological community currently encompasses 25 estuaries in the region defined by the border between South Australia and Victoria and the most southerly point of Wilsons Promontory. • The Powlett River is a known site within the EMBA for this TEC.	Approved Conservation for the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	O2: Water quality O3: Sediment quality S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment
Giant Kelp Marine Forests of South East Australia	• Giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs in cold temperate waters off south east Australia. The kelp grows up from the sea floor 8 m below the sea surface and deeper, vertically toward the water surface. It is the foundation species of this TEC in shallow coastal marine ecological communities. The kelp species itself is not protected, rather, it is	Approved Conservation Advice for Giant Kelp Marine Forests of South East Australia	O2: Water quality O3: Sediment quality S1: Water quality impact assessment S2: Sediment quality impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
	communities of closed or semi-closed giant kelp canopy at or below the sea surface that are protected. • The largest extent of the ecological community is in Tasmanian coastal waters; some patches may also be found in Victoria and South Australia.		S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment
Subtropical and Temperate Coastal Saltmarsh	• The coastal saltmarsh community consists mainly of salt-tolerant vegetation including grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses generally dominate and vegetation is generally less than 0.5 m in height. • The saltmarsh community is inhabited by a wide range of infaunal and epifaunal invertebrates and low and high tide visitors such as fish, birds and prawns. • It is often important nursery habitat for fish and prawn species. Insects are also abundance and an important food source for other fauna. The dominant marine residents are benthic invertebrates, including molluscs and crabs.	Conservation Advice for Subtropical and Coastal Saltmarsh	O2: Water quality O3: Sediment quality S1: Water quality impact assessment S2: Sediment quality impact assessment S4: Intertidal and coastal habitats impact assessment
Threatened or Migratory Fauna with BIAs			
White shark	• Vulnerable, migratory • Foraging, distribution and nursery BIAs	Recovery Plan for the White Shark (*Carcharodon carcharias*)	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Southern right whale	• Endangered, migratory • Migration and distribution BIAs • Presence may occur from May to November	Conservation Management Plan for the Southern Right Whale, 2011-2021	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Pygmy blue whale	• Endangered, migratory • Foraging and distribution BIAs • Typically forage in the Bass Strait region between January and April	Conservation Management Plan for the Blue Whale, 2015-2025	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Antipodean albatross	• Vulnerable, migratory • Foraging BIA	National recovery plan for threatened albatrosses and giant petrels 2011-2016	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Black-browed albatross	• Vulnerable, migratory • Foraging BIA		
Buller's albatross	• Vulnerable, migratory • Foraging BIA		

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Campbell albatross	• Vulnerable, migratory • Foraging BIA		
Shy albatross	• Vulnerable, migratory • Foraging BIA		
Wandering albatross	• Vulnerable, migratory • Foraging BIA		
Soft-plumaged petrel	• Vulnerable, migratory • Foraging BIA	Conservation Advice (*Pterodroma Mollis*) soft-plumaged petrel.	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Short-tailed shearwater	• Migratory • Foraging BIA	N/A	O4: Marine fauna surveillance S5: Marine fauna impact assessment
Key Ecological Features			
Upwelling East of Eden	• An area of high productivity and aggregations of marine life. • Dynamic eddies of the East Australian Current cause episodic productivity events when they interact with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms that are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish. • The upwelling supports regionally high primary productivity that supports fisheries and biodiversity, including top order predators, marine mammals and seabirds. This area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form. The area is also important for seals, other cetaceans, sharks and seabirds.	N/A	O2: Water quality O4: Marine fauna surveillance S1: Water quality impact assessment S5: Marine fauna impact assessment
West Tasmanian Canyons	• An area of high productivity and aggregations of marine life. • These canyons can influence currents, act as sinks for rich organic sediments and debris, and can trap waters or create upwellings that result in productivity and biodiversity hotspots. • Sponges are concentrated near the canyon heads, with the greatest diversity between 200-350 m depth. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts.	N/A	O2: Water quality S1: Water quality impact assessment

Key Area Location / Feature	Summary of Environmental Values and Sensitivities	Relevant Management Plan / Conservation Advice / Recovery Plan	Relevant Operational and Scientific Monitoring Studies
Big Horseshoe Canyon	• The steep, rocky slopes provide hard substrate habitat for attached large megafauna. • Canyons have a marked influence on diversity and abundance of species through their combined effects of topography, geology and localised currents, all of which act to funnel nutrients and sediments into the canyon. • Sponges and other habitat forming species provide structural refuges for benthic fish, including the commercially important pink ling (*Genypterus blacodes*).	N/A	O2: Water quality S1: Water quality impact assessment
Canyons of the eastern continental slope	• The canyons provide a unique seafloor feature with enhanced ecological functioning, integrity and biodiversity, which apply to both its benthic and pelagic habitats. • These canyons affect the water column by interrupting the flow of water across the seafloor and creating turbulent conditions in the water column. • This turbulence transports bottom waters to the surface, creating localised upwellings of cold, nutrient-rich waters, which result in regions of enhanced biological productivity relative to the surrounding waters.	N/A	O2: Water quality S1: Water quality impact assessment
Heritage Features			
Western Tasmanian Aboriginal Cultural Landscape	• The Western Tasmania Aboriginal Cultural Landscape contains evidence of semi-sedentary villages that indicate a unique way of life for Tasmanian Aboriginals. • The Western Tasmania Aboriginal Cultural Landscape also contains other stone artefact scatters, stone arrangements, rock engravings and shelters and human burials that provide further insight into this unique way of life.	N/A	S7: Heritage and socioeconomic impact assessment

3 Priority Planning for Scientific Monitoring

Priority planning for scientific monitoring has been developed based on two elements:

1. Sensitive areas that may be exposed within a short period of time; and
2. Study scopes that have a short lead time for preparing an initial Sampling and Analysis Plan (SAP) for implementation.

Priority planning areas for potential scientific monitoring have been identified where the following criteria are met:

- Section of coastline between Kilcunda and Cape Paterson, where shoreline contact is predicted for the pipeline rupture and MDO release scenarios;
- Predicted time to exposure is ≤48 hours;
- Any of the following sensitive environmental receptors are present:
  - AMPs;
  - State marine protected areas;
  - National or internationally important wetlands;
  - Mangrove or saltmarsh habitat;
  - Known breeding/calving/nesting aggregation areas for protected (threatened or migratory) fauna;
  - Known breeding/haul-out areas for pinnipeds;
  - TECs; and
- Time given for preparation of an initial SAP for a particular scientific monitoring study is ≤48 hours.

Note, the time requirement is based upon the shortest time allowed (i.e., 48 hours) for the Monitoring Provider to prepare an initial SAP for a scientific monitoring study (as defined in the Offshore Victoria OSMP, which is for scientific monitoring studies 1 and 2).

The selection of sensitive environmental receptors is consistent with the receptors used in determining the onshore priority response planning areas within the OPEP, with the addition of marine protected areas (both Commonwealth and State).

The priority planning areas and relevant scientific monitoring scopes identified for spill scenarios that are relevant to the BassGas operations are detailed in Table 3.1. A series of checklists have been developed for these priority planning areas to assist in implementing scientific monitoring studies in these areas (**Appendix A**).

Table 3.1. Priority planning areas and scientific studies for BassGas operations

Sensitive Environmental Receptor	Priority Planning Area	Priority Scientific Studies
State protected areas	Punchbowl Coastal Reserve	S2: Sediment quality impact assessment
	Kilcunda Coastal Reserve	S2: Sediment quality impact assessment
	Kilcunda – Harmers-Haven Coastal Reserve	S1: Water quality impact assessment S2: Sediment quality impact assessment
	Bunurong MNP	
	Bunurong Marine and Coastal Park	
	Cape Liptrap Coastal Park	S2: Sediment quality impact assessment
Internationally important wetlands	Western Port	S1: Water quality impact assessment S2: Sediment quality impact assessment
Nationally important wetlands	Anderson Inlet	S1: Water quality impact assessment S2: Sediment quality impact assessment
	Western Port	
	Powlett River	
Sheltered tidal flats	Anderson Inlet	S1: Water quality impact assessment S2: Sediment quality impact assessment
Mangrove habitat	None	None
Saltmarsh habitat	Anderson Inlet	S1: Water quality impact assessment S2: Sediment quality impact assessment
	Powlett River	
Known breeding/calving/nesting aggregation areas for protected fauna	Coastline from San Remo to Cape Paterson (shorebird roosting)	S5: Marine fauna impact assessment
Known breeding/haul-out areas for pinnipeds	Kanowna Island (seal breeding)	S5: Marine fauna impact assessment
TECs (Coastal Saltmarsh and/or Salt-wedge Assemblages)	Anderson Inlet (saltmarsh)	S1: Water quality impact assessment S2: Sediment quality impact assessment
	Shallow Inlet (saltmarsh)	
	Powlett River (salt-wedge assemblages)	
TECs (Giant Kelp)	None	None

4 Implementation Plan

4.1 Activation

In the unlikely event of a Level 2 or Level 3 offshore spill event, operational and scientific monitoring studies will be initiated once the relevant criteria have been met (as defined in the Offshore Victoria OSMP). The EMT Environment Leader (or delegate) will contact the Monitoring Provider Program Manager who will initiate their response.

4.1.1 Immediate response

Once notified, the Monitoring Provider Program Manager will confirm the availability of Study Leads, and specific sampling and analysis plans (SAPs) will be prepared based on the requirements of the individual spill event. Based on initiated studies and SAPs, personnel, equipment and mobilisation will commence.

4.2 Roles and responsibilities

The key roles and responsibilities for implementation of the OSMP are defined in Table 3.1 of the Offshore Victoria OSMP.

Key personnel within Beach with OSMP responsibilities are listed in Table 4.1.

Table 4.1. Key Beach personnel for OSMP implementation

Role	Name	Contact Details
Emergency Management Team (EMT) Leader	As per the on-call EMT Roster (refer to OPEP for details)	
EMT Environment Leader	As per the on-call EMT Roster (refer to OPEP for details)	

The Monitoring Provider and associated personnel will be identified and activated on a case-by-case basis. RPS has confirmed they have a pool of suitably trained and competent personnel to utilise in the event of a Level 2 or Level 3 hydrocarbon spill event and have confirmed their capacity and availability for the duration of BassGas operations. The key personnel for the monitoring scopes are listed in Table 4.2. The availability of these personnel is reviewed by RPS on a monthly basis and submitted to Beach.

Table 4.2. Key monitoring provider personnel for OSMP implementation

Role	Name	Contact Details
Program Manager	Jeremy Fitzpatrick	08 9211 1111 jeremy.fitzpatrick@rpsgroup.com.au
Study Lead/s	Jeremy Fitzpatrick	08 9211 1111 jeremy.fitzpatrick@rpsgroup.com.au
	Dr Garnet Hooper	
	Dr Mike Mackie	
	Dr Matthew Fraser	
	Peter Crockett	
	Tamara Al-Hashimi	

4.3 Capability, training and competency

Table 4.3 details the capability assessment for the implementation of the OSMP studies. It identifies the minimum number of personnel to manage and implement the OSMP studies and platforms (vessel, aircraft or vehicles) required to perform the studies. The studies have been group where appropriate to ensure effective use of resources.

The number of resources identified is based on:

- The fact that in the event of a spill, the full EMBA will not be impacted as it represents multiple spill simulations (e.g., 100 simulations per spill scenario);
- Shoreline contact is predicted from a surface MDO release and pipeline rupture scenario but not from the LoWC scenario, with the section of coast between Kilcunda and Cape Paterson most at risk;
- Higher concentrations of hydrocarbon are spatially limited to the vicinity of the release location (i.e., at the moderate and high exposure thresholds, the predicted surface exposure is up to 13.2 km for MDO and 3.7 km for condensate); however it is noted that lower concentrations that require monitoring do extend beyond these distances; and
- It is unlikely that wildlife would be oiled within the offshore environment, but some oiling of wildlife may occur along the maximum predicted 11 km length of coast exposed to moderate (100 g/m^2) to high (>1,000 g/m^2) MDO loading thresholds and 4 km for the same condensate loading thresholds.

RPS has confirmed they have a pool of suitably trained and competent personnel to fulfil the requirements of the OSMP. The availability of these personnel is reviewed by RPS on a monthly basis and submitted to Beach.

4.4 Sampling and Analysis Plans for Scientific Monitoring

Study S1 (water quality) and S2 (sediment quality) have implementation times of 72 hours once the study has been activated (refer to Offshore Victoria OSMP). Due to the short implementation time, draft standard operating procedures (SOP) have been prepared and are attached as **Appendix B**.

As the implementation times for the other scientific studies are longer (4–5 days), specific SAPs including SOP will be developed post-event by the Monitoring Provider. These will be based on the details provided in the Offshore Victoria OSMP and made fit-for-purpose to the nature and scale of the actual spill event.

4.5 Study Logistics

All field logistics in regard to survey timing, scheduling and scope are subject to safe operating conditions in accordance with Beach (and/or their Monitoring Providers) health, environment and safety policies. This includes the requirements for any additional qualifications and training for field personnel (e.g., medicals, BOSIET, HUET, ADAS Level 2, Coxswains etc.)

4.6 Survey Schedule

Survey scheduling (in terms of locations and sampling order) will be at the discretion of the Study Lead taking into account existing and predicted oil distributions, proximity to environmental sensitivities and forecasted weather/sea state conditions.

4.7 Permits

The worst-case spill scenarios for BassGas operations may cover Commonwealth, Victorian, Tasmanian and New South Wales (NSW) state waters (depending on scenario). The permits generally required by the governments are listed in Table 4.4.

Permit applications require details on the samples to be collected (including timing, species, numbers, methods to be used etc.), and can take up to approximately six weeks for approval. However, in the event of a hydrocarbon spill, this process is likely to be expediated and/or given exemptions.

The Monitoring Provider will confirm the need for any permits during the development of an initial SAP once a spill event has occurred.

Table 4.3. OSMP capability needs assessment for BassGas operations

Scope Description	Operational / Scientific Study	Study Lead	Field / Office Personnel	Platform
Program Manager	All	One Program Manager: • Bachelor degree in environmental science/engineering (or equivalent) • >20 years' experience in environmental practice • Familiarity with OSMP and OPEP, as relevant	N/A	N/A
Oil, water and sediment sampling	O1: Oil characterisation and behaviour O2: Water quality O3: Sediment quality (offshore and intertidal) S1: Water quality impact assessment S2: Sediment quality impact assessment	One Study Lead: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Familiar with OSMP and OPEP, as relevant	Two vessel-based personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques • Familiar with oil, water and sediment sampling and recording techniques including in situ profiling). One of the vessel personnel: • Familiar with oil visual observations. Two office personnel: • Bachelor degree in environmental science/engineering or equivalent • > 5 years' experience in environmental practice • Experienced in water and sediment quality data analysis	One vessel
Fish tainting, impact and recovery	O6: Fish tainting S6: Fisheries impact assessment	One Study Lead: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Familiar with OSMP and OPEP, as relevant	One vessel-based person: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques (biological tissue sampling, sensory analysis) One vessel-based person: • Familiar with oil and water sampling and recording techniques (hydrocarbon sensory assessment, field biological tissue sampling) • Trained and/or experienced olfactory analysts	One vessel

Scope Description	Operational / Scientific Study	Study Lead	Field / Office Personnel	Platform
			One office person: • Bachelor degree in environmental science/engineering or equivalent • > 5 years' experience in environmental practice • Experience in analysis and interpretation of biota data	
Intertidal and subtidal habitat impact and recovery	S3: Subtidal habitats impact assessment S4: Intertidal and coastal habitats impact assessment	One Study Lead: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Familiar with OSMP and OPEP, as relevant	Four vessel-base personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Commercial dive qualifications • Experienced in the relevant sampling and/or recording techniques One vessel person: • Experienced in commercial ROV operations Two mainland personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques Two office personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in identification, analysis and interpretation of benthic habitat data and sediment quality data analysis	One vessel One vehicle
Coastal habitat impact and recovery	O3: Sediment quality (shoreline) S2: Sediment quality (shoreline) impact assessment S4: Intertidal and coastal habitats impact assessment	One Study Lead: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice Familiar with OSMP and OPEP, as relevant	Four mainland personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques Two of the mainland personnel: • Familiar with sediment sampling and recording techniques Two office personnel: • Bachelor degree in environmental science/engineering or equivalent	Two vehicles

Scope Description	Operational / Scientific Study	Study Lead	Field / Office Personnel	Platform
			• >5 years' experience in environmental practice Experienced in identification, analysis and interpretation of benthic habitat data and sediment quality data analysis	
Marine fauna surveillance, impact and recovery	O4: Marine fauna surveillance S5: Marine fauna impact assessment *Note:* *Aerial surveillance requirements are detailed within the 'Monitor and Evaluate' response within the OPEP* *Oiled, injured, and diseased fauna handling to be undertaken by trained personnel resources are detailed in 'Oiled Wildlife Response' within the OPEP*	Two Study Leads (one for seabirds/shorebirds and one for marine megafauna (marine mammals, sharks, reptiles)): • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Familiar OSMP and OPEP, as relevant	Four vessel-based personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques • Familiar with fauna observation and recording techniques One of the vessel-based personnel: • Familiar with tissue sampling, storage and preservation One of the vessel-based personnel: • Experienced with ROV/UVA scopes Four field personnel for seabird/shorebirds: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques Two office personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experience in identification, analysis and interpretation of biota data Two office personnel: • Experienced with remote sensing scopes	One Vessel Two vehicles
Heritage and socioeconomic	S7: Heritage and socioeconomic impact assessment	One Study Lead: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Familiar OSMP and OPEP, as relevant	Desktop Assessment - One office person: • Bachelor degree in environmental or social science or equivalent • >10 years' experience in environmental/social practice • Experienced in interpretation and management of heritage, social and economic data	N/A

Scope Description	Operational / Scientific Study	Study Lead	Field / Office Personnel	Platform
			Four vessel-based personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Commercial dive qualifications • Experienced in the relevant sampling and/or recording techniques One vessel-based person: • Experienced in commercial ROV operations Two mainland personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice • Experienced in the relevant sampling and/or recording techniques One office person: • Bachelor degree in environmental or social science or equivalent • >10 years' experience in environmental practice • Experienced in interpretation and management of heritage, social and economic data Two office personnel: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice	One Vessel Two vehicles

Table 4.4. Permits that may be required for scientific monitoring

Permit	Relevance	Legislation	Government Agency
Commonwealth			
General Permit Application for: • threatened species and ecological communities • migratory species • whales and dolphins • listed marine species	Required for matters for scientific sampling for matters listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)	EPBC Act	Department of Agriculture, Water and the Environment (DAWE)
Access to Biological Resources in a Commonwealth Area for Non-Commercial Purposes	An applicant must obtain written permission from each Access Provider. The Access Provider must state permission for the applicant to: • enter the Commonwealth area • take samples from the biological resources of the area • remove samples from the area	EPBC Act	DAWE
Victoria			
Application for a scientific permit to conduct research in areas managed under the *National Parks Act 1975*	Required for any research activity in marine and intertidal parks protected under Victorian legislation	*National Parks Act* 1975	Department of Environment, Land, Water and Planning (DELWP)
Application for a scientific permit	Required for any research involving fauna subject to the *Wildlife Act 1975*	*Wildlife Act* 1975	DELWP
Tasmania			
Application for a scientific permit to collect or disturb native fauna	A scientific permit is usually required for any research involving the collection or disturbance of protected wildlife, and the collection of protected wildlife products in Tasmania.	*Nature Conservation Act* 2002	Department of Primary Industries, Parks, Water and the Environment (DPIPWE)
Fishery Permit Application	A Fishery Permit Application is required for the taking of marine fish (including marine invertebrates) for scientific research.	*Living Marine Resources Management Act* 1995	DPIPWE
Animal Ethics Committee approval	If intending to take or disturb living vertebrate or higher invertebrate wildlife, then Animal Ethics Committee approval from a licensed institution is required.	*Animal Welfare Act* 1993	DPIPWE

Permit	Relevance	Legislation	Government Agency
New South Wales			
Scientific licence (biodiversity or species impact statement)	Several classes of scientific licences are required for activities ranging from research, surveying and education to collecting seeds, bush regeneration and ecological burns.	Biodiversity Conservation Act 2016	Department of Planning, Industry and Environment (DPIW)
Animal ethics approval	If the research involves animals, it may need to meet animal ethics obligations under the *Animal Research Act* 1985.	Animal Research Act 1985	DPIW

Appendix A Scientific Monitoring Priority Planning Area Summaries

A. 1. Punchbowl Coastal Reserve

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the reserve in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the reserve. If shoreline sampling is required, cross-shore beach profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	None.	N/A

A. 2. Kilcunda Coastal Reserve

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the reserve in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the reserve. If shoreline sampling is required, cross-shore beach profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Kilcunda Coastal Reserve Management Plan	No specific management actions

A. 3. Kilcunda – Harmers-Haven Coastal Reserve

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S1: Water quality impact assessment	Refer to Appendix B for SOP. Given location of the reserve in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from the coast and the adjacent waters. Sample design to be confirmed by Monitoring Provider prior to implementation.
	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the reserve in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the reserve. If shoreline sampling is required, cross-shore beach profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Bunurong MNP, Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve management plan	No specific management actions

A. 4. Bunurong MNP

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S1: Water quality impact assessment	Refer to Appendix B for SOP. Given location of MNP in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the MNP. Sample design to be confirmed by Monitoring Provider prior to implementation.
	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the MNP in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the MNP. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S4: Intertidal and coastal habitats impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides

Element	Description	
	S3: Subtidal habitats impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Bunurong MNP, Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve management plan	No specific management actions

A. 5. Bunurong Marine and Coastal Park

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S1: Water quality impact assessment	Refer to Appendix B for SOP. Given location of the park in relation to the spill source, a linear sampling design is considered appropriate, with samples taken along an inshore-offshore gradient and including samples from both within and external to the boundaries of the park. Sample design to be confirmed by Monitoring Provider prior to implementation.
	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the park in relation to the spill source, a linear / grid sampling design is considered appropriate, including samples from both within and external to the boundaries of the park. If shoreline sampling is required, cross-shore beach profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S4: Intertidal and coastal habitats impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Bunurong MNP, Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve management plan	No specific management actions

A. 6. Powlett River Estuary

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S1: Water quality impact assessment	Refer to Appendix B for SOP. Given location of estuary in relation to the spill source, a linear sampling design is considered appropriate, with samples taken from both within and external to the boundaries of the estuary. Sample design to be confirmed by Monitoring Provider prior to implementation.
	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the estuary in relation to the spill source, a linear sampling design is considered appropriate, with samples taken from both within and external to the boundaries of the bay. If shoreline sampling is required, cross-shore profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S4: Intertidal and coastal habitats impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Powlett River Estuary Management Plan	Pollution events listed as specific threat to the estuary, no associated management actions relevant to spills
	Approved Conservation for the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Change in water quality (although listed from other sources) is identified as a threat. No specific actions for a post-impact change in water quality listed. General activities to monitor changes in condition.
	Conservation Advice for Subtropical and Coastal Saltmarsh	Pollution from oil spill events are identified as a threat Actions for this TEC include identifying coastal saltmarsh as important habitat in all oil spill contingency planning and monitor the application of protocols on the management of spills involving saltmarshes

A. 7. Cape Liptrap Coastal Park

Element	Description	
Potential oil exposure	Shoreline, Entrained, Dissolved	
Priority scientific studies	S1: Water quality impact assessment	Refer to Appendix B for SOP. Given location of the park in relation to the spill source, a linear sampling design is considered appropriate, with samples taken from both within and external to the boundaries of the park. Sample design to be confirmed by Monitoring Provider prior to implementation.
	S2: Sediment quality impact assessment	Refer to Appendix B for SOP. Given location of the park in relation to the spill source, a linear sampling design is considered appropriate, with samples taken along an inshore-offshore gradient and including samples from both within and external to the boundaries of the park. If shoreline sampling is required, cross-shore profiles from intertidal to above high-water mark. Sample design to be confirmed by Monitoring Provider prior to implementation.
Other scientific studies that may be implemented at the site	S4: Intertidal and coastal habitats impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S5: Marine fauna impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
	S7: Heritage and socioeconomic impact assessment	SOP to be developed post-spill; refer to Offshore Victoria OSMP for relevant guides
Management Plans	Cape Liptrap Coastal Park Management Plan	No specific management actions

Appendix B Standard Operating Procedures for Water and Sediment Sampling

The Monitoring Provider will review and confirm/update these SOP to ensure they are fit for purpose for the nature and scale of the spill event prior to the SAP being finalised and sampling commencing.

B. 1. Water Sampling – Surface Waters

The number of water samples will be determined on an ad-hoc basis, depending on the nature of the spill, the distribution of the spill in relation to sensitive receivers, the availability of resources on site (i.e. vessel availability) and coordination with others responding to the spill (e.g., Australian Maritime Safety Authority, AMSA).

Triplicate seawater samples will be collected from impact and control sites. Surface water samples will be collected using a marine grade stainless steel bucket from an available support vessel. Subsurface water samples will be collected using Niskin bottles deployed to the appropriate sample depth. The appropriate sample depth should be determined on site in consultation with other agencies, with regard to the modelled distribution of entrained hydrocarbons and a consideration of potential sensitive receivers. Samples will be collected at a range of depths. As a minimum, samples will be collected from 0.5 m below the surface, 0.5 m above the seabed, and mid water column.

Surface water sampling should be conducted as per the following instructions:

1. Prior to deployment, liaise with the vessel crew to ensure that all personnel are familiar with the planned operation.
2. After reviewing the Decon 90 Material Safety Data Sheet (MSDS), clean the sampling bucket using Decon 90, ensuring you are wearing appropriate PPE, including:
    a. High visibility clothing
    b. Safety boots
    c. Personal Floatation Device (PFD) if working on the deck
    d. Hard hat (if working on the deck)
    e. Safety glasses
    f. Nitrile gloves.
3. Rinse the sample bucket thoroughly with deionised water once cleaned with Decon 90.
4. Confirm with the deck supervisor and vessel master that the vessel is on station and is prepared for sampling to proceed.
5. Ensure the sampling location is free of potential sources of contamination, including:
    a. Grease and oils
    b. Overhead wires
    c. Exhaust fumes (e.g., incinerators, engine exhaust, cigarette smoke, etc.)
    d. Vessel discharges (e.g., ballast water, grey water, sullage, etc.)
6. Ensure the sampling location is free of entanglement risks (e.g., propellers, thrusters, etc.).
7. Ensure the sampling location is safe (guard rails in place, life ring available), and that weather conditions are suitable for sampling.
8. Prepare the sample containers by labelling them appropriately and completing any required field documentation.
9. Ensure one end of the rope is securely attached to the sampling bucket and the other end to the vessel.
10. Lower the bucket into the water, let the bucket fill and haul it back on board.
11. Once the sample is on board, put on a clean pair of nitrile gloves and collect the water samples using the laboratory sample containers provided. Attempt to collect primarily water in the larger bottles and primarily oil in the smaller bottle. Do not sample rinse the bottles and cap them immediately upon collecting the sample.
12. Once collected, ensure that samples are clearly labelled and stored in the refrigerator.
13. Clean the sampling bucket using Decon 90 (see item 2 above for details) and rinse with deionised water.

B. 2. Water Sampling – Subsurface Waters

Subsurface water sampling will be conducted using Niskin bottles, deployed at appropriate depths. The three 10 L Niskin bottles have Teflon coating and external springs making them suitable for trace and heavy metals and hydrocarbons. The number of Niskin bottles casts and the amount of bulk water needed will depend on the sampling design. Ensure all staff review and sign the water quality sampling JHA.

Niskin samples will be collected in accordance with the following procedure:

1. Prior to deployment, liaise with the vessel crew to ensure that all personnel are familiar with the planned operation.
2. After reviewing the Decon 90 MSDS, clean the Niskin bottles using Decon 90, ensuring you are wearing appropriate PPE, including:
    a. High visibility clothing
    b. Safety boots
    c. PFD if working on the deck
    d. Hard hat (if working on the deck)
    e. Safety glasses
    f. Nitrile gloves
3. Rinse the Niskin bottles thoroughly with deionised water once cleaned with Decon 90. If possible, fill the Niskin bottles with uncontaminated seawater and allow then to sit prior to sampling.
4. Confirm with the deck supervisor and vessel master that the vessel is on station and is prepared for sampling to proceed.
5. Ensure the sampling location is free of potential sources of contamination, including:
    a. Grease and oils
    b. Overhead wires
    c. Exhaust fumes (e.g. incinerators, engine exhaust, cigarette smoke etc.)
    d. Vessel discharges (e.g. ballast water, grey water, sullage, etc.).
6. Ensure the sampling location is free of entanglement risks (e.g. propellers, thrusters, etc.).
7. Ensure the sampling location is safe (guard rails in place, life ring available), and that weather conditions are suitable for sampling.
8. Ensure one end of the rope is securely attached to the sampling bucket and the other end to the vessel.
9. Ensure the winch line is clean, smooth and has no broken wires or other things that could obstruct the messenger going down the line.
10. Attach the clump weight to the end of the winch line, approx. 10 – 20 kg (consider current at site).
11. Attach the bottom or deepest bottle 1.5–3 m above the weight.
12. Ensure top air bleed is closed, nozzle is pulled out and the bottle is open or set to sample.
13. Before firing the bottles at depth, allow the bottles to flush with sea water for 1–2 minutes at the sample depth.
14. Send the messenger down the line with enough force that it is going to travel directly down the line.
15. You can keep your hand on the line to feel each bottle close. You should be able to feel a tug on the line as the bottle fires.
16. Raise winch line slowly to retrieve bottles.
17. Take care when removing bottles from the winch line as they will be heavy and care should be taken not too accidently open the bottles.
18. Decant sea water from the Niskin bottle directly into sample containers.
19. When using carboys, carboys should be rinsed three times with a small amount of the sample water prior to filing with the sample.
20. Prepare the sample containers by labelling them appropriately and completing any required field documentation.
21. Lower the bucket into the water, let the bucket fill and haul it back onboard.

22. Once the sample is onboard, put on a clean pair of nitrile gloves and collect the water samples using the laboratory sample containers provided. Attempt to collect primarily water in the larger bottles and primarily oil in the smaller bottle. Do not sample rinse the bottles and cap them immediately upon collecting the sample.
23. Once collected, ensure samples are clearly labelled and stored in a refrigerator.
24. Clean the sampling bucket using Decon 90 (see item 2 for details) and rinse with deionised water.

B. 3. Sediment Sampling

Sediment samples will be collected using a van Veen sediment grab (or similar sediment sampling device). Prior to taking a grab sample, clean the grab using detergent and a scrubbing brush. Be sure to remove any material adhering to the grab. Ensure all staff review and sign the grab sampling JHA. Sediment samples will be collected in accordance with the following procedure:

Note that the vessel crew will operate the grab with assistance from RPS staff and the winch will be operated by vessel crew. Prior to taking a grab sample, clean the grab using detergent and a scrubbing brush. Be sure to remove any material adhering to the grab.

1. Prior to deployment, liaise with the vessel crew to ensure that all personnel are familiar with the planned operation and that clear lines of communication are available.
2. Prepare the grab on the deck, making sure it is securely attached to the vessel winch cable. Mouse any shackles to ensure pin does not come undone under load. Be VERY careful around the grab - always keep clear of the grab jaws. Assume that they may trigger at any time.
3. Take care when the grab is off the deck. NEVER stand under the grab. Check all shackles, etc. before lifting grab off deck. Use strops if required to stabilise the grab.
4. Lower the grab to the seabed, it will trigger when the cable goes slack.
5. Bring the grab to the surface and ensure the sample is sufficient. If the grab begins to swing, lower the grab into the sea to dampen the motion.
6. Open the jaws of the grab slightly to allow emptying of surplus water from the sediment sample but try not to let the fine sediments wash away.
7. Once drained of all free water, open grab completely and empty contents onto a tarpaulin on the deck. Note: due to the mechanics of the grab when opening, surface sediments may be concentrated towards the middle of the sample.
8. Collect a sample of the surface sediments by scraping the 250 ml sample jars through the sediments. Be mindful of contamination sources and ensure that all staff handling samples are wearing clean nitrile gloves.
9. Securely stow the grab onboard when not in use.

B. 4. Cleaning and Care

Niskin bottles should be cleaned with Decon 90 before the sampling trip. Once in the field the bottles should be soaked in sea water. This can be done by attaching the Niskin bottles to the winch line and lowering off the vessel. If time permits, allow the bottles to soak for at least one hour. Avoid touching the internal parts of the Niskin bottle or sampling bucket. Ideally Niskin bottles should be stored upright in racks on the vessel. Take care to store equipment away from potential sources of contamination.

B. 5. Chain of Custody

All samples submitted for analysis will be accompanied by a Chain of Custody (CoC) form. The CoC form will accompany samples during transport and delivery. The form will be signed with the time and date recorded by each individual responsible for the samples including RPS staff and laboratory personnel. Upon each exchange, the CoC form is countersigned and duplicated by the relinquisher. The recipient retains the original. When samples are received by the

laboratory, a duplicate of the original will be issued to RPS confirming arrival. The CoC allows RPS to track the samples and ensure that samples arrive at the intended destinations on schedule.

B. 6. Sample Transport and Storage

Water and sediment samples should be transported as soon as practicable to a nominated laboratory (refer to the OSMP Implementation Plan) in appropriate containers (eskies) with ice bricks. The holding times for all samples are 7 days. Samples must be provided to the analytical laboratory within this time period. Liaise with RPS staff regarding sample transport, etc., as outlined in the personnel section of the OSMP Implementation Plan.

The proposed analyses to be undertaken by the primary analytical laboratory are total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) for both sediments and water.