SO-00-BI-20003.02

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Bedout Multi-Well Drilling Oil Pollution Emergency Plan

PROJECT / FACILITY	Bedout Multi-Well
REVIEW INTERVAL	60 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s Managerial/Technical/Site	Approver
0	Senior Oil Spill Response Coordinator	Team Leader – Security & Emergency Response Emergency Response Coordinator	7/4/21 Manager – HSE Offshore Division

Any hard copy of this document, other than those identified above, are uncontrolled. Please refer to the Santos Offshore Document Management System for the latest revision.

REV No	DATE	Author/Editor	Amendment
A	08/02/2021	Consultant/Santos	Internal review
B	03/03/2021	Consultant/Santos	Internal review
0	7/4/2021	Santos	Submitted to NOPSEMA

Distribution	Oil Pollution Emergency Plan	
	Electronic	Hardcopy
Intranet – Emergency Preparedness	link only	
Manager – HSE Offshore Division	link only	
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IMT Room – Perth office		● x 4
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DoT	●	
AMSA	●	
OSRL	●	

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List of Acronyms

Abbreviation	Description
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre Pty Ltd
AMP	Australian Marine Park
AMSA	Australian Marine Safety Authority
APASA	Asia-Pacific Applied Sciences Associates
APPEA	Australian Petroleum Production & Exploration Association
API	American Petroleum Institute
BAOAC	Bonn Agreement Oil Appearance Codes
C&R	containment and recovery
CHARM	chemical hazard and risk management
CMT	Crisis Management Team
CSR	company site representative
DBCA	Department of Biodiversity, Conservation and Attractions
DFAT	Department of Foreign Affairs and Trade
DISER	Department of Industry, Science, Energy and Resources
DMIRS	Department of Mines, Industry Regulation and Safety
DoE	(Australian) Department of the Environment (now Department of the Environment and Energy)
DOR	dispersant to oil ratio
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environment Regulation
EMBA	environment that may be affected
EP	Environment Plan
ER	emergency response
EVPO	Executive Vice President Offshore
FOB	forward operating base
FPSO	floating production, storage and offloading vessel
FWADC	fixed wing aerial dispersant capability
GIS	geographic information system
GPS	global positioning system

Abbreviation	Description
HMA	Hazard Management Agency
HR	human resources
IAP	Incident Action Plan
ICC	incident command centre
IMT	Incident Management Team
IR	industrial relations
IUCN	International Union for Conservation of Nature
LAT	lowest astronomical tide
LOWC	loss of well control
MARPOL	International Convention for the Prevention of Pollution from Ships
MEECC	Maritime Environmental Emergency Coordination Centre
MEER	Maritime Environmental Emergency Response
MNES	matters of national environmental significance
MODU	mobile offshore drilling unit
MoU	Memorandum of Understanding
MP	marine park
MSA	Master Services Agreement
MSP	monitoring service providers
N	North
NatPlan	National Plan for Maritime Environmental Emergencies
NEBA	net environmental benefit analysis
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NW	north west
OPEP	Oil Pollution Emergency Plan
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSC	on-scene commander
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response
PPA	Priority Protection Area
PS	people services
S	South
SCP	Source Control Plan

Abbreviation	Description
SDA	surface dispersant application
SFRT	Subsea First Response Toolkit
SHP-MEE	State Hazard Plan for Maritime Environmental Emergencies
SIMA	spill impact mitigation assessment
SMP	Scientific Monitoring Plan
SMPC	State Marine Pollution Coordinator
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plans
SSDI	Subsea dispersant injection
SW	South West
TRP	Tactical Response Plan
UAV	unmanned aerial vehicle
VI	Varanus Island
VOC	volatile organic compound
VOO	vessels of opportunity
W	West
WA	Western Australia
WAOWRP	Western Australian Oiled Wildlife Response Plan
WOMP	Well Operation Management Plan
WSP	waste service provider
WWC	Wild Well Control

1 Quick Reference Information

<table>
<tr><th>Parameter</th><th colspan="3">Description</th><th>Further Information</th></tr>
<tr><td>Petroleum Activity</td><td colspan="3">Drilling of up to 12 wells in permit areas WA-437-P, WA-438-P, WA-541-P (all Commonwealth Waters). Drilling to be performed using a jack-up mobile offshore drilling unit (MODU), with auxiliary activities including support vessels, helicopters and ROV</td><td>Section 2 of the Environment Plan (EP)</td></tr>
<tr><td rowspan="3">Location (Lat/Long)</td><td colspan="3"><u>Bedout West</u>
Latitude: 19°24'08.7" (S)
Longitude: 117°55'44.6" (E)</td><td rowspan="3">Table 3-1 of the EP</td></tr>
<tr><td colspan="3"><u>Bedout North</u>
Latitude: 18° 46' 32.1" (S)
Longitude: 118°59'55.9" (E)</td></tr>
<tr><td colspan="3"><u>Bedout South</u>
Latitude: 19°27'40.9" (S)
Longitude: 119°19'42.3" (E)</td></tr>
<tr><td>Petroleum Title/s (Blocks)</td><td colspan="3">WA-437-P, WA-438-P, WA-541-P (all Commonwealth waters)</td><td></td></tr>
<tr><td>Installation Type</td><td colspan="3">Exploration and appraisal wells</td><td>Section 2 of the EP</td></tr>
<tr><td>Water Depth</td><td colspan="3">30 to 110 m</td><td>N/A</td></tr>
<tr><td rowspan="4">Worst-case Spill Scenarios</td><td>Scenario</td><td>Hydrocarbon</td><td>Worst-case volume (m³)</td><td rowspan="4">Section 6.1</td></tr>
<tr><td>Loss of well control (LOWC) (subsea release)</td><td>Caley Condensate</td><td>2,083,121</td></tr>
<tr><td>LOWC (surface release)</td><td>Caley Condensate</td><td>2,049,258</td></tr>
<tr><td>Surface diesel release (surface spill)</td><td>Marine Diesel Oil (MDO)</td><td>329</td></tr>
<tr><td>Hydrocarbon Properties</td><td colspan="3"><u>Caley Condensate</u> [1,2]
Specific gravity = 0.7735
Dynamic viscosity (cSt) = 1.878 @ 20° C
American Petroleum Institute (API) Gravity = 51.4
<u>Marine Diesel Oil</u>
Density kg/m³ at 25°C = 829
Dynamic viscosity (cP) = 3.9 @ 20° C
API Gravity = 37.6</td><td>Appendix A</td></tr>
</table>

Parameter	Description	Further Information
Weathering Potential	Caley Condensate [1,2] is a heavy condensate with a moderate degree of persistence in the marine environment. Under moderate winds (5 m/s), 62% of the initial surface slick is predicted to evaporate within 48 hours, with the remaining 38% dispersing into the water column within 78 hours. MDO is a mixture of volatile and persistent hydrocarbons with low viscosity. It will spread quickly and thin out to low thickness levels, thereby increasing the rate of evaporation. Up to 60% will generally evaporate over the first two days. Approximately 5% is considered "persistent hydrocarbons", which are unlikely to evaporate and will decay over time.	**Appendix A**
Protection Priorities	Ashmore Reef Australian Marine Park (AMP), Barrow Island, Bedout Island, Clerke Reef Marine Park (MP), Dampier Archipelago, Eighty Mile Beach, Exmouth Gulf Coast, Imperieuse Reef MP, Lowendal Islands, Montebello Islands, Muiron Islands and Ningaloo Coast North	**Section 6.6**

[1] *Caley Condensate has also been referred to as 'Caley Condensate' and 'Caley Crude' (Intertek 2020) however the properties of the hydrocarbon are more aligned to a condensate.*

[2] *LAVRANS condensate was used as a modelling analogue for Caley Condensate.*

2 First Strike Response Actions

The initial response actions to major oil spill incidents will be undertaken by the relevant Vessel Master or the Offshore Installation Manager, depending on the nature of the incident (vessel or MODU based).

If the spill is related to the MODU, the rig Offshore Installation Manager (hereafter referred to as the On-Scene Commander or OSC) will be notified, or in the case of a support vessel, the Vessel Master will be notified.

Following those initial actions undertaken by the On-Scene Commander or Vessel Master to ensure the safety of personnel on the vessel or MODU, and to control the source of the spill, the Santos Company Site Representative will assess the situation based on:

+ What has caused the spill?
+ Is the source under control?
+ What type of hydrocarbon has been spilled?
+ How much has been spilled?

For spills from support vessels, initial response actions to major incidents are under the direction of the Vessel Master and in accordance with vessel-specific procedures (e.g., Shipboard Oil Pollution Emergency Plans (SOPEPS)).

Response information contained within this Oil Pollution Emergency Plan is concerned primarily with a large scale (Level 2/3) hydrocarbon spill where the Perth-based Incident Management Team (IMT) and Santos Crisis Management Team (CMT) are engaged for support and implementation of response strategies. Level 1 spills are managed through on-site response and IMT is available to assist with regulatory requirements/notifications and support as required. Therefore, the immediate response actions listed in **Table 2-1** are relevant for any spill. Once sufficient information is known about the spill, the Incident Commander will classify the level of the spill. If the spill is classified as a Level 1 spill, then the actions related to Level 2/3 spills do not apply, unless specified by the Incident Commander.

Table 2-1: First strike activations

When (indicative)	Activations		Who
	Objective	Action	
All spills			
Immediate	Manage the safety of personnel	Implement site incident response procedures (MODU Operator's Emergency Response Plan and Santos MODU Operator Emergency Response Bridging document) or vessel-specific procedures, as applicable	On-Scene Commander/Vessel Master
Immediate	Control the source using site resources, where possible	Control the source using available onsite resources (MODU/vessel) Refer to source control plan – **Section 9**	On-Scene Commander/Vessel Master
30 minutes of incident being identified	Notify Santos Offshore Duty Manager	Verbal communication to Offshore Duty Manager's duty phone	On-Scene Commander via the Company Site Representative (CSR)
As soon as practicable	Obtain as much information about the spill as possible	Provide as much information to the IMT (Incident Commander or delegate) as soon as possible	On-Scene Commander via CSR
60 minutes	Gain situational awareness and begin onsite spill surveillance	If spill reaches marine waters gain further situational awareness by undertaking surveillance of the spill from vessel or MODU Refer to Monitor and Evaluate Plan – **Section 10**	On-Scene Commander via CSR Incident Commander
Refer timeframes Go to **Section 7**	Make regulatory notifications within regulatory timeframes	Activate the External Notifications and Reporting Procedures – **Section 7**	Initial notifications by Environment/ Safety Team Leads – **Table 7-1**

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When (indicative)	Activations		Who
	Objective	Action	
Level 2/3 spills (in addition to actions above)			
Immediately once notified of spill (to Incident Commander)	Activate IMT, if required	Notify IMT	Duty Manager Incident Commander
IMT actions (0 to 48 hours)			
Within 90 minutes from IMT callout	Set-up IMT room	Refer to IMT tools and checklists for room and incident log set-up	Incident Commander IMT Data Manager
	Gain situational awareness and set incident objectives, strategies and tasks	Begin reactive Incident Action Planning process Go to **Section 8** Review First Strike Activations (this table)	Incident Commander Planning Team Leader
Refer timeframes **Section 7**	Make regulatory notifications as required Notify and mobilise/put on standby external oil spill response organisations and support organisations, as required	Go to **Section 7**	Initial notifications by Environment/ Safety Team Leads Oil Spill Response Organisations (Australian Marine Oil Spill Centre [AMOSC] and Oil Spill Response Ltd [OSRL]) activation by designated call-out authorities (Incident Commanders/Duty Managers)

When (indicative)	Activations		Who
	Objective	Action	
Refer timeframes **Section 10**	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making	Vessel Surveillance (**Section 10.1**) Aerial Surveillance (**Section 10.2**) Tracking Buoys (**Section 10.3**) Oil Spill Trajectory Modelling (**Section 10.4**) Initial Oil Characterisation (**Section 10.6**) Operational Water Quality Monitoring (**Section 10.7**) Shoreline and Coastal Habitat Assessment (**Section 10.8**)	IMT Operations Team Leader IMT Logistics/Supply Team Leaders IMT Environment Team Leaders
Activate on Day 1 for applicable scenarios	Source control support to stop the release of hydrocarbons into the marine environment. **Degree of IMT support will be scenario-dependent**	Go to **Section 9**	IMT Operations Team Leader (IMT Drilling Team Leader as appropriate to scenario) IMT Logistics/Supply Team Leaders
Activate on Day 1 for applicable scenarios Refer **Section 12** and **13**	Reduce exposure of shorelines and wildlife to floating oil through mechanical/ chemical dispersion	For Caley Condensate spills: Activate the Mechanical and/or Chemical Dispersion Plan Go to **Section 12** and/or **13**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders
Activate on Day 1 for applicable scenarios Refer **Section 11**	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Activate the Containment and Recovery Plan Go to **Section 11**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders
Day 1	Identify environmental sensitivities at risk and conduct Net Environmental Benefit Analysis (NEBA)	Review situational awareness and spill trajectory modelling Review strategic NEBA and begin operational NEBA (**Section 6.7**)	IMT Environmental Team Leader

When (indicative)	Activations		Who
	Objective	Action	
Day 1	Develop forward operational base/s to support forward operations	Begin planning for forward operations base as per Forward Operations Plan. **Appendix Q**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders
Day 1	Ensure the health and safety of spill responders	Identify relevant hazards controls and develop hazard register Begin preparation Site Health and Safety Management requirements Refer Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016)	IMT Safety Team Leader
If/when initiated Refer **Section 14**	Protect identified shoreline protection priorities	Activate the Shoreline Protection and Deflection Plan Go to **Section 14**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders IMT Environment Team Leader
If/when initiated Refer **Section 16**	Prevent or reduce impacts to wildlife	Activate the Oiled Wildlife Response Plan Go to **Section 16**	IMT Environment Team Leader IMT Operations Team Leader IMT Logistics/Supply Team Leaders
If/when initiated Refer **Section 18**	Assess and monitor impacts from spill and response	Activate the Scientific Monitoring Plan Go to **Section 18**	IMT Environment Team Leader IMT Logistics/Supply Team Leaders IMT Operations Team Leader
If/when initiated	Clean-up oiled shorelines	Activate Shoreline Clean-Up resources Go to **Section 15**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders
If/when initiated	Safely transfer, transport and dispose of waste collected from response activities.	Activate the Waste Management Plan. Go to **Section 17**	IMT Operations Team Leader IMT Logistics/Supply Team Leaders

When (indicative)	Activations		Who
	Objective	Action	
IMT Actions (48+ hours)			
Ongoing	+ For ongoing incident management – indicatively 48 + hours – a formal incident action planning process is to be adopted to continue with spill response strategies identified above. An Incident Action Plan (IAP) is to be developed for each successive operational period. + Santos will maintain control for those activities for which it is the designated Control Agency/Lead IMT. + Depending on the specifics of the spill, Australian Maritime Safety Authority (AMSA) and/or Western Australia (WA) Department of Transport (DoT) may be relevant Control Agencies (refer **Section 4.2**). + Where another Control Agency has taken control of aspects of the response, Santos will provide support to that Control Agency. Santos' support to DoT for a State waters response is detailed in **Section 5.2.3**.		Control Agency IMT Santos to provide the following roles to DoT MEECC/IMT for State waters response: CMT Liaison Officer Intelligence Support Officer Deputy Planning Officer Environmental Support Officer Public Information Support & Media Liaison Officer Deputy Logistics Officer Facilities Support Officer Deputy Finance Officer Deputy On-Scene Commander (Forward Operating Base [FOB])

3 Introduction

This document is the accompanying Oil Pollution Emergency Plan (OPEP) to the *Bedout Multi-Well Drilling Environment Plan* (*SO-00-BI-20003*) required by Regulation 14(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations).

3.1 Description of activity

Santos proposes to drill up to 12 exploration and/or appraisal wells throughout the Bedout Multi-Well Drilling Operational Area, located in permit areas WA-437-P, WA-438-P, WA-541-P (all Commonwealth Waters) (**Figure 3-1**).

The Operational Area is wholly within Commonwealth Waters of the Bedout Basin (a sub-basin of the Roebuck Basin) in the NW Shelf region of Western Australia. Water depths in the Operational Area range from approximately 30 m to 110 m.

Drilling will be undertaking using a jack-up MODU, with auxiliary activities including support vessels and helicopters. Specific activities will include well evaluation, well testing and abandonment activities related to exploration and appraisal drilling. A 500 m circular exclusion zone will be applied around the MODU centred at the rig's surface location, with only one MODU operating in the exclusion zone at any point in time (multiple support vessels and helicopters may be operating in the same area at any one time).

Refer to Section 2 of the Bedout Multi-Well Drilling EP (SO-00-BI-20003) for detail on the activity.

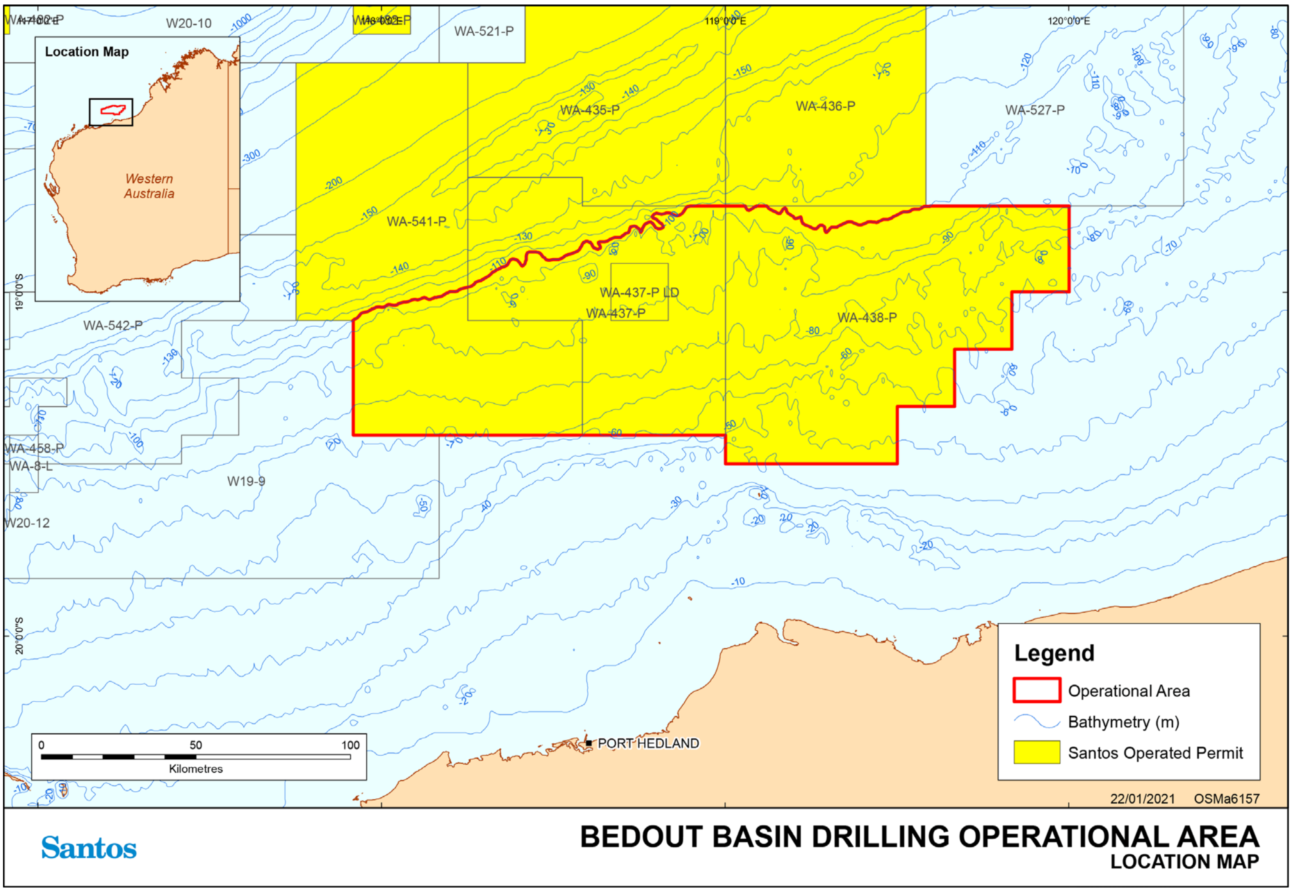

Figure 3-1: Location of the Bedout multi-well drilling operational area

3.2 Purpose

The purpose of this OPEP is to describe Santos' response to a hydrocarbon spill during Bedout Multi-Well Drilling activities.

This OPEP has been developed to meet all relevant requirements of the Commonwealth (OPGGS (E) Regulations. It is consistent with the national and State (WA) systems for oil pollution preparedness and response, being the National Plan for Maritime Environmental Emergencies (NatPlan) managed by AMSA and the WA State Hazard Plan for Maritime Environmental Emergencies (SHP-MEE).

This OPEP is to be read in conjunction with the Bedout Multi-Well Drilling EP (SO-00-BI-20003) when considering the existing environment, environmental impacts, risk management, performance standards and the reporting compliance requirements.

This OPEP will apply from acceptance of the Santos Bedout Multi-Well Drilling EP (SO-00-BI-20003) and will remain valid for the duration of life of the EP.

The response strategies outlined in this OPEP have been developed by Santos utilising risk assessments to identify credible worst case hydrocarbon spill scenarios, expected/calculated release rates, known information of hydrocarbon types and behaviour, and expected partitioning of the hydrocarbon within the marine environment with an estimate of the volume of persistent oil. This information has been modelled to give a theoretical zone of dispersion that is used to identify potential sensitive receptors and response strategies required to reduce the consequences of a spill to 'as low as reasonably practicable' (ALARP). The response strategies are identified under a NEBA process so the most effective response strategies with the lowest environmental consequences can be identified, documented and prepared for.

3.3 Objectives

The aim of this OPEP is to provide detailed guidance to Santos' IMT, so that it will direct its response effort with the aim of preventing long term significant environmental impacts by safely limiting the adverse environmental effects from an unplanned release of hydrocarbons to the marine environment to a level that is ALARP. This will be achieved through the implementation of the various strategies and spill response mechanisms presented throughout this OPEP. Through their implementation, Santos will:

+ initiate spill response immediately following a spill
+ establish source control as soon as reasonably practicable to minimise the amount of oil being spilt into the environment
+ assess the spill characteristics and understand its fate in order to be able to make informed and clear response decisions
+ monitor the spill to identify the primary marine and coastal resources requiring protection
+ remove as much oil as possible from the marine environment while keeping environmental impacts from the removal methods to ALARP
+ reduce the impacts of the remaining floating and stranded oil to ALARP
+ respond to the spill using efficient response strategies that do not damage the environment themselves
+ comply with all relevant environmental legislation when implementing this OPEP
+ conduct all responses safely without causing harm to participants
+ monitor the impacts from a spill until impacted habitats have returned to baseline conditions
+ remain in a state of 'Readiness' at all times for implementation of this OPEP by keeping resources ready for deployment, staff fully trained and completing response exercises as scheduled
+ keep stakeholders informed of the status of the hydrocarbon spill response to aid in the reduction of social and economic impacts.

3.4 Area of operation

The Bedout Multi-Well Drilling EP (SO-00-BI-20003) is located within petroleum permit areas WA-437-P, WA-438-P and WA-541-P, all of which are located in Commonwealth Waters. The nearest landmass to the Operational Area is Bedout Island, located approximately 10 km south, with the nearest significant landmass, De Grey River-mouth, located approximately 50 km south of the Operational Area. Port Hedland and Karratha are located 99 km south and 182 km southwest of the Operational Area respectively (see **Figure 3-2**). Water depths in the Operational Area range between 30 m and 110 m.

Section 3 of the Bedout Multi-Well Drilling EP (SO-00-BI-20003) includes a comprehensive description of the existing environment. A summary of nearest regional features and distances from Operational Area are provided in **Table 3-1**.

Table 3-1: Approximate distances from operational area to key regional features

Regional Feature	Approximate Distance from Operational Area
Ningaloo Marine Park (IUCN II)	578 km SW
Eighty Mile Beach Marine Park	0.15 km S
State/Commonwealth waters boundary	40 km S/352 km N
Muiron Islands Marine Management Area (IUCN VI)	268 km W
Barrow Island Marine Park	304 km SW
North West Cape (Mainland WA)	472 km SW
Exmouth (Mainland WA)	484 km SW

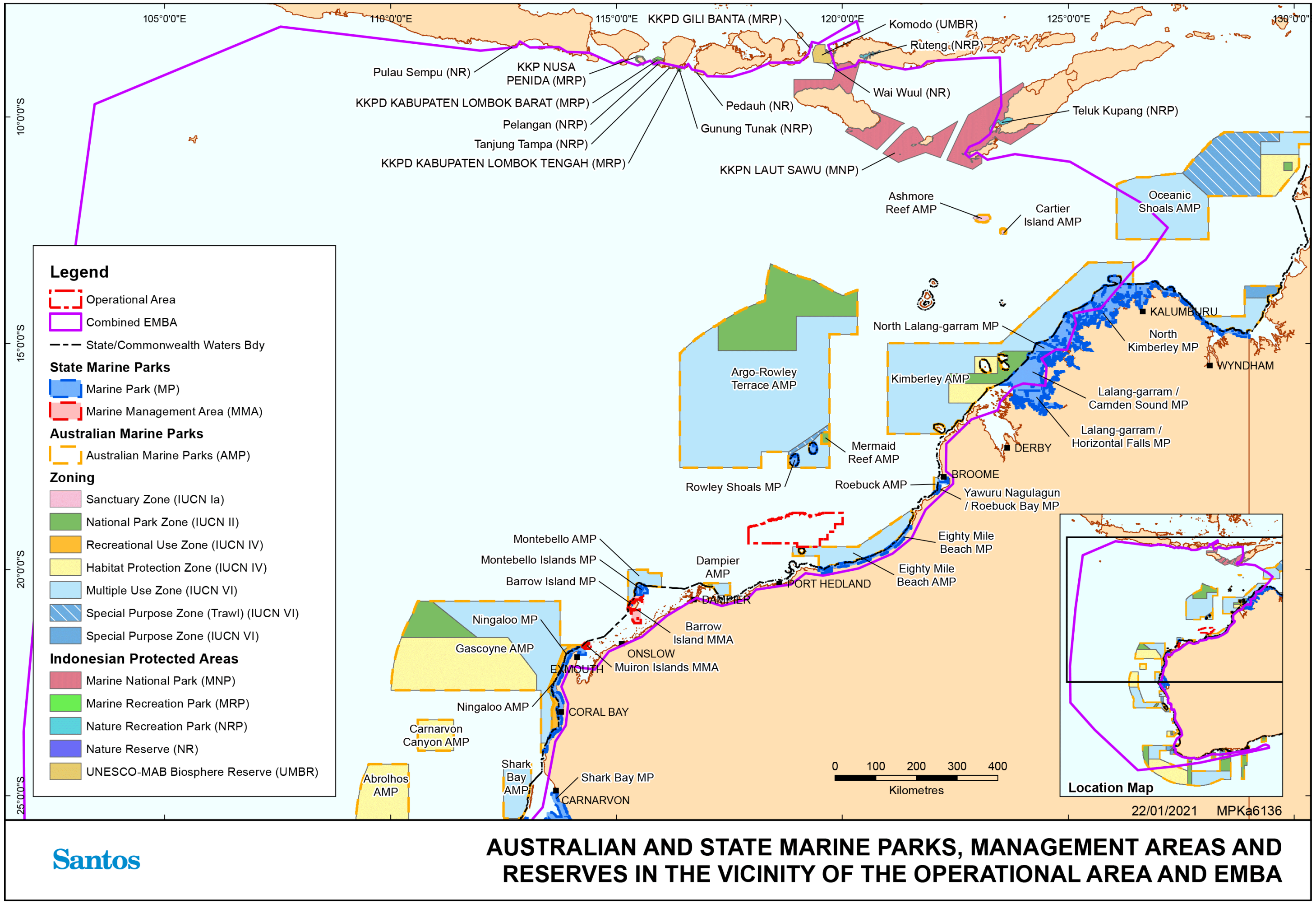

Figure 3-2: Bedout multi-well drilling location map and regional features

3.5 Interface with internal documents

In addition to this OPEP, a number of other Santos documents provide guidance and instruction relevant to spill response, including:

+ Incident Command & Management Manual (SO-00-ZF-00025)
+ Bedout Multi-Well Drilling Environment Plan (SO-00-BI-20003.01)
+ MODU Operator's Emergency Response Plan
+ Santos-MODU Operator Emergency Response Bridging Document
+ Incident Response Telephone Directory (SO-00-ZF-00025.020)
+ Refuelling and Chemical Management Standard (SO-91-IQ-00098)
+ Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001)
+ Well-Specific or Campaign Source Control Plan
+ Oil Pollution Waste Management Plan (SO-91-IF-10053)
+ Oil Spill Response Health and Safety Manual (SO-91-RF-10016)
+ Oil Spill Scientific Monitoring Plan (EA-00-RI-10099)
+ Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)
+ Oil Spill Scientific Monitoring Baseline Data Review (SO-00-BI-20001)
+ Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001).

Relevant Tactical Response Plans are made available within the 'First Strike Resources' folder within the Offshore Emergency Response on Santos intranet site.

4 Oil Spill Response Framework

4.1 Spill response levels

Santos uses a tiered system of incident response levels consistent with State and National incident response plans including SHP-MEE and the NatPlan. Spill Response Levels help to identify the severity of an oil spill incident and the level of response required to manage the incident and mitigate environmental impacts. Incident response levels are outlined within the Santos Incident Command and Management Manual (SO-00-ZF-00025) and further detailed in **Table 4-1** for hydrocarbon spills.

Table 4-1: Santos oil spill response levels

<table>
<tr><th colspan="2">Level 1</th></tr>
<tr><td colspan="2">An incident which will not have an adverse effect on the public or the environment which can be controlled by the use of resources normally available onsite without the need to mobilise the Santos IMT or other external assistance.</td></tr>
<tr><td>Oil is contained within the incident site.
Spill occurs within immediate site proximity.
Discharge in excess of permitted oil in water (OIW) content (15 ppm).
Incident can be managed by the Emergency Response Team and its resources.</td><td>Source of spill has been contained.
Oil is evaporating quickly and no danger of explosive vapours.
Spill likely to naturally dissipate.
No media interest/not have an adverse effect on the public.</td></tr>
<tr><th colspan="2">Level 2</th></tr>
<tr><td colspan="2">An incident that cannot be controlled by the use of onsite resources alone and requires external support and resources to combat the situation; or
An incident that can be controlled onsite but which may have an adverse effect on the public or the environment.</td></tr>
<tr><td>Danger of fire or explosion.
Possible continuous release.
Concentrated oil accumulating in close proximity to the site or vessel.
Potential to impact other installations.</td><td>Level 1 resources overwhelmed, requiring additional regional resources.
Potential impact to sensitive areas and/or local communities.
Local/national media attention/may adversely affect the public or the environment.</td></tr>
<tr><th colspan="2">Level 3</th></tr>
<tr><td colspan="2">An incident which has a wide-ranging impact on Santos and may require the mobilisation of external state, national or international resources to bring the situation under control.</td></tr>
<tr><td>Loss of well integrity.
Actual or potentially serious threat to life, property, industry.
Major spill beyond site vicinity.
Significant shoreline environmental impact.</td><td>Level 2 resources overwhelmed, requiring international assistance.
Level 3 resources to be mobilised.
Significant impact on local communities.
International media attention.</td></tr>
</table>

4.2 Jurisdictional authorities and control agencies

During a spill response there will be both a Jurisdictional Authority and a Control Agency assigned to the oil spill incident for all spill response levels.

Definitions of Jurisdictional Authority and Control Agency are as follows:

+ Control Agencies: the organisation assigned by legislation, administrative arrangements or within the relevant contingency plan, to control response activities to a maritime environmental emergency. Control Agencies have the operational responsibility of response activities, but may have arrangements in place with other parties to provide response assistance under their direction.
+ Jurisdictional Authority: the agency which has responsibility to verify that an adequate spill response plan is prepared and, in the event of an incident, that a satisfactory response is implemented. The Jurisdictional Authority is also responsible for initiating prosecutions and the recovery of clean-up costs on behalf of all participating agencies.

With respect to a hydrocarbon spill from Bedout Multi-Well Drilling activities, the relevant Jurisdictional Authority and Control Agency varies dependent upon the location of the oil pollution (Commonwealth or State waters), the nature of the incident (vessel based or petroleum activity) and the spill response level (refer **Table 4-2**).

To aid in the determination of a vessel versus a facility spill, the following guidance is adopted:

+ A vessel is a ship at sea to which the *Navigation Act 2012* applies.
+ A facility is a petroleum facility as defined under the OPGGS Act, Volume 3, Schedule 3, Part 1, Clause 4 & Volume 2, Part 6.8, Section 640.

Table 4-2: Jurisdictional authorities and control agencies for Bedout multi-well drilling oil spill response

Role	Spill Level	State waters/shoreline oil pollution		Commonwealth waters oil pollution	
		Petroleum Activity[1]	Vessel[2]	Petroleum Activity	Vessel
Control Agency	1	Petroleum Titleholder (Santos)	DoT	Petroleum Titleholder (Santos)	AMSA
	2/3	DoT	DoT	Petroleum Titleholder (Santos)	AMSA
Jurisdictional Authority	1/2/3	DoT	DoT	NOPSEMA	AMSA

4.3 Petroleum activity spill in Commonwealth waters

For an offshore petroleum activity spill in Commonwealth waters, the Jurisdictional Authority is National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA). NOPSEMA is responsible for the oversight of response actions to pollution events from offshore Petroleum Activities, in areas of Commonwealth jurisdiction. During a spill incident, NOPSEMA's role will be to implement regulatory

[1] Includes a 'Facility', such as a fixed platform, FPSO/FSO, MODU, subsea infrastructure, or a construction, decommissioning and pipelaying vessel. As defined by Schedule 3, Part 1, Clause 4 of the OPGGSA 2006.

[2] Vessels are defined by Australian Government Coordination Arrangements for Maritime Environmental Emergencies (AMSA, 2017) as a seismic vessel, supply or support vessel, or offtake tanker.

processes to monitor and secure compliance with the *OPGGS Act 2006* and *OPGGS (E) Regulations*, including the issuing of directions as required, and investigate accidents, occurrences and circumstances involving deficiencies in environment management.

Under the *OPGGS (E) Regulations* and the *OPGGS Act 2006*, the Petroleum Titleholder (i.e., Santos) is responsible for responding to an oil spill incident as the Control Agency in Commonwealth waters, in accordance with its OPEP.

Santos is responsible as Control Agency unless NOPSEMA identifies a requirement to delegate control. In this situation, Control Agency responsibility may be delegated to AMSA who will assume control of the incident and respond in accordance with AMSA’s NatPlan. In such an occurrence, Santo would assume a Support Agency role and make available all necessary resources to support AMSA in AMSA’s performance of their Control Agency responsibilities.

4.4 Cross-jurisdiction facility spills

For a Level 2/3 Petroleum Activity spill, there is the possibility of the spill crossing jurisdictions between Commonwealth and State waters. In these instances, the Jurisdictional Authority remains true to the source of the spill (i.e., NOPSEMA for Commonwealth waters and DoT for State waters). Where a Level 2/3 spill originating in Commonwealth waters moves into State waters two Control agencies will exist: DoT and the Petroleum Titleholder (Santos), each with its own IMT and Lead IMT responsibilities.

The arrangements between DoT and Santos for sharing resources and coordinating a response across both Commonwealth and State waters are further detailed in **Section 5.2.3**.

4.5 Vessel spills in Commonwealth waters

For a vessel incident originating in Commonwealth Waters, the jurisdictional authority and control agency is AMSA. AMSA is the national shipping and maritime industry regulator and was established under the *Australian Maritime Safety Authority Act 1990*. AMSA manages the NatPlan on behalf of the Australian Government, working with State and the Northern Territory governments, emergency services and private industry to maximise Australia’s marine pollution response capability.

Santos will be responsible for coordinating a first-strike response to a vessel-based spill in Commonwealth waters until such time as AMSA takes over the role as Control agency, at which time Santos would provide all available resources as a Supporting Agency.

4.6 Cross-jurisdictional vessel spills

For a large vessel spill (Level 2/3) that crosses Jurisdictions between Commonwealth and State waters, two Jurisdictional Authorities exist (AMSA for Commonwealth waters and DoT for State waters). Coordination of Control Agency responsibilities will be determined by DoT and AMSA, based on incident specifics with Santos providing first strike response and all necessary resources (including personnel and equipment) as a Supporting Agency.

5 Santos Incident Management

The Santos IMT (Perth) and CMT will be activated in the event of a Level 2/3 hydrocarbon spill regardless of the type of spill or jurisdiction. As outlined above, control of the response may be taken over by the relevant Control agency as the incident progresses. The Santos response structure to a major emergency incident is detailed in the Incident Command and Management Manual (SO-00-ZF-00025). The Incident Command and Management Manual describes response planning and incident management that would operate under emergency conditions – describing how the Santos IMT operates and interfaces with the CMT and external parties.

The first priority of an escalating oil spill response to a Level 2/3 spill is the formation of an IMT and establishment of an incident command centre (ICC). The ongoing involvement of the IMT and CMT will be dependent on the severity and type of spill and the obligations of Santos and other agencies/authorities in the coordinated spill response.

Santos' incident response structure relevant to a Bedout Multi-Well Drilling incident includes:

+ Facility-based Emergency Response Team
+ Santos IMT – Perth-based to coordinate and execute responses to an oil spill incident
+ Santos Crisis Management Team (CMT) – to coordinate and manage threats to the company's reputation and to handle Santos' corporate requirements in conjunction with the Perth-based Santos – Executive Vice President Offshore Oil and Gas (EVPO)
+ other field-based command, response and monitoring teams for implementing strategies outlined within the OPEP.

The first priority of an escalating oil spill response is the formation of an IMT to establish an Incident Operations Centre. The establishment and involvement of the CMT will depend on the severity of the spill.

The Santos incident response organisational structure is defined in the Incident Command and Management Manual (SO-00-ZF-00025) and in **Figure 5-1** for reference.

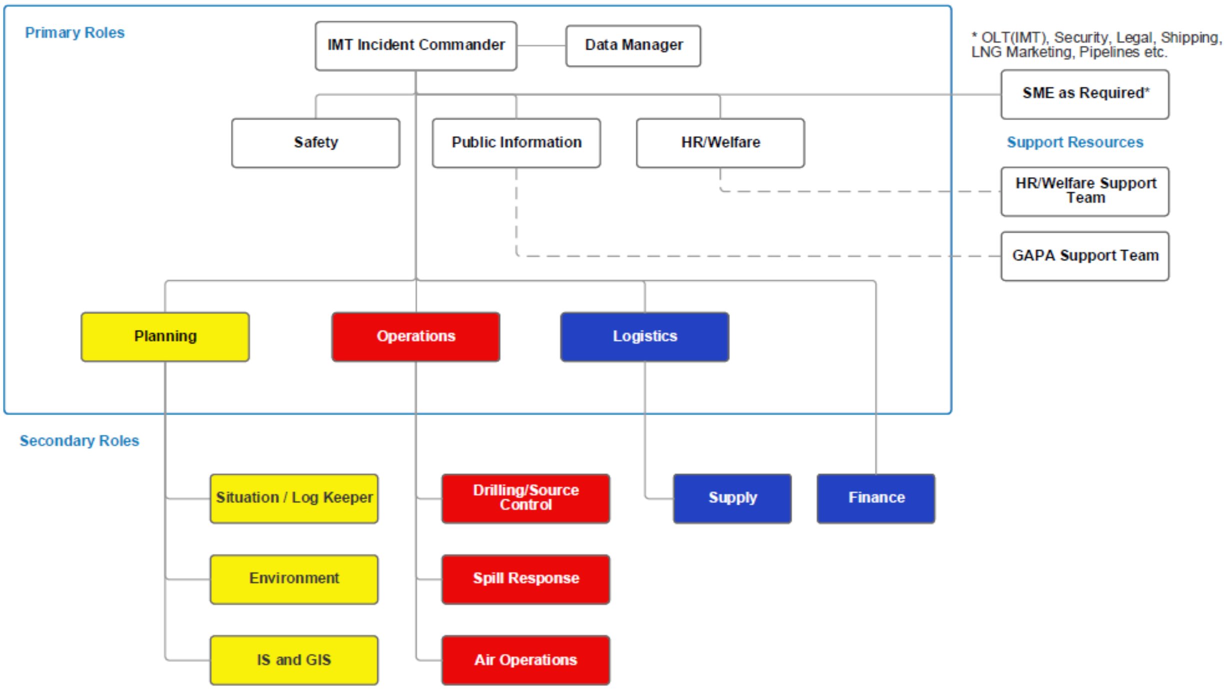

Figure 5-1: Santos incident response organisational structure

Note: For a Level 2/3 Petroleum Activity spills whereby DoT is involved as a Control agency, either within a single jurisdiction (State water only spills) or cross-jurisdictional (spills from Commonwealth to State waters), Santos will work in coordination with the DoT in providing spill response capability. Santos' expanded organisational structure for these situations is detailed in ***Section 5.2.3****.*

5.1 Roles and responsibilities

The following tables provide an overview of the responsibilities of the Santos CMT (**Table 5-1**), IMT (**Table 5-2**), and field-based response team members in responding to an incident (**Table 5-3**).

Also provided are the roles and responsibilities of Santos personnel required to work within DoT's organisational structure (**Table 5-5**), where DoT has responsibilities for spill response as a Control Agency, as per DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements.

DoT will provide a Liaison Officer/Duty Incident Commander and the Santos IMT in a coordinated response, as outlined for reference (**Table 5-4**).

Table 5-1: Roles and responsibilities in the crisis management team

Santos CMT Role	Main Responsibilities
CMT Leader	+ Maintain contact with IMT or Issue Notification stakeholder until the CMT is fully functional. + Articulate the overall response priorities and required actions using the PEARL approach + Consider response options to achieve priorities, including mitigating the potential worst-case scenario. + Determine Key Messages and Stakeholders, assigning Santos points of contact for each stakeholder. + Ensure CEO or delegate is engaged for all internal (staff) and external communications. + Confirm frequency of CMT reports and meetings and coordination with CEO, IMT and other stakeholders. + Consider how a change in the situation over time may alter the most likely and worst-case scenarios originally identified, and how this impacts response options and priorities. + Consider CMT requirements for the next phase of activity, allocating actions as appropriate.
Administrator – Environmental, Health, Safety and Governance	+ Provide location, time and meeting medium details (e.g., telecon) to CMT members. + Work with the CMT Log Keeper to maintain an accurate CM Log with key situation details, meeting decisions/actions and next meeting time/location details. + Disseminate approved briefing material to personnel following CMT Leader's direction. + Liaise with Public Affairs/Safety & Security/Facilities on any reception, premises security or media/adviser briefing requirements. + Ensure role discipline of CMT representatives, monitoring action progress and any coordination. + At each CMT meeting, summarise and record: – any change/handover in CMT representatives – the situation reviews and actions since last CMT meeting – any issues raised between meetings requiring escalation to, or coordination with, the CMT.

Santos CMT Role	Main Responsibilities
Duty Manager	+ With CEO agreement and appointment of a CMT Leader, assist with/oversee activation of the CMT. + Ensure the core CMT and specialist members are given details for the initial CMT meeting including location, time and meeting medium (e.g., telecon). + Where applicable contact IMT Leader or Issue Notification stakeholder and gain latest update for team. + Articulate the overall response priorities and required actions using the PEARL approach. Ensure ongoing monitoring for hidden or emerging risks. + Determine Key Messages and Stakeholders, assigning Santos points of contact for each stakeholder. + Ensure appropriate Legal Protocols are established on advice from CMT Legal. + Ensure CEO or delegate is engaged for all internal (staff) and external communications. + Consider how a change in the situation over time may alter the most likely and worst-case scenarios originally identified, and how this impacts response options and priorities.
Government and Public Affairs	+ Without delaying CMT attendance, gain advice from Government and Public Affairs teams on main and social media situation, government stakeholder requests and requirements, and immediate strategy. + Gain requirements from the CEO or delegate on strategy, timings, and media representation. + Follow the Crisis Management Process using the nominated support tools. + An initial CMT meeting, take the lead role setting out and updating the stakeholder communications plan. + Identify current and immediate messaging needs (i.e., Holding Statements, internal communications, industry advices, government notifications, media releases) and ongoing issues management. + Advise on Government and Public Affairs recommendations and other considerations to support company sustainability and resilience. + Advise on and coordinate the stakeholder management approach across all levels of Santos, including media monitoring and media inquiry. + Engage and oversee any specific asset or sub teams required for stakeholder management.

Santos CMT Role	Main Responsibilities
Risk and Audit	+ Advise on current and potential company risk issues. + Determine if additional specialists are needed. If so, coordinate and monitor their implementation (via the IMT Leader where an IMT is active) and keep the CMT updated. + Advise on Santos risk options and recommendations, other mitigation controls to company sustainability, and resilience requirements. + Monitor and assess cumulative risk consequences and potential exposures to Santos. + Engage and oversee any specific sub teams or specialists required for Risk and Audit support. + Between meetings, liaise with sub teams and specialist advisers to ensure an effective response. Ensure confidentiality and authorised comment is continually observed.
Safety and Security	+ Identify current and potential safety and security response, support or regulatory issues. + Determine if additional safety or security specialists are needed. If so, coordinate and monitor their implementation (via the IMT Leader where an IMT is active) and keep the CMT updated. + Advise on safety and security recommendations and other considerations to support company sustainability and resilience. + Advise on notifications to any safety or security related stakeholders, including mandatory regulatory advice or reports. + Monitor and assess safety and security consequences, advise on strategies and potential penalties and financial exposures to Santos. + Engage and oversee any specific sub teams or specialists required for Safety and Security support. + Between meetings, liaise with sub teams and specialist advisers to ensure an effective response. Ensure confidentiality and authorised comment is continually observed.

Santos CMT Role	Main Responsibilities
Human Resource Team Leader	+ Identify current and potential Human Resources (HR), People Support (PS) and Industrial Relations (IR) response, support (including incident site deployment) or regulatory issues. + Determine if additional HR, PS or IR specialists are needed. If so, coordinate and monitor their implementation (via the IMT where active with the respective IMT Leader) and keep the CMT updated. + Advise on and coordinate the personnel and next of kin communication approach across all levels of Santos with support from the Government and Public Affairs representative. + Advise on HR, PS and IR recommendations and other considerations to support company sustainability and resilience. + Monitor and report on any casualty condition, movement and health tracking to support injured parties (staff, contractors, and community as applicable). + Advise and coordinate management of HR, PS and IR stakeholders (via the IMT Leader where an IMT is active), including emergency services, union representation. + Monitor any HR or IR consequences, advise on strategies and potential penalties and financial exposures to Santos. + Engage and oversee any specific asset or sub teams used for HR, PS and IR stakeholder management. + Between meetings, liaise with asset and sub teams and specialist advisers to ensure an effective response. Ensure confidentiality and authorised comment is continually observed.
Legal and Company Secretariat	+ Identify current and potential legal and company secretary issues. + Determine if additional legal specialists are needed. If so, coordinate and monitor their implementation (via the IMT Leader where an IMT is active) and keep the CMT updated. + Advise on Legal Professional Privilege matters for the CMT and coordinate with other groups (including IMT representation) to ensure company information and personnel are appropriately advised. + Advise the CMT, asset and sub teams about contractual obligations, including Joint Venture and supply agreements, as required. + Advise on legal and company secretariat recommendations and other considerations to support company sustainability and resilience. + Advise on notifications to regulatory or legal related stakeholders, including mandatory advice or reports. + Monitor and assess legal consequences, advise on strategies and potential penalties and financial exposures to Santos.

Santos CMT Role	Main Responsibilities
Additional CMT support available as required: + Environment and Land Access + Assets and Operations + Engineering and Technical + Exploration + Finance + Information Systems + Insurance + Marketing and Trading + Treasury + Commercial and Procurement	

Table 5-2: Roles and responsibilities in the incident management team

Santos Management/ IMT Role	Main Responsibilities
Executive Vice President – Offshore Oil and Gas	+ Depending on the level of the incident, the EVPO (and/or their delegate) will act as the primary liaison to the CMT Duty Manager. + On the activation of the IMT, the EVPO is advised by the Incident Commander.
Level 3 Senior Manager	Division Subject Matter Expert activated as required to: + Advise on ongoing legal aspects. + Review all external information for approval via Santos CMT (JV Partners, Santos, customers, etc.) and manager briefings. + Validate media and holding statements releasable information with regards to personnel matters. + Work with CMT Public Affairs and HR on content of internal statements to staff. + Put Employee Assistance Program on alert if appropriate. + Work with police welfare person or doctors as required. + Manage all financial commitments through the response. + Advise EVPO of financial commitments through the response. + Subject Matter Expert = Finance, Legal, Government & Public Affairs, Human Resources, Joint Venture coordinator/liaison.
Incident Commander	+ Coordinate all onshore support in accordance with the Incidence Response Plan (IRP) and/or activity specific Oil Spill Contingency Plan or Oil Pollution Emergency Plan. + Set the response objectives and strategic direction. + Oversee the development and implementation of IAPs. + Oversee implementation of MoUs and contracted support for ‘mutual aid’. + Ensure coordination with external organisations/police, etc.

Santos Management/ IMT Role	Main Responsibilities
	+ Prepare and review strategic and tactical objectives with the EVPO. + Liaise with the EVPO and provide factual information. + Set response termination criteria in consultation with regulatory authorities. + Coordinate authorities for search and rescue.
Planning Team Leader	+ Collect and document situational awareness information of the incident. + Develop, document, communicate and implement IAPs to achieve incident objectives. + Determine the status of action/s or planned activities under the IAPs and assess and document performance against the objectives. + Manage the Geographic Information System (GIS) Team in a response.
Operations Team Leader **or** **Drilling Team Leader**	+ Coordinate operational aspects of Incident Response. + Provide the key contact for On-Scene Commanders (OSCs). + Liaise with contractors or third parties. + Mobilise additional Santos staff and external experts to form Technical Support Team. + Assist Planning Team Leader with overall general plan preparation and preparation of IAPs. + Implement IAPs. + Manage field response teams and activities.
Public Information	+ Manage all communications with media. + Prepare media releases for CMT approval. + Ensure timely approve by CMT and release of communications briefs to the Crisis Call Centre.
Logistics Team Leader	+ Mobilise response equipment, helicopters, vessels, supplies and personnel. + Provide transport and accommodation for evacuated personnel. + Oversee the implementation of the Waste Management Plan throughout a Level 2 or Level 3 oil spill response. + Liaise with the Supply Team to activate supply contracts and arrange procurements.
Supply Team Leader	+ Arrange fast track procurement. + Activate supply contracts as required. + Implement and maintain Cost Tracking System to enable the tracking of all costs associated to the response of the incident.
Environmental Team Leader	+ Manage notification to Designated Environmental Authorities and liaise as required. + Assist in the development of IAPs. + Advise of the Net Environmental Benefit Analysis of oil spill response strategies and tactics. + Oversee the implementation of scientific monitoring programs in an oil spill response. + Provide liaison for implementation of the WA Oiled Wildlife Response Plan in an oil spill response.

Santos Management/ IMT Role	Main Responsibilities
HR/Welfare Team Leader	+ Obtain personnel status involved in the incident. + Review Persons on Board (POB) lists and clarify accuracy through Safety Team Leader. + Obtain list of Contactor Companies involved in the incident and obtain Third-Party Contractor contact to advise of situation and safety of personnel when appropriate. + Obtain employee's emergency contact list (Next of Kin) to advise of situation and safety of personnel when appropriate. + Liaise with the CMT HR Team Leader. + Work with Logistics Team Leader to arrange transport for affected families to hospitals, etc. + Assist with arrangements through Employee Assistance Program to support families/employees. + Validate media and holding statements information with regards to personnel matters. + Work with Public Information on content of internal statements to staff and approved by CMT. + Put Employee Assistance Program on alert if appropriate. + Work with Police welfare person or doctors as required. + Be prepared to accompany police to provide initial company support. + Arrange Next of Kin notifications for affected personnel (excluding Police managed fatalities). + Determine Next of Kin assistance required; i.e., family travel to hospital, child support, etc. + Arrange for dedicated management support for families and next-of-kin, if appropriate. + Arrange Employee Assistance Program counselling at airports and homes where required – HR personnel to attend where possible.
Safety Team Leader	+ Manage notification to Designated Safety Authorities and liaise as required. + Assist in the development of IAPs. + Oversee the development and implementation of incident Safety Management Plans as required. + Work with the Welfare Team Leader to support personnel safety.
IMT Data Manager	+ Ensure IMT resources are in place and functional in the ICC. + Oversee the setting up of communications systems by the Computing and Communications Leader. + Establish the incident/exercise specific electronic folder system for records/information management. + Distribute manuals, contact lists and supporting information to IMT personnel. + Record and collect all information associated with the response to the incident. + Maintain filing system for Incident Response.

Santos Management/ IMT Role	Main Responsibilities
GIS	+ Manage and keep up-to-date facility and asset drawings, data sets, and photos in the 'GIS in IMT Database'. + Manage and keep up-to-date environmental features and sensitivity data sets in the 'GIS in IMT Database'. + Manage and keep up-to-date marine maps in the 'GIS in IMT Database'. + Provide IMT with quick access to up-to-date drawings and data sets in the ICC. + Provide software system to IMT that allows tactical response mapping overlays on facility drawings and area maps.
Finance	+ Handle accounting services and financial record-keeping, track and report on incident costs. + Facilitate all procurement requirements and ensure that expenditures are properly audited. + May be tasked with handling the receipt and processing of IMT third party claims.
Drilling/Source Control	+ Provide specific advice and support to the IMT on source control matters. + Activate and supervise drilling/source control elements in accordance with the IAP and direct its execution. + Direct dedicated source control equipment, request or release resources, approve group operational plans, and approve source control changes to the IAP as necessary.
Spill Response	+ Provide specific advice and support to the IMT on spill response matters, excluding source control. + Activate and supervise spill response elements in accordance with the IAP and direct its execution. + Direct dedicated spill response equipment, request or release resources, approve group operational plans, and approve spill response changes to the IAP as necessary.
Air Operations	+ Provide specific advice and support to the IMT on air operation matters. + Activate and supervise air operation elements in accordance with the IAP and directs its execution. + Direct dedicated air operations equipment, request or release resources, approve group operational plans, and approve air operations changes to the IAP as necessary.
Situation /Log Keeper	+ Maintain the IMT main event log. + Collate inputs from other IMT members into the main event log. + Assist with updating status boards, and other visual displays. + Collate IMT information on stand down.
Information Systems	+ Provide specific advice and support to the IMT on Information Systems matters. + Activate and lead Information Systems support resources as required.
Subject Matter Expert	+ Provide specific advice to the IMT on your area of expertise. + Develop assessments and strategies to address the incident. + Activate and lead a Subject Matter Expert support team as required.

Table 5-3: Roles and responsibilities in the field-based response team

Field-Based Position	Main Responsibilities
On-Scene Commander (MODU)	+ Assess facility-based situations. + Be single point of communications between facility/site and IMT. + Communicate the incident response actions and delegates actions to the Incident Coordinator. + Manage the incidents in accordance with MODU Emergency Response Plan. + Coordinate medical evacuations as required. + Refer to the MODU Emergency Response Plan for detailed descriptions of roles and responsibilities.
Company Site Representative	+ Notify the Perth based Incident Commander of oil spills. + Coordinate onsite monitoring of oil spill and ongoing communication with Incident Commander.
Off-Asset On-Scene Commander	+ Coordinate the field response as outlined in the Incident Action Plan developed by the IMT. + Command an FOB for the coordination of resources mobilised to site.
Off-Asset Oil Spill Response Teams	+ Respond to oil spills at sea to minimise the impacts to as low as reasonably practical. + Refer to activity-specific Oil Spill Contingency Plans and OPEPs for detailed descriptions of roles and responsibilities within the Off-Asset Oil Spill Response Team.
Source Control Team	+ Respond to incidents involving well loss of containment to stop the flow of oil to sea. + Refer to the Santos Source Control Planning and Response Guideline (DR-00-OZ-20001) for detailed descriptions of roles and responsibilities within the Source Control Team.
Oiled Wildlife Response Team	+ Respond to oiled wildlife incidents to minimise the impacts to wildlife. + Refer to the Western Australia Oiled Wildlife Response Plan for detailed descriptions of roles and responsibilities within the Oiled Wildlife Response Team.
Scientific Monitoring Teams	+ Monitor the impacts and recovery to sensitive receptors from an oil spill and associated response actions. + Refer to the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) for detail on Scientific Monitoring Team roles and responsibilities.

Table 5-4: Department of Transport roles embedded within Santos' crisis/incident management team

DoT roles embedded within Santos' CMT/IMT	Main Responsibilities
DoT Liaison Officer (prior to DoT assuming role of Control agency) **Deputy Incident Controller – State Waters (after DoT assumes role of Control agency)**	+ Facilitate effective communications between DoT's State Marine Pollution Coordinator (SMPC) the Incident Controller and Santos' appointed CMT Leader/Incident Commander. + Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters. + Assist in the provision of support from DoT to Santos. + Facilitate the provision of technical advice from DoT to Santos' Incident Commander as required.
Media Liaison Officer	+ Provide a direct liaison between the Santos Media team and DoT IMT Media team. + Facilitate effective communications and coordination between the Santos and DoT media teams. + Assist in the release of joint media statements and conduct of joint media briefings. + Assist in the release of joint information and warnings through the DoT Information & Warnings team. + Offer advice to the Santos Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.

Table 5-5: Santos personnel roles embedded within the State Maritime Environmental Emergency Coordination Centre/Department of Transport incident management team

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
CMT Liaison Officer[3]	+ Provide a direct liaison between the Santos CMT and the State MEECC. + Facilitate effective communications and coordination between the Santos CMT Leader and the SMPC. + Offer advice to SMPC on matters pertaining to Santos crisis management policies and procedures
Deputy Incident Controller	+ Provide a direct liaison between the DoT IMT and the Santos IMT. + Facilitate effective communications and coordination between the Santos Incident Commander and the DoT Incident Controller. + Offer advice to the DoT Incident Controller on matters pertaining to the Santos incident response policies and procedures. + Offer advice to the Safety Coordinator on matters pertaining to Santos safety policies and procedures particularly as they relate to Santos employees or contractors operating under the control of the DoT IMT.
Deputy Intelligence Officer	+ As part of the DoT Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. + Facilitate the provision of relevant modelling and predications from the Santos IMT. + Assist in the interpretation of modelling and predictions originating from the Santos IMT. + Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Santos IMT. + Facilitate the provision of relevant mapping from the Santos IMT. + Assist in the interpretation of mapping originating from the Santos IMT. + Facilitate the provision of relevant mapping originating from the Santos IMT.

[3] The role described as the *Santos Liaison Officer (CMT)* in **Figure 5-2**.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Planning Officer	+ As part of the DoT Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub-plans + Facilitate the provision of relevant IAP and sub-plans from the Santos IMT. + Assist in the interpretation of the Santos OPEP from Santos. + Assist in the interpretation of the Santos IAP and sub-plans from the Santos IMT. + Facilitate the provision of relevant IAP and sub-plans originating from the DoT IMT to the Santos IMT. + Assist in the interpretation of Santos' existing resource plans. + Facilitate the provision of relevant components of the resource sub-plan originating from the DoT IMT to the Santos IMT. (Note this individual must have intimate knowledge of the relevant Santos OPEP and planning processes).
Environment Support Officer	+ As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process + Assist in the interpretation of the Santos OPEP and relevant Tactical Response Plan (TRPs). + Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the Santos IMT. + Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Santos IMT.
Deputy Public Information Officer	+ As part of the Public Information Team, provide a direct liaison between the Santos Media team and DoT IMT Media team. + Facilitate effective communications and coordination between Santos and DoT media teams. + Assist in the release of joint media statements and conduct of joint media briefings. + Assist in the release of joint information and warnings through the DoT Information & Warnings team. + Offer advice to the DoT Media Coordinator on matters pertaining to Santos media policies and procedures. + Facilitate effective communications and coordination between Santos and DoT Community Liaison teams. + Assist in the conduct of joint community briefings and events. + Offer advice to the DoT Community Liaison Coordinator on matters pertaining to Santos community liaison policies and procedures. + Facilitate the effective transfer of relevant information obtained from the Contact Centre to the Santos IMT.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Logistics Officer	+ As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. + Facilitate the acquisition of appropriate supplies through Santos' existing OSRL, AMOSC and private contract arrangements. + Collects Request Forms from DoT to action via the Santos IMT. (Note this individual must have intimate knowledge of the relevant Santos logistics processes and contracts).
Deputy Waste Management Coordinator	+ As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. + Facilitate the acquisition of appropriate services and supplies through Santos' existing private contract arrangements related to waste management; and Collects Waste Collection Request Forms from DoT to action via the Santos IMT.
Deputy Finance Officer	+ As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Santos' existing OSRL, AMOSC and private contract arrangements. + Facilitate the communication of financial monitoring information to Santos to allow them to track the overall cost of the response. + Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Santos.
Deputy Operations Officer	+ As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. + Facilitate effective communications and coordination between the Santos Operations Section and the DoT Operations Section. + Offer advice to the DoT Operations Officer on matters pertaining to Santos incident response procedures and requirements. + Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of Santos and DoT response efforts.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Division Commander (FOB)	+ As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. + Provide a direct liaison between Santos' Forward Operations Base/s (FOB/s) and the DoT FOB. + Facilitate effective communications and coordination between Santos FOB Operations Commander and the DoT FOB Operations Commander. + Offer advice to the DoT FOB Operations Commander on matters pertaining to Santos incident response policies and procedures. + Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to Santos employees or contractors. + Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to Santos safety policies and procedures.

5.2 Regulatory arrangements and external support

5.2.1 Australian Marine Oil Spill Centre

Santos is a Participating Company of AMOSC and as such has access to AMOSC's Level 2/3 equipment and personnel as outlined in the AMOSPlan.

AMOSC has contracts with all its member companies to enable the immediate release of Core Group personnel to be made available for any Santos requirements, as outlined in Santos' *Master Service Contract* and *Principle and Agency Agreement* with AMOSC.

The mutual aid arrangements that AMOSC operates under are collaborated under the AMOSPlan. This provides the mechanism for members of AMOSC to access oil spill response capability of other members. To further enhance the mutual aid arrangements, Santos, BHPB, Chevron and Woodside have signed a Memorandum of Understanding (MoU) that defines the group's mutual aid arrangements. Under this MoU, Santos, BHPB, Chevron and Woodside have agreed to use their reasonable endeavours to assist in the provision of emergency response services, personnel, consumables and equipment.

5.2.2 Australian Maritime Safety Authority

AMSA is the designated Control Agency for oil spills from vessels within Commonwealth jurisdiction.

Upon notification of an incident involving a ship, AMSA will assume control of the incident and response in accordance with AMSA's Marine Pollution Response Plan. AMSA's Marine Pollution Response Plan is the operational response plan for the management of ship-source incidents. AMSA is to be notified immediately of all ship-source incidents through RCC Australia (Santos Incident Response Telephone Directory (SO-00-ZF-00025.020)).

An MoU has been established between Santos and AMSA, outlining respective roles and responsibilities when responding to vessel-sourced marine pollution incidents and petroleum activity related marine pollution incidents.

AMSA manages the NatPlan, Australia's key maritime emergency contingency and response plan. All resources under the NatPlan are available to Santos through request to AMSA under the arrangements of the MoU.

For any oil pollution event, Santos agrees to notify AMSA immediately in the interests of facilitating the most efficient and effective response to the incident.

5.2.3 Western Australian Department of Transport

In the event that a Level 2/3 Marine Oil Pollution Incident enters, or has potential to enter, State waters, the Hazard Management Agency (HMA) (DoT Director General or proxy) will take on the role as the SMPC and DoT will take on the role as a Control Agency.

Santos will notify the DoT Maritime Environmental Emergency Response (MEER) unit as soon as reasonably practicable (within 2 hours of spill occurring) of such an incident. On notification, the HMA will activate their MEECC and the DoT IMT.

For facility oil spills entering State waters (i.e., across jurisdictions) both Santos and DoT will be Control Agencies. Santos will work in partnership with DoT during such instances, as outlined within the DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements Available online: DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements.

Santos will conduct initial response actions in State waters as necessary in accordance with its OPEP and continue to manage those operations until formal handover of incident control is completed. Appendix 1 within DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements provides a checklist for formal handover.

For a cross-jurisdictional response, there will be a Lead IMT (DoT or Santos) for each spill response activity, with DoT's control resting primarily for State waters activities.

Appendix 2 within DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements provides guidance on the allocation of a Lead IMT to response activities for a cross jurisdictional spill.

To facilitate coordination between DoT and Santos during a cross jurisdictional response, a Joint Strategic Coordination Committee will be established. The Joint Strategic Coordination Committee will be jointly chaired between the SMPC and a nominated senior representative of Santos and will ensure alignment of objectives and provide a mechanism for de-conflicting priorities and resourcing requests.

For a cross jurisdictional response Santos will be responsible for ensuring adequate resources are provided to DoT as Control Agency, initially 11 personnel to fill roles in the DoT IMT or FOB (refer **Section 5.1**) and operational personnel to assist with those response strategies where DoT is the Lead IMT. Concurrently DoT will also provide two of their personnel to the Santos IMT as described in **Table 5-4**. Santos' CMT Liaison Officer and the Deputy Incident Controller are to attends the DoT Fremantle ICC as soon as possible after the formal request has been made by the SMPC. It is an expectation that the remaining initial cohort will attend the DoT Fremantle ICC no later than 8am on the day following the request being formally made to Santos by the SMPC.

Figure 5-2 shows the organisational structure of Santos incident management personnel within Santos IMT and embedded within DoT's MEECC/IMT.

Figure 5-3 shows the overall cross jurisdictional organisational structure referenced from the SHP-MEE.

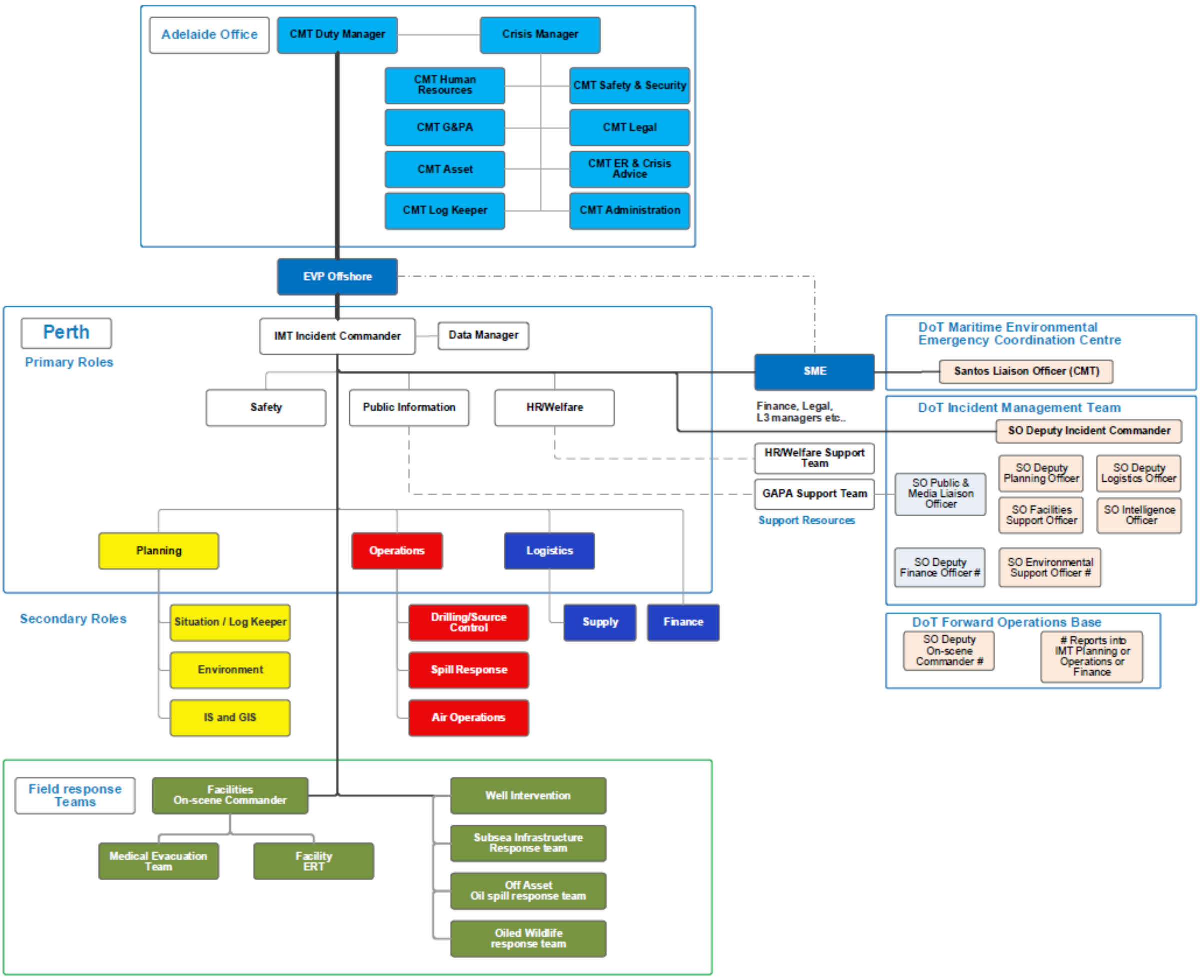

Figure 5-2: Santos cross jurisdictional incident management structure for Commonwealth waters Level 2/3 facility oil pollution incident entering State waters

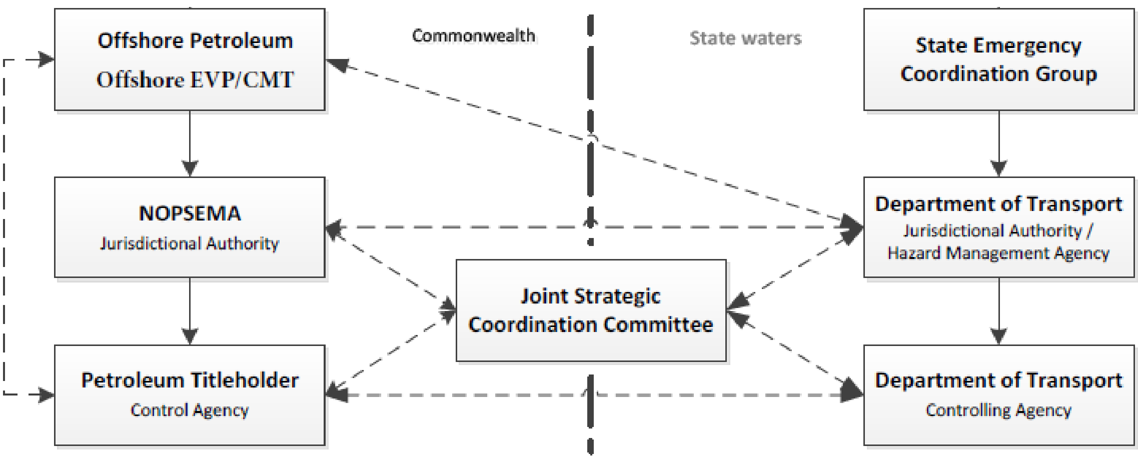

Figure 5-3: Overall control and coordination structure for offshore petroleum cross-jurisdiction incident

5.2.4 Western Australian Department of Biodiversity, Conservation and Attractions

The Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) has responsibilities associated with wildlife and activities in national parks, reserves and State marine parks. The *Biodiversity Conservation Act 2016* (WA) is the legislation that provides DBCA with the responsibility and Statutory Authority to treat, protect and destroy wildlife. In State waters, DBCA is the Jurisdictional Authority for Oiled Wildlife Response (OWR), providing advice to the Control Agency (DoT). The role of DBCA in an OWR is outlined in the Western Australian Oiled Wildlife Response Plan (WAOWRP) and regional sub-plans.

For a Level 2/3 petroleum spill that originates within or moves into State waters, DoT will be the Control Agency responsible for overall command of an oiled wildlife response. Santos will provide all necessary resources (equipment and personnel primarily through AMOSC membership) to DoT to facilitate this response.

For matters relating to environmental sensitivities and scientific advice in State waters DBCA may provide an Environmental Scientific Coordinator to support the SMPC and/or DoT Incident Controller.

This may include advice on priorities for environmental protection, appropriateness of proposed response strategies and the planning and coordination of scientific monitoring for impact and recovery assessment.

5.2.5 Oil Spill Response Limited

Through an associate membership, Santos has access to spill response services from OSRL with offices in Perth, Singapore, UK and at other various locations around the. In the event of a Level 2/3 response, Santos could access OSRL's international personnel, equipment and dispersants, primarily through OSRL's Singapore stockpile, to supplement resources available within Australia. Santos may also call on OSRL for technical services to support its IMT.

Response equipment and personnel are allocated on a 50% of inventory basis under OSRL's Service Level Agreement. Santos also has access to additional dispersant stockpiles held by OSRL through a Global Dispersant Stockpile Supplementary Agreement.

5.2.6 Department of Foreign Affairs and Trade

In the event of a spill predicted to migrate into neighbouring countries Exclusive Economic Zones, Santos will notify the Department of Foreign Affairs and Trade (DFAT) who will in turn notify the affected government(s) and engage the preferred methods for Santos to respond in order to minimise the impacts to ALARP. In most cases, NOPSEMA, DISER and DFAT will form an inter-agency panel; the Australian Government Control Crisis Centre, who may request AMSA to coordinate the response operations across the trans-national boundary. Santos remain willing to respond as per the direction of the affected government(s) and designated Control Agency, following approvals established between DFAT and the affected countries government.

5.2.7 Department of Industry, Science, Energy and Resources

The Department of Industry, Science, Energy and Resources (DISER) will be the lead Commonwealth Agency for the provision of strategic oversight and Commonwealth government support to a significant offshore petroleum incident (including oil spill incidents). DISER will be notified by NOPSEMA of a significant oil pollution incident and under the Offshore Petroleum Incident Coordination Framework will stand up the Offshore Petroleum Coordination Committee as the mechanism to provide Commonwealth strategic advice and support to the incident. To facilitate information between the Petroleum Titleholder IMT and Offshore Petroleum Incident Coordination Committee, Liaison Officer/s will be deployed from DISER to the Petroleum Titleholders IMT.

For incidents that are classified at a greater level than Significant (i.e., Crisis level), a whole of government crisis committee will be formed under the Australian Government Crisis Management Framework to provide strategic advice and support and the Offshore Petroleum Incident Coordination Committee will not be convened, although DISER will remain as the lead agency.

5.3 External plans

Information from the following external documents have been used or referred to within this Plan:

+ AMOSPlan – Australian Industry Cooperative Spill Response Arrangements:
  - Details the cooperative arrangements for response to oil spills by Australian oil and associated industries.
+ Offshore Petroleum Incident Coordination Framework – provides overarching guidance on the Commonwealth Government's role and responsibilities in the event of an offshore petroleum incident in Commonwealth waters.
+ NatPlan – National Plan for Maritime Environmental Emergencies and National Marine Oil Spill Contingency Plan:
  - Sets out national arrangements, policies and principles for the management of maritime environmental emergencies. The plan provides for a comprehensive response to maritime environmental emergencies regardless of how costs might be attributed or ultimately recovered.
+ HazPlan – SHP-MEE – Western Australia State Hazard Plan for Maritime Environmental Emergencies:
  - Details the management arrangements for preparation and response to a marine pollution incident occurring in State waters.
+ DoT Oil Spill Contingency Plan:
  - Defines the steps required for the management of marine oil pollution responses that are the responsibility of the DoT.
  - DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (available online: DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements).
+ Shipboard Oil Pollution Emergency Plans:
  - Under International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I requirements, all vessels of over 400 gross tonnage are required to have a current SOPEP. The SOPEP includes actions to be taken by the crew in the event of an oil spill including steps taken to contain the source with equipment available onboard the vessel.
+ Western Australia Oiled Wildlife Response Plan:
  - Defines the steps, personnel, equipment and infrastructure required for the management of wildlife in an oil pollution response. Each region has a Regional Oiled Wildlife Response Plan that gives further details on sensitivities and available resources. The Pilbara Region Oiled Wildlife Response Plan is the relevant regional plan for OWR associated with Bedout Multi-Well Drilling activities.

- OSRL Associate Agreement:
  - Defines the activation and mobilisation methods of OSRL spill response personnel and equipment allocated under contract.
- Australian Government Coordination Arrangements for Maritime Environmental Emergencies:
  - Provides a framework for the coordination of Australian Government departments and agencies in response to maritime environmental emergencies.

5.4 Cost recovery

As required under Section 571(2) of the *OPGGS Act 2006*, Santos has financial assurances in place to cover any costs, expenses and liabilities arising from carrying out its Petroleum Activities, including major oil spills. This includes costs incurred by relevant Control agencies (e.g., DoT) and third-party spill response service providers.

5.5 Training and exercises

5.5.1 Incident management team training and exercises

Santos provides training to its personnel to fill all required positions within the IMT.

Competency is maintained through participation in regular response exercises and workshops. Exercise and training requirements for Santos' IMT members are summarised in **Table 5-6**.

Table 5-6: Training and exercise requirements for incident management team positions

IMT Role	Exercise	Training
Incident Commander Operations/IMT Drilling Team Leader	One Level 2 exercise annually or two Level 2 desktop exercises annually	+ PMAOMIR320 + PMAOMIR418 + AMOSC – IMO3 Oil Spill Command & Control
Planning Team Leader Logistics Team Leader Environmental Team Leader		+ PMAOMIR320 + AMOSC – IMO2 Oil Spill Management Course
Safety Team Leader Supply Team Leader GIS Team Leader Data Manager HR/Welfare Team Leader		+ PMAOMIR320 + AMOSC – Oil Spill Response Familiarisation Training

5.5.2 Oil spill responder training

Santos has an internal capability of trained oil spill responders who can be deployed in the field in a spill response and has access to external, trained spill responder resources (**Table 5-7**).

Table 5-7: Spill responder personnel resources

Responder	Role	Training	Available Number
Santos AMOSC Core Group Responders	Santos personnel trained and competency assessed by AMOSC as the AMOSC Core Group. Deployed by IMT for spill response operations.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 Oil Spill Operators Course	12
Santos Facility Emergency Response Teams	Present at Devil Creek, Varanus Island and Ningaloo Vision Facilities for first strike response to incidents.	Internal Santos training and exercises as defined in each facility's Emergency Response Plan OSC to have AMOSC – Oil Spill Response Familiarisation Training.	One Emergency Response (ER) team per operational facility per shift
Santos Aerial Observers	Undertake aerial surveillance of spill. Deployed by IMT in the aerial surveillance aircrafts.	AMOSC – Aerial Surveillance Course (refresher training undertaken tri-annually).	7
AMOSC Core Group Oil Spill Responders	Industry personnel as the AMOSC Core Group, available to Santos under the AMOSPlan. For providing incident management (IMT) and operations (field response) assistance.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 Oil Spill Operators Course and/or IMO2 Oil Spill Management Course	As defined in Core Group Member Reports Min. 84 Max. 140 (incl. Santos)
OSRL Oil Spill Response Personnel	Oil Spill Response Ltd professionals, providing technical, incident management and operational advice and assistance available under Santos-OSRL contract.	As per OSRL training and competency matrix.	18
AMOSC Oil Spill Response Specialists	Professionals, providing technical, incident management and operational advice and assistance available under Santos-AMOSC contract.	As per AMOSC training and competency matrix.	8
Oiled Wildlife Response Roles (Level 6)	Refer **Section 16** and **Appendix M**.		

Responder	Role	Training	Available Number
Monitoring Service Provider: Monitoring Coordination Team (MCT) and Scientific Monitoring Plan Teams	Monitoring Coordination Team (MCT) Scientific Monitoring Plan Teams: Technical Advisers Field Team Leader Field Team Member	As defined in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Capability defined in Monthly Capability Reports. MCT – five personnel Scientific Monitoring Plan Teams 12+ per team
Level 1 Oiled Wildlife Responders (Workforce Hire)	Provide oiled wildlife support activities under supervision.	No previous training required; on the job training provided.	Nominally over 1,000
Shoreline clean-up personnel (Workforce Hire)	Manual clean-up activities under supervision.		

In addition to the resources listed in **Table 5-7**, the following resources are available for spill response and may be activated by the relevant Control Agency:

+ National Plan: National Response Team – Trained oil spill response specialists, including aerial observers, containment and recovery crews, and shoreline clean-up personnel, deployed under the direction of AMSA and the IMT in a response. The National Response Team is trained and managed in accordance with the National Response Team Policy, approved by the National Plan Strategic Coordination Committee (AMSA, 2013b).
+ State Hazard Plan for Maritime Environmental Emergencies (SHP-MEE): State Response Team (SRT)– Oil pollution response team available to assist under the jurisdiction of the DoT. SRT members remain trained and accredited in line with the State Hazard Plan (SHP-MEE) requirements.

In the event of a spill, the trained spill responders listed in **Table 5-7** would be required to undertake various roles in key spill response operations, including operational monitoring, shoreline protection, shoreline clean-up, oiled wildlife response and scientific monitoring.

In the event of a spill, Team Leader roles for protection and deflection and shoreline clean-up would be filled through Santos' AMOSC Core Group Responders and then industry Core Group Responders.

5.5.3 Response testing

Following acceptance of an OPEP, notification arrangements of the plan are tested through a communications test to all external agencies and companies with roles defined within the plan. The communications tests are repeated annually for activities that extend longer than one year.

IMT members undertake workshops and exercises as outlined within the Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001) to clarify and familiarise themselves with their respective roles and responsibilities within OPEPs and other emergency plans. Learning aids are also introduced through these workshops to assist improvement of capability for the personnel to perform the functions of their role. Santos conducts IMT desktop and activation exercises using emergency scenarios across its main operating facilities on the North West Shelf or a drilling activity. An oil spill incident scenario is used for the activation exercise once per year. Both safety and oil spill incidents test the chain of command of the Santos response system, communications and notification with external parties, communication processes between office and facility, and field response tactics.

Testing of key response provider arrangements is done as part of larger exercises or as standalone tests where the capability and availability of resources through the response provider are assessed against the performance requirement.

Field deployment tests are undertaken by Santos as a sole responder and through Santos' involvement in multi-operator response deployment exercises.

5.5.4 Testing schedule

Oil spill specific training, exercises, workshops and tests are detailed in the Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001). Once completed, records of exercises and workshops are entered into the Santos Training and Induction Database (Learning Management System). Key actions arising from exercises are recorded and tracked through the Santos Action Tracking System. Progress of training, exercise and workshop completion against the schedule is tracked and reported against on a monthly basis.

The Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001) is reviewed and revised annually.

5.5.5 Oil spill response audits

Oil spill response audits will follow the Santos Assurance Procedure (SMS-MS15.1) and are scheduled as per the Santos Assurance Schedule. Audits will assist in identifying and addressing any deficiencies in systems and procedures. At the conclusion of the audit, any opportunities for improvement and corrective actions required (non-conformances) will be formally noted and discussed, with corrective actions developed and accepted. In some instances, audits may conclude with potential amendments to the OPEP.

The deployment readiness and capability of AMOSC's oil spill response equipment and resources in Geelong and Fremantle are audited every two years under the direction of AMOSC's participating members. The intent of this audit is to provide assurances to Santos and associated members about AMOSC's ability to respond to an oil spill incident as per the methods and responsibilities defined in oil pollution emergency plans.

The deployment readiness and capability of OSRL's oil spill response equipment and personnel in Singapore are audited every two years. The intent of this audit is to provide assurances to Santos of OSRL's ability to respond to an oil spill incident as per its Service Level Agreement.

The objectives and frequency of oil spill response testing and auditing relevant to Bedout Multi-Well Drilling activities oil spill response are summarised in **Table 5-8**.

Table 5-8: Oil spill response testing arrangements

Exercise	Objective	Frequency	Recording and review
Communication Test	To test all communication and notification processes to service providers and regulatory agencies defined within the OPEP.	Required for every approved OPEP. When response arrangements have changed. At least annually.	Any results of the test are recorded in a Test Report. Corrections are updated within the Incident Response Telephone Directory (SO-00-ZF-00025.020).
IMT Workshops	To refresh IMT roles and responsibilities and provide familiarisation with OPEP processes and arrangements.	As per Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001)	Workshops undertaken are recorded in Santos' Learning Management System.
OPEP Plan and Activation Desktop/ Exercise	Desktop/exercise: To familiarise IMT with functions and process in response to a simulated oil spill scenario. Activation: To activate an IMT in response to oil spill scenario and test arrangements contained within OPEPs.	As per Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001). Minimum of one oil spill response activation oil spill exercise per year.	Desktop/exercise undertaken are recorded in Santos' EHS Toolbox and key recommendations are recorded are tracked to completion.
Response arrangement tests	Tests of response arrangements outlined within the OPEP either as part of an activation desktop/exercise or as standalone desktop. Response arrangement tests to include testing of OPEP response timeframes.	As per Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001).	Test reports are recorded if not already included within reports for IMT activation desktop/ exercise. Key recommendations are recorded and tracked to completion in Santos' EHS Toolbox
Equipment deployment exercises/tests	To focus on Santos' deployment capability. To inspect and maintain the condition of the Santos oil spill response equipment. To maintain training of field response personnel.	When new response equipment is added. As per Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001). Santos-owned equipment inspected and/or tested are: + tracker buoys + offshore boom/ nearshore boom + power packs + vessel dispersant spray systems.	Reports are generated for exercises and recorded in Santos' EHS Toolbox. Key recommendations are recorded and tracked to completion. Tracker Buoy tests are recorded.

Exercise	Objective	Frequency	Recording and review
AMOSC audit	To test deployment readiness and capability of AMOSC.	Every two years.	Undertaken by two of AMOSC's participating members and the audit report made available to members.
OSRL Audit	To test deployment readiness and capability of OSRL in Singapore.	Every two years.	Undertaken by Santos or in coordination/consultation with other member company. Recommendations provided to OSRL for action and close-out.

6 Response Strategy Selection

6.1 Spill scenarios

This OPEP outlines strategies, actions and supporting arrangements applicable for all credible oil spill events associated with Bedout Multi-Well Drilling activities. Of the credible spill scenarios identified in the Bedout Multi-Well Drilling EP (SO-00-BI-20003), all have been selected to represent worst case spills from a response perspective, taking into account the following characteristics:

- They represent all hydrocarbon types that could be spilt during Bedout Multi-Well Drilling activities.
- They represent maximum credible release volumes.
- Those scenarios that represent the greatest spatial extent from a response perspective based on surface oil and shoreline accumulation as these are the key factors contributing to response.
- Proximity to sensitive receptors, shorelines, State/Commonwealth boundaries etc.

The worst-case credible spill risks selected to inform this OPEP are presented in **Table 6-1**. Detail on the derivation of these maximum credible spills is provided within the Bedout Multi-Well Drilling EP (SO-00-BI-20003).

For a description of the characteristics and behaviour associated with hydrocarbons that may unintentionally be released refer to **Appendix A**.

Table 6-1: Maximum credible spill scenarios for Bedout multi-well drilling operations

Worst-case credible spill scenario	Location	Approx. depth of spill	Hydrocarbon type	Maximum credible volume released (m^3)	Release duration	Maximum extent of surface hydrocarbons
LOWC – subsea release	Bedout West	71 m	Caley Condensate	2,083,121	77 days	Approx. 1,900 km (1 g/m²) Approx. 600 km (10 g/m²) Approx. 300 km (50 g/m²)
	Bedout North	99 m				Approx. 1,900 km (1 g/m²) Approx. 650 km (10 g/m²) Approx. 300 km (50 g/m²)
	Bedout South	46 m				Approx. 1,500 km (1 g/m²) Approx. 275 km (10 g/m²) Approx. 150 km (50 g/m²)
LOWC – surface release	Bedout West	0 m (surface)	Caley Condensate	2,049,258	77 days	Approx. 2,200 km (1 g/m²) Approx. 900 km (10 g/m²) Approx. 350 km (50 g/m²)
	Bedout North	0 m (surface)				Approx. 1,900 km (1 g/m²) Approx. 700 km (10 g/m²) Approx. 500 km (50 g/m²)
	Bedout South	0 m (surface)				Approx. 1,600 km (1 g/m²) Approx. 500 km (10 g/m²) Approx. 250 km (50 g/m²)
Surface diesel release (surface spill)	Bedout West	0 m (surface)	Marine Diesel Oil	329	0.5 hours	Approx. 250 km (1 g/m²) Approx. 200 km (10 g/m²) Approx. 100 km (50 g/m²)
	Bedout North	0 m (surface)				Approx. 300 km (1 g/m²) Approx. 200 km (10 g/m²) Approx. 100 km (50 g/m²)
	Bedout South	0 m (surface)				Approx. 175 km (1 g/m²) Approx. 150 km (10 g/m²) Approx. 100 km (50 g/m²)

6.2 Response planning thresholds

Environmental impact assessment thresholds are addressed in Section 7.5.4 of the EP. In addition to the environmental impact assessment thresholds, response thresholds have been developed for response planning to determine the conditions that response strategies would be effective. These are shown in **Table 6-2**.

Table 6-2: Surface hydrocarbon thresholds for response planning

Hydrocarbon concentration (g/m^2)	Description
>1	Estimated minimum threshold for commencing some scientific monitoring components (refer to **Appendix O**)
>50	Estimated minimum floating hydrocarbon threshold for containment and recovery and surface dispersant application
>100	Estimated floating hydrocarbon threshold for effective containment and recovery and surface dispersant application Estimated minimum shoreline accumulation threshold for shoreline clean-up

Containment and recovery effectiveness drops significantly with reduced oil thickness (McKinney and Caplis, 2017; NOAA, 2013). McKinney and Caplis (2017) tested the effectiveness of various oil skimmers at different oil thicknesses. Their results showed that the oil recovery rate of skimmers dropped significantly when oil thickness was less than 50 g/m^2.

Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50 to 100 g/m^2 on the sea surface. EMSA (2010) recommends thin layers of spilled hydrocarbons should not be treated with dispersant. This includes Bonn Agreement Oil Appearance Codes (BAOAC) 1 to 3 (EMSA, 2010) (**Table 13-2**).

6.3 Stochastic spill modelling results

Table 6-3 presents the spill modelling results at Protection Priority locations for selected worst-case scenarios only. All scenarios were modelled using a stochastic approach running multiple simulations (150 simulations) across all seasons using a number of unique environmental conditions sampled from historical metocean data.

As detailed in Section 7.5.3 of the EP, modelling was conducted using a hydrocarbon analogue (LAVRANS condensate) to represent Caley Condensate. Across properties influencing weathering behaviour (e.g., density, boiling point curve, pour point) LAVRANS and Caley Condensate match very well (refer Section 7.5.3 of the EP). Wax content and asphaltene content are key drivers of emulsification potential since emulsification increases with the proportion of these components, especially over a threshold above 0.5% for asphaltene content (CSIRO, 2016). Increased rates of emulsification reduce the rate of natural weathering and increase the volume of oily waste, making recovery and treatment of oil more difficult. The modelled hydrocarbon has a similar asphaltene content (0.01%) to recent assays of Caley Condensate (<0.5%). Caley Condensate has a slightly higher wax content (9.2%) than that of the modelled analogue (6%), with both oils having higher wax content than is typical for condensates. LAVRANS has a viscosity of 2 cSt (at 20°C), slightly thicker (more conservative) than that of Caley Condensate (1.878 cSt at 20°C). Comparative distillation curves of LAVRANS and Caley Condensate match very closely (GHD, 2020). On this basis, and in view of the similarity in other factors influencing weathering and persistence in the environment (refer Section 7.5.3 of the EP), the modelling conducted is considered representative of how Caley Condensate would behave in the environment.

For the purpose of spill response preparedness, outputs relating to floating oil and oil accumulated on the shoreline are most relevant (i.e., oil that can be diverted, contained, collected or dispersed through the use of spill response strategies) for the allocation and mobilisation of spill response resources. Therefore, these are the results presented in this OPEP for primary consideration.

Modelling results for dissolved and entrained oil for the worst-case scenarios have not been included in this OPEP, given there are limited response strategies that will reduce subsurface impacts. Refer to Section 7.6.1.1 of the EP for dissolved and entrained thresholds and Section 7.6.2 for impacts to receptors.

The worst case shoreline loading and/or probability of total contact at more than 1 g/m^2 (percentage) for all emergent and intertidal receptors is presented in **Table 6-3** to **Table 6-9**. For each scenario, these results represent the worst loading or floating oil contact probability for each receptor from all stochastic modelling runs. Refer to Section 7.5.4 of the EP for further description on selection of oil exposure values.

Table 6-3: Worst-case spill modelling results – Bedout West subsea loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
LOWC – subsurface release (Caley Condensate) of 2,083,121 m³ over 77 days								
Barrow-Montebello Surrounds*	63.3	11.1	NC	NC	NC	NC	NC	NC
Outer Ningaloo Coast North*	62.0	17.4	NC	NC	NC	NC	NC	NC
Imperieuse Reef MP	58.0	12.7	63.3	13.2	63.3	13.2	2,371.9	56.9
Montebello Islands	55.3	15.5	64.0	11.7	63.3	11.7	936.9	22.7
Dampier Archipelago	54.0	11.2	68.7	11.2	66.7	11.2	1,631.0	85.3
Ningaloo Coast North	53.3	24.3	57.3	20.9	56.7	20.9	1,452.0	176.2
Southern Islands Coast	52.0	15.7	53.3	15.7	52.0	15.7	721.0	28.4
Mermaid Reef AMP*	50.7	14.5	NC	NC	NC	NC	NC	NC
Barrow Island	49.3	12.1	62.7	12.2	60.0	12.2	1,370.6	62.5
Clerke Reef MP	49.3	12.4	56.0	12.4	56.0	12.4	2,220.7	51.2
Muiron Islands	41.3	21.8	58.0	17.9	55.3	17.9	756.2	17.1
Bedout Island	32.0	6.6	40.0	6.7	30.0	6.7	268.5	5.7
Lowendal Islands	26.0	21.9	31.3	20.4	26.0	20.4	212.2	5.7
Northern Islands Coast	23.3	17.2	21.3	35.1	14.0	35.1	65.3	11.4

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Thevenard Islands	20.0	27.2	47.3	20.3	43.3	20.3	311.0	11.4
Eighty Mile Beach	16.0	24.3	20.0	30.5	5.3	33.5	141.5	11.4
Port Hedland-Eighty Mile Beach	16.0	18.3	18.0	11.1	12.0	19.2	400.6	17.1
Scott Reef South	14.7	38.7	25.3	43.9	25.3	43.9	301.2	45.5
Seringapatam Reef*	14.0	40.1	NC	NC	NC	NC	NC	NC
Karratha-Port Hedland	13.3	18.1	10.0	19.0	4.0	19.0	94.0	11.4
Roebuck - Eighty Mile Beach	12.0	25.5	12.0	27.4	10.7	27.4	141.7	11.4
Ningaloo Coast South	11.3	69.8	28.7	56.3	25.3	56.3	74.0	34.1
Ashmore Reef AMP	6.0	82.0	10.0	70.7	10.0	70.7	110.5	28.4
Scott Reef North*	6.0	52.1	16.0	39.0	16.0	39.0	152.4	22.7
Broome - Roebuck	4.0	32.2	6.0	34.2	3.3	34.2	77.8	5.7
Broome North Coast	4.0	43.6	7.3	43.6	6.0	43.6	66.4	11.4
Indonesia - East	4.0	56.7	5.3	56.8	5.3	56.8	96.8	22.7
Outer Shark Bay Coast	3.3	50.3	18.7	50.6	15.3	50.6	103.3	39.8
Cartier Island AMP	2.0	87.5	2.0	86.6	2.0	86.6	22.8	5.7
Exmouth Gulf Coast	2.0	42.8	4.0	37.3	3.3	37.3	34.9	22.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Lacepede Islands	1.3	53.3	NC	NC	NC	NC	NC	NC
Kimberley Coast PMZ	0.7	105.6	0.7	108.5	0.7	108.5	56.7	5.7
King Sound	0.7	107.4	2.0	79.0	2.0	79.0	45.3	11.4
Middle Islands Coast	0.7	66.0	5.3	30.5	4.0	44.1	5.7	5.7
Geographe Bay - Augusta	NC	NC	0.7	106.0	NC	NC	NC	NC
Geraldton - Jurien Bay	NC	NC	1.3	104.3	NC	NC	NC	NC
Indonesia - West	NC	NC	0.7	111.6	NC	NC	NC	NC
Jurien Bay - Yanchep	NC	NC	1.3	93.8	0.7	104.4	8.1	5.7
Kalbarri - Geraldton	NC	NC	0.7	107.7	0.7	107.7	1.9	5.7
Perth Southern Coast	NC	NC	0.7	86.3	NC	NC	NC	NC
Rottnest Island	NC	NC	0.7	91.7	0.7	91.7	15.2	5.7
Zuytdorp Cliffs - Kalbarri	NC	NC	4.0	76.9	1.3	108.0	3.9	5.7

**Intertidal receptor*

Table 6-4: Worst-case spill modelling results – Bedout North subsea loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Imperieuse Reef MP	70.0	7.8	81.3	7.6	81.3	7.6	3,159.5	56.9
Mermaid Reef AMP*	66.0	13.3	NC	NC	NC	NC	NC	NC
Clerke Reef MP	59.3	13.6	73.3	13.6	73.3	13.6	2,798.3	51.2
Outer Ningaloo Coast North*	48.7	26.0	NC	NC	NC	NC	NC	NC
Barrow-Montebello Surrounds*	40.7	16.9	NC	NC	NC	NC	NC	NC
Ningaloo Coast North	39.3	31.5	44.0	31.6	42.0	31.6	631.2	108.0
Dampier Archipelago	38.7	21.2	46.0	21.2	44.7	21.2	900.0	62.5
Southern Islands Coast	36.0	22.2	45.3	24.0	43.3	24.0	451.9	22.7
Barrow Island	32.7	25.1	44.7	24.6	42.7	24.6	473.5	45.5
Montebello Islands	32.0	19.5	41.3	17.1	36.7	17.1	487.3	22.7
Bedout Island	31.3	13.5	36.0	14.1	32.7	14.1	274.8	5.7
Broome North Coast	29.3	23.3	29.3	23.9	28.7	23.9	517.7	68.2
Muiron Islands	23.3	32.3	40.7	23.2	38.7	23.2	400.9	17.1
Broome - Roebuck	22.7	22.9	20.0	25.5	19.3	25.5	332.8	22.7
Roebuck - Eighty Mile Beach	20.7	20.2	21.3	22.1	16.7	31.5	517.1	28.4

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Scott Reef South	18.0	46.2	30.7	45.9	30.7	45.9	955.5	56.9
Seringapatam Reef*	18.0	45.2	NC	NC	NC	NC	NC	NC
Karratha-Port Hedland	13.3	24.2	10.0	27.9	3.3	44.8	102.6	17.1
King Sound	11.3	39.1	13.3	40.7	11.3	40.7	188.7	17.1
Scott Reef North*	11.3	58.8	17.3	51.6	17.3	51.6	186.6	39.8
Eighty Mile Beach	10.7	25.4	16.0	31.7	6.0	31.7	75.0	11.4
Ashmore Reef AMP	10.0	63.1	14.0	50.8	13.3	50.8	282.3	39.8
Lowendal Islands	8.7	39.2	18.0	37.1	14.0	37.1	39.3	5.7
Thevenard Islands	8.7	44.9	35.3	31.0	31.3	31.0	201.8	11.4
Northern Islands Coast	7.3	39.6	12.7	51.0	6.0	54.3	34.3	11.4
Port Hedland-Eighty Mile Beach	6.7	19.2	14.7	24.9	8.0	24.9	257.1	11.4
Ningaloo Coast South	4.7	65.3	16.7	62.2	14.0	62.2	149.5	51.2
Lacepede Islands	4.0	58.9	NC	NC	NC	NC	NC	NC
Indonesia - East	3.3	79.3	6.0	80.9	5.3	80.9	153.9	51.2
Kimberley Coast PMZ	3.3	73.4	3.3	78.6	3.3	78.6	324.7	22.7
Cartier Island AMP	2.7	63.8	4.0	81.0	4.0	81.0	71.4	5.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Adele Island	2.0	65.9	2.7	40.4	2.7	40.4	66.1	5.7
Hibernia Reef*	1.3	95.7	NC	NC	NC	NC	NC	NC
Outer Shark Bay Coast	1.3	84.0	11.3	69.8	7.3	81.1	67.7	28.4
Browse Island	0.7	94.2	NC	NC	NC	NC	NC	NC
Camden Sound	0.7	99.3	0.7	99.9	0.7	99.9	56.2	5.7
Abrolhos Islands Easter Group	NC	NC	0.7	80.7	0.7	80.7	4.9	5.7
Abrolhos Islands Pelsaert Group	NC	NC	2.0	102.7	1.3	102.7	13.0	5.7
Abrolhos Islands Wallabi Group	NC	NC	4.0	89.5	3.3	89.5	34.5	5.7
Carnarvon - Inner Shark Bay	NC	NC	1.3	62.0	NC	NC	NC	NC
Exmouth Gulf Coast	NC	NC	1.3	42.0	0.7	61.3	5.1	5.7
Geraldton - Jurien Bay	NC	NC	0.7	105.7	NC	NC	NC	NC
Jurien Bay - Yanchep	NC	NC	2.0	92.1	NC	NC	NC	NC
Perth Northern Coast	NC	NC	0.7	110.0	0.7	110.0	1.1	5.7
Zuytdorp Cliffs - Kalbarri	NC	NC	0.7	104.3	0.7	104.3	1.2	5.7

**Intertidal receptor*

Table 6-5: Worst-case spill modelling results – Bedout South subsea loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
LOWC – subsurface release (Caley Condensate) of 2,083,121 m³ over 77 days								
Bedout Island	98.7	0.7	98.7	1.4	98.0	1.4	404.4	5.7
Port Hedland-Eighty Mile Beach	98.7	1.3	76.0	5.3	63.3	5.3	876.63	73.9
Eighty Mile Beach	80.7	2.8	72.7	7.3	60.7	7.3	4,506.0	227.4
Dampier Archipelago	30.7	18.3	47.3	15.1	42.7	15.1	296.3	45.5
Karratha-Port Hedland	25.3	17.2	22.0	13.6	7.3	27.9	58.5	17.1
Barrow-Montebello Surrounds*	27.3	30.1	NC	NC	NC	NC	NC	NC
Roebuck - Eighty Mile Beach	26.0	19.6	52.0	19.9	31.3	19.9	290.8	39.8
Outer Ningaloo Coast North*	20.7	34.8	NC	NC	NC	NC	NC	NC
Montebello Islands	16.7	31.4	36.7	18.4	30.0	18.4	213.2	17.1
Imperieuse Reef MP	16.7	34.4	31.3	38.4	30.7	38.4	416.7	51.2
Mermaid Reef AMP*	14.0	22.9	NC	NC	NC	NC	NC	NC
Broome North Coast	8.7	22.8	33.3	23.7	16.0	23.7	228.4	28.4
Broome - Roebuck	6.7	27.8	28.0	28.1	8.0	28.9	125.6	17.1

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Ningaloo Coast North	10.7	49.4	26.7	46.1	21.3	46.1	149.2	34.1
Southern Islands Coast	10.7	54.7	22.0	32.4	20.7	32.4	69.8	17.1
Clerke Reef MP	6.7	41.6	24.7	33.5	22.0	33.5	329.3	45.5
Barrow Island	4.0	42.4	30.0	27.9	20.7	29.3	208.0	34.1
Northern Islands Coast	4.0	31.8	3.3	41.5	2.7	41.5	55.1	11.4
Lowendal Islands	4.0	61.8	20.7	19.6	10.0	31.0	29.8	5.7
Scott Reef South	3.3	62.9	6.0	58.8	5.3	58.8	72.3	17.1
Muiron Islands	2.0	82.2	29.3	32.4	24.7	32.4	93.7	17.1
Adele Island	1.3	63.7	1.3	70.6	1.3	70.6	35.7	5.7
King Sound	1.3	45.3	12.0	42.6	2.7	45.9	64.3	11.4
Lacepede Islands	1.3	81.8	NC	NC	NC	NC	NC	NC
Seringapatam Reef*	0.7	97.8	NC	NC	NC	NC	NC	NC
Scott Reef North*	NC	NC	3.3	87.1	2.0	87.1	54.4	11.4
Ashmore Reef AMP	NC	NC	2.0	73.2	2.0	73.2	40.5	22.7
Camden Sound	NC	NC	1.3	93.9	NC	NC	NC	NC
Geraldton - Jurien Bay	NC	NC	0.7	106.1	NC	NC	NC	NC
Kimberley Coast PMZ	NC	NC	0.7	94.3	NC	NC	NC	NC

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Ningaloo Coast South	NC	NC	2.7	92.4	1.3	103.3	14.3	5.7
Outer Shark Bay Coast	NC	NC	2.7	85.3	1.3	104.3	3.6	5.7
Thevenard Islands	NC	NC	10.7	36.8	8.7	41.1	39.8	11.4
Zuytdorp Cliffs - Kalbarri	NC	NC	0.7	100.7	0.7	100.7	10.4	5.7

**Intertidal receptor*

Table 6-6: Worst-case spill modelling results – Bedout West surface loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
LOWC – surface release (Caley Condensate) of 2,049,258 m³ over 77 days								
Outer Ningaloo Coast North*	60.0	17.7	NC	NC	NC	NC	NC	NC
Imperieuse Reef MP	59.3	12.7	68.0	12.7	68.0	12.7	2,595.6	56.9
Barrow-Montebello Surrounds*	58.0	11.1	NC	NC	NC	NC	NC	NC
Mermaid Reef AMP*	56.7	12.7	NC	NC	NC	NC	NC	NC
Montebello Islands	54.7	12.9	64.7	12.0	62.0	12.0	922.5	22.7
Ningaloo Coast North	53.3	21.8	58.0	18.2	55.3	18.2	2,051.0	181.9
Clerke Reef MP	50.0	12.1	59.3	12.1	59.3	12.1	2,334.7	51.2
Barrow Island	49.3	12.7	61.3	12.2	58.7	12.2	1,412.4	62.5
Southern Islands Coast	46	19.1	52.7	16.9	51.3	16.9	840.5	39.8
Dampier Archipelago	45.3	13.7	60.0	17.8	54.0	17.8	962.4	62.5
Bedout Island	44.0	6.2	46.7	7.1	44.7	7.1	302.6	5.7
Muiron Islands	40.0	19.2	52.7	16.9	50.0	16.9	867.7	17.1
Port Hedland-Eighty Mile Beach	31.3	8.3	26.0	8.8	18.7	8.8	386.5	34.1

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Lowendal Islands	28.7	19.0	34.7	19.1	29.3	19.1	114.0	5.7
Thevenard Islands	27.3	21.75	45.3	21.2	45.3	21.2	512.7	11.4
Eighty Mile Beach	20.7	8.9	29.3	19.1	10.7	19.1	127.0	17.1
Northern Islands Coast	16.7	24.4	9.3	24.4	5.3	24.4	41.1	17.1
Karratha-Port Hedland	15.3	3.4	14.7	3.9	9.3	3.9	807.5	39.8
Scott Reef South	15.3	51.6	25.3	49.5	25.3	49.5	509.2	51.2
Seringapatam Reef*	14.7	50.5	NC	NC	NC	NC	NC	NC
Ningaloo Coast South	12.7	49.3	30.7	51.1	29.3	51.1	132.3	68.2
Roebuck - Eighty Mile Beach	10.7	37.3	12.7	34.2	6.0	38.5	71.0	11.4
Ashmore Reef AMP	10.0	74.8	12.7	68.4	12.7	68.4	175.4	28.4
Scott Reef North*	8.7	56.5	19.3	52.8	18.7	52.8	262.4	34.1
Broome - Roebuck	5.3	27.1	7.3	28.1	5.3	28.1	68.5	11.4
Broome North Coast	4.7	48.5	9.3	49.4	6.7	49.4	66.9	22.7
Indonesia - East	4.0	95.3	6.0	87.7	6.0	87.7	44.9	17.1
Outer Shark Bay Coast	3.3	72.0	23.3	56.0	19.3	56.0	106.2	51.2
Cartier Island AMP	2.7	60.9	4.7	65.3	4.7	65.3	48.2	5.7
Exmouth Gulf Coast	2.7	47.1	6.7	38.8	3.3	45.6	15.2	5.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Carnarvon - Inner Shark Bay	2.0	62.8	NC	NC	NC	NC	NC	NC
Middle Islands Coast	1.3	43.1	4.7	43.9	4.7	43.9	15.2	5.7
Abrolhos Islands Easter Group	0.7	110.0	2.0	93.7	0.7	110.8	15.5	5.7
Abrolhos Islands Wallabi Group	0.7	88.0	2.7	79.3	1.3	79.3	19.4	5.7
Browse Island	0.7	110.2	NC	NC	NC	NC	NC	NC
Hibernia Reef*	0.7	87.3	NC	NC	NC	NC	NC	NC
Kimberley Coast PMZ	0.7	88.8	NC	NC	NC	NC	NC	NC
Abrolhos Islands Pelsaert Group	NC	NC	4.0	97.3	2.0	97.3	8.8	5.7
Geraldton - Jurien Bay	NC	NC	0.7	94.1	NC	NC	NC	NC
Jurien Bay - Yanchep	NC	NC	2.0	71.0	1.3	71.0	20.9	11.4
Kalbarri - Geraldton	NC	NC	1.3	96.1	0.7	96.1	5.6	5.7
King Sound	NC	NC	3.3	58.6	0.7	78.1	8.9	5.7
Zuytdorp Cliffs - Kalbarri	NC	NC	5.3	79.2	4.0	89.5	18.1	11.4

**Intertidal receptor*

Table 6-7: Worst-case spill modelling results – Bedout North surface loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
LOWC – surface release (Caley Condensate) of 2,049,258 m³ over 77 days								
Imperieuse Reef MP	75.3	6.8	84.7	6.9	84.7	6.9	3,580.5	56.9
Mermaid Reef AMP*	72.7	12.1	NC	NC	NC	NC	NC	NC
Clerke Reef MP	61.3	9.0	78.0	9.1	78.0	9.1	2,920.9	51.2
Outer Ningaloo Coast North*	48.7	26.0	NC	NC	NC	NC	NC	NC
Barrow-Montebello Surrounds*	44.0	17.4	NC	NC	NC	NC	NC	NC
Ningaloo Coast North	41.3	31.8	40.7	32.3	40.0	32.3	884.0	136.4
Southern Islands Coast	38.0	24.4	45.3	24.1	44.0	24.1	541.2	22.7
Barrow Island	34.0	24.8	44.7	18.6	43.3	18.6	554.6	51.2
Broome North Coast	34.0	18.8	34.7	21.4	32.7	21.4	1,102.7	73.9
Dampier Archipelago	34.0	16.8	46.0	16.8	42.7	16.8	454.4	51.2
Montebello Islands	30.7	19.6	47.3	18.3	43.3	18.3	473.6	22.7
Muiron Islands	26.7	26.9	45.3	24.3	45.3	24.3	537.7	17.1
Bedout Island	26.0	3.7	30.7	6.3	27.3	6.3	263.6	5.7
Broome - Roebuck	26.0	22.9	22.7	24.3	18.0	24.3	347.2	22.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Scott Reef South	24.7	42.8	34.0	36.1	34.0	36.1	1753.8	56.9
Roebuck - Eighty Mile Beach	24.0	19.7	26.0	19.8	18.7	19.8	638.9	45.5
Eighty Mile Beach	23.3	15.8	18.7	25.3	6.0	25.3	118.0	22.7
Seringapatam Reef*	21.3	46.2	NC	NC	NC	NC	NC	NC
Lowendal Islands	16.0	29.6	15.3	28.8	9.3	28.8	35.6	5.7
Thevenard Islands	12.0	34.8	38.7	26.4	32.7	26.4	195.8	11.4
King Sound	10.0	58.9	11.3	37.8	9.3	37.8	102.7	17.1
Port Hedland-Eighty Mile Beach	10.0	6.3	12.0	15.4	7.3	15.4	194.2	11.4
Scott Reef North*	10.0	45.7	21.3	51.8	20.7	51.8	336.0	45.5
Ningaloo Coast South	9.3	77.3	20.7	58.7	19.3	58.7	139.2	56.9
Karratha-Port Hedland	8.0	26.3	6.0	41.9	2.0	41.9	44.7	5.7
Northern Islands Coast	7.3	35.3	6.7	40.6	5.3	40.6	72.6	11.4
Lacepede Islands	6.0	35.1	NC	NC	NC	NC	NC	NC
Ashmore Reef AMP	5.3	61.6	12.7	50.4	12.0	50.4	799.4	39.8
Cartier Island AMP	5.3	62.0	6.0	56.8	6.0	56.8	103.5	5.7
Indonesia - East	4.0	76.4	5.3	80.9	4.0	80.9	98.6	28.4

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Outer Shark Bay Coast	2.7	69.5	12.7	65.5	12.0	66.4	139.5	28.4
Browse Island	2.0	101.3	NC	NC	NC	NC	NC	NC
Camden Sound	2.0	90.5	2.7	69.9	0.7	100.7	3.0	5.7
Carnarvon - Inner Shark Bay	1.3	66.6	0.7	67.4	0.7	67.4	8.0	5.7
Kimberley Coast PMZ	1.3	85.8	2.0	91.0	0.7	91.0	51.0	5.7
Adele Island	0.7	108.5	2.7	80.2	2.7	80.2	71.1	5.7
Hibernia Reef*	0.7	90	NC	NC	NC	NC	NC	NC
Indonesia - West	0.7	71.7	0.7	72.3	0.7	72.3	25.1	5.7
Abrolhos Islands Pelsaert Group	NC	NC	1.3	105.1	NC	NC	NC	NC
Abrolhos Islands Wallabi Group	NC	NC	0.7	87.4	NC	NC	NC	NC
Exmouth Gulf Coast	NC	NC	2.0	45.9	NC	NC	NC	NC
Geraldton - Jurien Bay	NC	NC	0.7	97.4	NC	NC	NC	NC
Jurien Bay - Yanchep	NC	NC	1.3	98.1	0.7	98.1	16.6	5.7
Middle Islands Coast	NC	NC	1.3	55.3	0.7	55.3	3.7	5.7
Zuytdorp Cliffs - Kalbarri	NC	NC	0.7	109.1	NC	NC	NC	NC

**Intertidal receptor*

Table 6-8: Worst-case spill modelling results – Bedout South surface loss of well control

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
LOWC – surface release (Caley Condensate) of 2,049,258 m³ over 77 days								
Bedout Island	100.0	0.5	99.3	0.6	99.3	0.6	400.5	5.7
Port Hedland-Eighty Mile Beach	98.7	0.8	78.0	2.4	71.3	2.4	5,133.4	176.2
Eighty Mile Beach	82.7	1.8	73.3	4.3	65.3	4.3	16,561.4	483.2
Dampier Archipelago	46.7	11.7	54.0	11.7	52.7	11.7	716.3	68.2
Roebuck - Eighty Mile Beach	44.7	11.7	55.3	12.5	48.0	12.5	1,186.7	62.5
Karratha-Port Hedland	44.0	5.0	32.0	5.8	20.7	5.8	612.3	39.8
Barrow-Montebello Surrounds*	43.3	21.3	NC	NC	NC	NC	NC	NC
Outer Ningaloo Coast North*	34.7	28.7	NC	NC	NC	NC	NC	NC
Montebello Islands	32.0	19.8	44.7	16.9	42.0	16.9	480.1	22.7
Southern Islands Coast	28.0	27.4	38.7	24.7	38.0	27.5	247.3	22.7
Ningaloo Coast North	24.7	31.8	34.0	31.7	31.3	31.7	354.8	79.6
Barrow Island	24.0	31.3	42.7	24.7	38.0	24.7	284.8	51.2
Imperieuse Reef MP	24.0	17.2	34.7	17.3	34.0	17.3	777.4	56.9

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Broome North Coast	22.0	21.0	41.3	22.6	30.0	22.6	616.6	68.2
Broome - Roebuck	20.0	18.8	42.0	20.6	23.3	20.6	331.7	28.4
Mermaid Reef AMP*	19.3	24.4	NC	NC	NC	NC	NC	NC
Clerke Reef MP	12.7	30.0	26.0	30.0	24.7	30.0	994.9	51.2
Lowendal Islands	12.7	26.8	28.7	22.9	20.7	22.9	131.8	5.7
Muiron Islands	11.3	37.8	40.0	21.1	35.3	25.6	216.9	17.1
Northern Islands Coast	10.0	38.9	11.3	25.9	8.7	25.9	58.6	17.1
Thevenard Islands	4.0	28.8	23.3	24.6	17.3	24.6	81.6	11.4
King Sound	3.3	40.3	17.3	40.8	4.7	40.8	70.2	17.1
Lacepede Islands	3.3	25.3	NC	NC	NC	NC	NC	NC
Seringapatam Reef*	2.7	71.6	NC	NC	NC	NC	NC	NC
Scott Reef South	1.3	97.5	8.7	59.8	7.3	59.8	41.2	17.1
Ashmore Reef AMP	0.7	93.3	3.3	74.6	2.0	74.6	51.6	5.7
Cartier Island AMP	0.7	107.7	0.7	109.5	0.7	109.5	4.7	5.7
Middle Islands Coast	0.7	55.1	0.7	67.8	NC	NC	NC	NC
Scott Reef North	0.7	109.0	2.7	57.6	1.3	57.6	30.4	5.7
Adele Island	NC	NC	2.0	89.8	0.7	89.8	8.4	5.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Camden Sound	NC	NC	0.7	101.5	0.7	101.5	1.7	5.7
Kimberley Coast PMZ	NC	NC	1.3	95.3	NC	NC	NC	NC
Ningaloo Coast South	NC	NC	6.0	65.4	4.7	67.7	50.1	28.4
Outer Shark Bay Coast	NC	NC	6.0	70.8	5.3	80.5	33.1	5.7

**Intertidal receptor*

Table 6-9: Worst-case spill modelling results – vessel collision (marine diesel oil)

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation> 10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Vessel collision with third-party vessel and surface spill (MDO) of 393 m³ over 0.5 hours								
Bedout West (Latitude: 19°24'08.7" S / Longitude: 117°55'44.6" E)								
Clerke Reef MP	NC	NC	1.3	13.7	NC	NC	NC	NC
Bedout North (Latitude: 18° 46' 32.1" S / Longitude: 118°59'55.9" E)								
Imperieuse Reef MP	NC	NC	0.7	9.4	0.7	9.4	1.6	2.8
Bedout South (Latitude: 19°27'40.9" S / Longitude: 119°19'42.3" E)								
Bedout Island	10.0	0.5	17.3	0.8	6.7	0.8	52.8	1.4
Port Hedland - Eighty Mile Beach	4.0	1.6	2.7	2.6	1.3	2.6	1.6	2.8
Eighty Mile Beach	2.7	2.7	4.0	6.4	2.0	6.4	1.4	4.2

6.4 Deterministic modelling

Deterministic modelling is a useful tool for response planning. It uses a single spill run from the group of stochastic runs to help understand the likely behaviour and impacts of a single simulation of a worst-case spill scenario. This allows for effective scaling of response strategies.

Deterministic runs were selected for each scenario based on the largest predicted oil mass accumulated on all shorelines. To help further understand the predicted effectiveness of response options, deterministic modelling was completed for all of the Caley Condensate LOWC spill scenarios.

In order to inform the appropriate scale of Containment and Recovery response planning, an additional deterministic run was carried out. In this instance, the run that resulted in the highest mass of surface oil exceeding 50 g/m² was selected for the deterministic run (Bedout North – Surface LOWC, stochastic realisation #4).

Deterministic runs of subsea LOWC scenarios were run under three scenarios; no mitigation, with subsea dispersant injection (SSDI) as the sole mitigative response, and with both SSDI and surface dispersant (SDA) application as a combined response. Deterministic runs of surface LOWC scenarios were run with no mitigation and with SDA application as a response. Surface dispersant application was simulated using vessel and fixed wing aerial dispersant capability (FWADC), using the parameters described in **Table 6-10**.

Unlike stochastic modelling, deterministic modelling takes into account hydrocarbon weathering, degradation and dispersion. This results in a discrepancy between the maximum shoreline accumulation for a stochastic run and a deterministic run. For the purpose of this OPEP, floating oil and shoreline accumulation volumes are conservatively based on stochastic modelling outcomes. However, to assess the effect of dispersants on shoreline accumulation the deterministic modelling is considered in **Section 6.4.1**.

Table 6-10: Surface dispersant application parameters used in modelling

Parameter	Vessel/s	Aircraft (FWADC)	Aircraft (Hercules)
Location of operational base	Port Hedland	Port Hedland	Port Hedland
Dispersant application rate	1:25		
Dispersant efficacy	40% for Caley Condensate (refer to **Appendix A**)		
Minimum thickness threshold for dispersant application	>50 g/m²		
Maximum viscosity threshold for dispersant application	<10,000 cSt		
Exclusion zones	+ Habitat Protection Zone or National Park Zone of an Australian Marine Park (application in Multiple Use Zones allowed) + State Marine Parks + State Waters + Within 10 km of water depths greater than 10 m lowest astronomical tide (LAT) + Within exclusion zones of offshore facilities + Not within 25 km of well site[4].		

6.4.1 Dispersant mitigated scenario results

6.4.2 Loss of well control subsea – Bedout West

Modelling of the unmitigated stochastic realisation #113 resulted in a predicted peak loading of 3,671.8 tonnes, occurring on day 88.5. Under the SSDI mitigated scenario, the predicted peak load ashore was 3,343.8 tonnes (reduction of 9% from unmitigated scenario) occurring on day 87.1. The SSDI+SDA mitigated scenario predicted a peak loading of 3,022.3 tonnes (reduction of 18% from unmitigated scenario and 9% from SSDI mitigated scenario), occurring on day 87.8.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the mitigated, SSDI and SSDI+SDA scenarios is shown in **Table 6-11**. The total volume of surface dispersant applied under the mitigative modelling scenario was 9,637.8 m³, which treated a total of 96,377.6 tonnes of oil (**Table 6-11**).

The predicted minimum arrival time at the receptor with the highest shoreline loading, Clerke Reef MP, is 61.5 days under the unmitigated scenario, with the receptor predicted to receive a peak load of 1,503 tonnes on day 76.1. Under the SSDI mitigated scenario, peak loading increased to 1,697.4 tonnes (increase of 13%) with no change in arrival time, and peak loading occurring approximately three days earlier. When compared

[4] Santos confirmed during modelling that leaving a 25 km buffer around the LOWC location allows for a significant proportion of Caley Condensate to evaporate (62% within 48 hours under moderate (5 m/s) wind conditions) (GHD, 2021). The 25 km buffer represents the approximate distance that surface oil will travel from the LOWC location under moderate wind conditions within a 48-hour period. This approach allows for response techniques to be more effective on the remaining proportion of hydrocarbons within the marine environment.

against the unmitigated scenario, SSDI+SDA application extends the arrival time at Clerke Reef MP from 61.5 to 64 days with negligible difference in peak loading (less than 5%).

Table 6-11: Spill modelling results showing application of subsea dispersant and surface dispersant as a mitigation strategy for Bedout West subsea loss of well control scenario[5]

Location	Maximum mass oil ashore (tonnes)			Minimum arrival time (days)			Peak loading time (days)		
	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated
Clerke Reef MP	1,503	1,697.4	1,534.2	61.5	61.5	64	76.1	73.2	73
Imperieuse Reef MP	1,097.6	1,063.5	831.7	59.5	62.5	59.3	90.7	91.3	90.8
Barrow Island	471	162.3	70.3	25.9	24.9	23.8	66.8	67.3	59.9
Dampier Archipelago	393.3	370.2	389.7	12.8	13.8	12	62.6	66.3	70.4
Montebello Islands	330.4	180.8	295.5	23.5	22.1	21.9	57	56	66.8
Southern Islands Coast	226.7	284	200.3	38	31.8	31.6	58	56.7	57.8
Muiron Islands	163	105.8	161.1	41	31.9	40.3	66.8	57	66.5
Thevenard Islands	147.1	113.9	108.6	39	29.7	29.5	58.4	59	61.9
Ningaloo Coast North	93.8	74.8	10.7	57	36.3	38.8	64.1	63.7	64.5
Lowendal Islands	15.1	1.6	3.7	58.5	28.9	27.2	67.3	29.9	31.8
Bedout Island	0.4	NC	NC	88.7	NC	NC	88.7	NC	NC
Middle Islands Coast	0.2	7.5	NC	66.9	65.9	NC	66.9	65.9	NC

[5] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Location	Maximum mass oil ashore (tonnes)			Minimum arrival time (days)			Peak loading time (days)		
	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated
Northern Islands Coast	NC	0.2	31.4	NC	67.3	59.7	NC	67.3	60.6
All shorelines	3,671.8	3,343.8	3,022.3	12.8	13.8	12	88.5	87.1	87.8

Table 6-12: Bedout West subsea loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m^3)
FWADCs	61,257.5	6,125.8
Hercules	20,214.5	2,021.5
Vessels	14,905.6	1,490.6
Total amount of oil treated with dispersants (tonnes)	96,377.6	
Total volume of dispersant used (m^3)	9,637.8	

6.4.3 Loss of well control subsea – Bedout North

Unmitigated modelling for this scenario (stochastic realisation 28) resulted in a predicted peak loading of 2,995.2 tonnes, occurring on day 66.4. Under the SSDI mitigated scenario, the predicted peak load ashore was 3,420.2 tonnes (14 % increase from unmitigated scenario), occurring on day 66.4. The SSDI and SDA mitigated scenario predicted a peak loading of 3,069.8 tonnes (increase of 2 % from the unmitigated summary, and a decrease of 12% from the SSDI mitigation scenario), occurring on day 64.8. Although no deterministic scenarios were run with SDA application as the sole mitigation strategy, it can be inferred based on these results that the application of SDA alone is likely to result in a minor decrease of predicted loading ashore when compared against the unmitigated scenario.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the mitigated, SSDI and SSDI+SDA scenarios are shown in **Table 6-13**. The total volume of surface dispersant applied under the mitigative modelling scenario was 17,077.9 m^3, which treated a total of 170,7791 tonnes of oil (**Table 6-14**).

Table 6-13: Spill modelling results showing application of subsea dispersant and surface dispersant as a mitigation strategy for Bedout North subsea loss of well control scenario[6]

Location	Maximum mass oil ashore (tonnes)			Minimum arrival time (days)			Peak loading time (days)		
	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated
Clerke Reef MP	1,542.6	1,602.4	1,668	41.3	41.4	37.3	57.1	65.5	65.8
Imperieuse Reef MP	1,459.8	1,629.8	1,418.7	37.8	33.2	35.4	78.2	66.4	64.8
Bedout Island	169.9	171.7	82.8	73.4	71.2	70.6	75.2	87.2	96.4
Broome North Coast	126.3	129.1	NC	32.3	45.2	NC	58.1	NC	NC
Scott Reef South	131.4	102	65.6	94.3	95.3	95.8	99.9	109.6	99.3
Ashmore Reef AMP	86.6	146.1	19.1	104.3	102.7	104.4	111.1	110.4	111.7
Eighty Mile Beach	5	1.2	NC	63.2	82	NC	87.3	109.2	NC
Scott Reef North	2.5	25.2	84	97.2	98.3	99	112	99	101.3
Broome – Roebuck	1.8	127.9	NC	36.9	50	NC	82	55.5	NC
Port Hedland – Eighty Mile Beach	1.3	1.1	NC	80.8	81.5	NC	80.8	90.1	NC

[6] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Location	Maximum mass oil ashore (tonnes)			Minimum arrival time (days)			Peak loading time (days)		
	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated
King Sound	0.5	NC	NC	58.1	NC	NC	58.1	NC	NC
Cartier Island AMP	NC	12.9	NC	NC	111.3	NC	NC	111.3	NC
All shorelines	2,995.2	3,420.2[7]	3,069.8	32.2	33.2	35.4	66.4	66.4	64.8

[7] Applying subsea dispersant injection at the well site may reduce the surface oil mass in proximity to the well, however it has a lesser influence at greater distances such as the Rowley Shoals (~150 km from the well). By the time oil is transported to this location, much of the dispersed oil has surfaced after spending several days entrained in the water column. The surfaced oil (that was previously entrained) has therefore had less opportunity to undergo weathering by evaporation in comparison to the unmitigated scenario in which the oil surfaces earlier, prior to reaching the Rowley Shoals. This dynamic has therefore resulted in a slight increase in surface oil in proximity to the Rowley Shoals for the SSDI mitigated scenario, which leads to an increase in shoreline loading at Clerke Reef MP and Imperieuse Reef MP.

Table 6-14: Bedout North subsea loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m^3)
FWADCs	70,565.3	7,065.5
Hercules	27,370.7	2,737.1
Vessels	18,143.4	1,814.3
Total amount of oil treated with dispersants (tonnes)	116,079.4	
Total volume of dispersant used (m^3)	11,607.9	

6.4.4 Loss of well control subsea – Bedout South

Modelling of the unmitigated stochastic realisation #32 resulted in a predicted peak loading of 3,558.1 tonnes, occurring on day 69.8. Under the SSDI mitigated scenario, the predicted peak load ashore was 3,775.8 tonnes (increase from unmitigated scenario of 6%), occurring on day 69.6. The SSDI+SDA mitigated scenario predicted a peak loading of 1,235.3 tonnes (reduction of 65% from unmitigated and 67% from SSDI mitigated scenarios), occurring on day 68.6.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the mitigated, SSDI and SSDI+SDA scenarios are shown in **Table 6-15**. The total volume of surface dispersant applied under the mitigative modelling scenario was 11,722 m^3, which treated a total of 117,220.2 tonnes of oil (**Table 6-16**).

Bedout South is the closest LOWC location to the Western Australian coast. SSDI application resulted in a minor increase in total shoreline loading, however the SSDI+SDA mitigation strategy resulted in the greatest reduction in total shoreline loading of all LOWC scenarios to which mitigation strategies were applied. This reduction (65%) can be attributed entirely to the SDA component of this response, with SSDI having minimal effect on reducing shoreline loading at most receptors (see **Table 6-15** for further information).

The predicted minimum arrival time at the receptor with the highest shoreline loading, Eighty Mile Beach, is 15.8 days under the unmitigated scenario, with the receptor predicted to receive a peak load of 3,032.5 tonnes on day 69.9. A minor change is seen in the SSDI mitigated scenario, with the arrival time reducing from 15.6 days (unmitigated) to 10.9 days (SSDI mitigated), a 6% increase in the peak load of oil ashore (3,391.3 tonnes) and peak loading occurring 0.1 days earlier. When compared against the unmitigated scenario, SSDI+SDA application extends the arrival time at Eighty Mile beach from 15.8 to 17.7 days and reduces the peak load to 977 tonnes, a 68% reduction.

Table 6-15: Spill modelling results showing application of subsea dispersant and surface dispersant as a mitigation strategy for Bedout South subsea loss of well control scenario [8]

Location	Maximum mass oil ashore (tonnes)			Minimum arrival time (days)			Peak loading time (days)		
	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated	Unmitigated	SSDI Mitigated	SSDI & SDA Mitigated
Eighty Mile Beach	3,032.5	3,391.3	977.0	15.8	10.9	17.7	69.9	69.8	69.8
Port Hedland – Eighty Mile Beach	654.7	377.2	229.1	22.8	22.3	23.2	33.3	41.5	28.0
Bedout Island	203.7	217.8	221.1	19.9	20.0	19.9	51.8	27.6	28.5
Karratha – Port Hedland	131.9	101.6	NC	40.2	37.9	NC	41.5	41.5	NC
Barrow Island	NC	0.4	0.1	NC	100.4	102.0	NC	100.4	102.0
All shorelines	3,558.1	3,775.8	1,235.3	15.8	10.9	17.7	69.8	69.6	68.6

[8] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Table 6-16: Bedout South subsea loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m^3)
FWADCs	78,087.8	7,808.8
Hercules	20,973.1	2,097.3
Vessels	18,159.4	1,815.9
Total amount of oil treated with dispersants (tonnes)	117,220.2	
Total volume of dispersant used (m^3)	11,722.0	

6.4.5 Loss of well control at surface – Bedout West

Unmitigated modelling for this scenario (stochastic realisation 113) resulted in a predicted peak loading of 4,403.7 tonnes, occurring on day 86.8. Under the SDA mitigated scenario, the predicted peak load ashore was 4,186.7 tonnes (an increase of 5% from the unmitigated scenario), occurring on day 90.3.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the unmitigated and SDA mitigated scenarios are shown in **Table 6-17**. The total volume of surface dispersant applied under the mitigative modelling scenario was 13,627.3 m^3, which treated a total of 136,273.1 tonnes of oil (**Table 6-18**).

Table 6-17: Spill modelling results showing application of surface dispersant as a mitigation strategy for Bedout West surface loss of well control scenario[9]

Location	Maximum volume oil ashore (tonnes)		Minimum arrival time (days)		Peak loading time (days)	
	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated
Clerke Reef MP	1,495.5	1,498.4	61.1	60.4	72.8	75.8
Imperieuse Reef MP	1,467.2	1,238.4	62.4	58.6	92.6	87.7
Barrow Island	558.1	594.1	24	23.8	66.1	66.3
Montebello Islands	447.7	303.2	23.8	25.1	56.7	65.8
Southern Islands Coast	354.4	378.1	36.7	36.8	66.6	61
Thevenard Island	276.2	195.5	39	46.8	64.7	59
Muiron Islands	162.5	311.8	42	36.7	62.1	67.5
Ningaloo Coast North	157.4	98.4	44.2	37.9	56.9	66.6
Dampier Archipelago	115.4	82.4	61	29.9	65.9	65.9
Lowendal Islands	15.2	54.8	56.3	55.7	56.3	57.7
Northern Islands Coast	10.1	0.2	53	67.8	66.8	67.8
Middle Islands Coast	0.9	0.8	66.7	66.7	66.8	66.7
Exmouth Gulf Coast	0.1	NC	60.4	NC	60.4	NC
All shorelines	4,403.7	4,186.7	23.8	23.8	86.8	85.6

[9] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Table 6-18: Bedout West surface loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m^3)
FWADCs	83,238	8,323.8
Hercules	31,349.4	3,135
Vessels	21,685.6	2,168.6
Total amount of oil treated with dispersants (tonnes)	1,36,723.1	
Total volume of dispersant used (m^3)	13,627.3	

6.4.6 Loss of well control at surface – Bedout North

Unmitigated modelling for this scenario (stochastic realisation 19) resulted in a predicted peak loading of 3,655.2 tonnes, occurring on day 92.3. Under the SDA mitigated scenario, the predicted peak load ashore was 3,163.2 tonnes (a reduction of 13% from the unmitigated scenario), occurring on day 92.4.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the unmitigated and SDA mitigated scenarios are shown in **Table 6-19**. The total volume of surface dispersant applied under the mitigative modelling scenario was 11,353.6 m^3, which treated a total of 113,536.3 tonnes of oil (**Table 6-20**).

Santos

Table 6-19: Spill modelling results showing application of SDA as a mitigation strategy for Bedout North surface loss of well control scenario [10]

Location	Maximum volume oil ashore (tonnes)		Minimum arrival time (days)		Peak loading time (days)	
	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated
Imperieuse Reef MP	1,572.8	1,645.6	6.9	6.9	75.5	21.0
Clerke Reef MP	1,498.7	1,489.4	14.9	13.3	84.8	92.4
Broome North Coast	604.7	182	86.6	86.4	92.2	92.1
Scott Reef South	92.5	48.1	39.4	87.4	91.5	89.8
Scott Reef North	18.1	NC	61.3	NC	95.3	NC
King Sound	0.2	NC	108.2	NC	108.2	NC
Ashmore Reef AMP	NC	0.3	NC	99.1	NC	99.1
All shorelines	3,655.2	3,162.2	6.9	6.9	92.3	92.4

[10] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Table 6-20: Bedout North surface loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m³)
FWADCs	68,730.7	6,873.1
Hercules	28,535.2	2,853.5
Vessels	16,270.4	1,627
Total amount of oil treated with dispersants (tonnes)	113,536.3	
Total volume of dispersant used (m³)	11,353.6	

6.4.7 Loss of well control at surface – Bedout South

Unmitigated modelling for this scenario (stochastic realisation 30) resulted in a predicted peak loading of 11,946 tonnes, occurring on day 90.3. Under the SDA mitigated scenario, the predicted peak load ashore was 8,746.3 tonnes (a reduction of 27% from the unmitigated scenario), occurring on day 90.3.

Total mass of oil ashore, minimum arrival time and peak loading time for each receptor impacted under the unmitigated and SDA-mitigated scenarios are shown in **Table 6-21**. The total volume of surface dispersant applied under the mitigative modelling scenario was 17,077.9 m³, which treated a total of 170,7791 tonnes of oil (**Table 6-22**).

Santos

Table 6-21: Spill modelling results showing application of surface dispersant as a mitigation strategy for Bedout South surface loss of well control scenario [11]

Location	Maximum volume oil ashore (tonnes)		Minimum arrival time (days)		Peak loading time (days)	
	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated	Unmitigated	SDA Mitigated
Eighty Mile Beach	8,836.6	7,296.7	16.7	13.1	90.0	92.4
Port Hedland – Eighty Mile Beach	4,112	1,803.9	45	45.2	64.3	64.3
Karratha – Port Hedland	556.5	286.4	58.8	63	64.3	64.8
Bedout Island	206.3	203.9	42.8	42.8	51.7	44.7
Roebuck – Eighty Mile Beach	25.8	19.8	22.4	25	40.8	40.5
Broome North Coast	0.2	0.5	83	84	83	84
All shorelines	11,946	8,746.3	16.7	13.1	90.3	90.3

[11] Green cells indicate receptors that received at least a 5% reduction in shoreline loading, increased arrival time or increased peak loading time and red cells indicate receptors that received at least a 5% increase in maximum shoreline loading, decreased arrival time, or decreased peak loading time under the respective dispersant application summary (compared against the unmitigated scenario).

Table 6-22: Bedout South surface loss of well control – summary of surface dispersant responses

Response Item	Amount of	
	Oil treated (tonnes)	Dispersant applied (m^3)
FWADCs	104,893.3	10,489.3
Hercules	36,679	3,667.9
Vessels	29,206.9	2,920.7
Total amount of oil treated with dispersants (tonnes)	170,779.1	
Total volume of dispersant used (m^3)	17,077.9	

6.5 Evaluation of applicable response strategies

Based on the nature and scale of the credible spill scenarios outlined in **Section 6.1** and spill modelling results (**Sections 6.3** and **6.4**) the following spill response strategies have been assessed as potentially applicable for combatting a spill (**Table 6-23**).

Note: The information contained in **Table 6-23** has been developed by Santos for preparedness purposes. Santos may not be the Control Agency or Lead IMT for implementing a spill response. For example, for Level 2/3 spills within or entering State waters, DoT will ultimately determine the strategies and controls implemented for most State water activities with Santos providing resources and planning assistance.

Table 6-23: Evaluation of applicable response strategies

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Source Control	Spill kits	✓ 1	✓ 1	Relevant for containing spills that may arise on board a vessel or MODU.
	Secondary containment	✓ 1	✓ 1	Relevant for spills that may arise due to stored hydrocarbons, and from spills arising from machinery and equipment on board a vessel or MODU. Bunded areas will contain hydrocarbons reducing the potential for a spill escaping to marine waters. Where applicable open deck drainage will be closed to prevent hydrocarbon draining into the marine environment.
	Shipboard Oil Pollution Emergency Plan	✗	✓ 1	MARPOL requirement for applicable vessels. In the event a vessel hydrocarbon storage tank is ruptured, applicable strategies for reducing the volume of hydrocarbon releases will be contained within the vessel SOPEP. This may include securing cargo via transfer to another storage area on-board the vessel, transfer to another vessel, or through pumping in water to affected tank to create a water cushion (tank water bottom). Trimming the vessel may also be used to avoid further damage to intact tanks. These actions will aim to minimise the volume of fuel spilled.
	Surface well kill	✓ 1	✗	Considered during relief well planning but may not be possible depending upon technical and safety constraints. Surface well kill is only considered when the estimated leak rate is small enough not to generate an explosive gas cloud and access to the MODU is still preserved. This methodology would not be considered should safe access to the MODU or ability to operate a vessel alongside the MODU not be achievable.
	Capping stack	✗	✗	A subsea Capping Stack response strategy is not applicable given the petroleum activity will take place from a jack-up MODU. Under a credible subsea LOWC event there is no connection points for Capping Stack installation.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
	Relief well drilling	✓ 1	✗	Relevant to LOWC. Relief well drilling is the primary method for killing the well if access to the MODU is not preserved. To be conducted as per the Source Control Emergency Response Plan (DR-00-OZ-20001) and Well-specific or Campaign-specific Source Control Plan.
In-Situ Burning	Controlled burning of oil spill	✗	✗	Not applicable to condensate wells due to safety hazards. Not applicable to diesel spills due to inability to contain marine diesel making it very difficult to maintain necessary slick thickness for ignition and sustained burning.
Monitor and Evaluate Plan (Operational Monitoring)	Vessel surveillance	✓ 1	✓ 1	Provides real-time information on spill trajectory and behaviour (e.g., weathering). Informs implementation of other response strategies. Vessel personnel may not be trained observers. Vessel observers on leaking vessel may not have capacity to observe oil during emergency response procedure implementation. Constrained to daylight. Limited to visual range from the vessel. Limited capacity to evaluate possible interactions with sensitive receptors.
	Aerial surveillance	✓ 1	✓ 1	Provides real-time information on spill trajectory and behaviour (e.g., weathering). May identify environmental sensitivities impacted or at risk of impact (e.g., seabird aggregations, other users such as fishers). Informs implementation of other response strategies.
	Tracking buoys	✓ 1	✓ 1	Can be implemented rapidly. Can provide indication of near-surface entrained/dissolved hydrocarbons (most other monitor and evaluate techniques rely on the hydrocarbon being on the surface or shoreline).

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
	Trajectory Modelling	✓ 1	✓ 1	Can be implemented rapidly. Predictive - provides estimate of where the oil may go, which can be used to prepare and implement other responses. No additional field personnel required. Not constrained by weather conditions. Can predict floating, entrained, dissolved and stranded hydrocarbon fractions. May not be accurate. Requires in-field calibration.
	Satellite Imagery	✓ 1	✓ 1	Can work under large range of weather conditions (e.g., night-time, cloud cover, etc). Mobilisation likely to be more than 24 hours. Requires processing. May return false positives.
	Operational Water Quality Monitoring	✓ 1	✓ 1	Fluorometry surveys are used to determine the location and distribution of the entrained oil and dissolved aromatic hydrocarbon components of a continuous subsea spill and validate the spill fate modelling predictions.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
	Shoreline and Coastal Habitat Assessment	✓ 1	✓ 1	Provides information on shoreline oiling (state of the oil, extent of pollution, etc). Can provide information on amenability of shoreline response options (e.g., clean up, protect and deflect). Provides information on status of impacts to sensitive receptors. Considerable health & safety considerations. Requires trained observers. Constrained to daylight. Delayed response time.
Chemical dispersion	Vessel Application	✓ 1	✗	*Caley Condensate* Testing of Caley Condensate indicated the condensate to be amenable to dispersants. For all worst case LOWC scenarios, the expression of oil at the surface is expected to be within the suitable parameters for surface dispersant application and containment and recovery. Modelling conducted on surface dispersants as a mitigation strategy (**Section 6.4**) shows that application via vessel and aerial application is considered a feasible response strategy. Maintaining a 25 km buffer zone around the well location in which no chemical dispersants are applied allows for a significant portion of the hydrocarbon to evaporate (62% under normal wind conditions) prior to the application of SDA. SSDI is only suitable for subsea LOWC scenarios. For this activity, the most likely type of loss of well control would be a surface discharge. Modelling indicates SSDI provides an insignificant benefit in reducing shoreline loading (**Section 6.4.1**). Accordingly, using the Subsea First Response Toolkit for debris clearance or SSDI is considered a secondary response strategy for this activity, due to: + no ROV-controllable devices installed subsea (surface wellhead and BOP used)
	Aerial Application	✓ 1	✗	
	Subsea dispersant injection	✓ 2	✗	

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
				+ the high exit velocity of subsea plumes which results in small, entrained droplets that are not materially affected by the subsea application of chemical dispersants that indicates minimal environmental benefit from SSDI (**Section 6.7**). For the reasons stated above, surface dispersant application is considered a primary strategy with SSDI considered a secondary strategy that may be considered if surface dispersant application and containment and recovery were not effective in meeting their performance outcome. Deterministic modelling scenarios to which chemical dispersants were applied predicted varying levels of effectiveness in reducing shoreline loading for each LOWC scenario. This is likely due to the volatile nature of Caley Condensate meaning that more mass of fresh oil is lost, however once the oil is weathered dispersant may be more effective. *Marine Diesel* Marine diesel is not considered a persistent hydrocarbon and has high natural dispersion rates in the marine environment. Chemical dispersant application is not recommended as a beneficial option for diesel as it has a low additional benefit of increasing the dispersal rate of the spill while introducing the potential for more chemicals into the marine environment.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Offshore Containment and Recovery	Use of offshore booms/skimmers or other collection techniques deployed from vessel/s to contain and collect oil	✓ 1	✗	*Caley Condensate* Likely to be effective on Caley Condensate, which has a moderate persistent component (62% of surface slick predicted to evaporate after 48 hours under moderate wind speed conditions). Deterministic modelling predicted all LOWC scenarios would result in sufficient thickness on the water for effective containment and recovery. If metocean weather conditions are unsuitable for containment and recovery (more than 1.8 m for offshore systems and more than 1.0 m for nearshore systems), then this will result in significantly higher rates of weathering and entrainment in the product reducing surface thicknesses to a level at which containment and recovery may not be effective. Due to the low viscosity of the oil prior to weathering containment and recovery may not be effective on the unweathered oil. Additionally, the volatilisation of the fresh oil at the surface may prevent safe containment and recovery operations. *Marine Diesel* Not suitable for marine diesel given its rapid weathering nature. Marine diesel spreads quickly to a thin film, making recovery via skimmers difficult and ineffective.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Mechanical Dispersion	Vessel prop-washing	✓ 2	✓ 2	Safety is a key factor and slicks with potential for high volatile organic compound (VOC) emission are not suitable. Mechanical dispersion may be applicable for the localised entrainment of surface oil but is not considered to have a significant effect on removing oil from the surface. Mechanical dispersion will entrain surface oil into the top layer of the water column. The aim of mechanical dispersion is to reduce the concentration of oil floating at the surface which could potentially contact receptors at the sea surface (e.g., sea birds) or shoreline receptors (e.g., mangroves). Once dispersed in the water column the smaller droplet sizes enhance the biodegradation process. Marine diesel is a light oil that can be easily dispersed in the water column by running vessels through the plume and using the turbulence developed by the propellers to break up the slick. Mechanical dispersion may be considered for targeted small breakaway patches of crude but may have limited effectiveness. The potential disadvantage of mechanical dispersion is that it could temporarily increase the concentration of entrained and dissolved oil in the vicinity of submerged shallow water receptors (e.g., corals, seagrass ad macroalgae). This is most likely in shallow water of a few metres deep. The suitability of mechanical dispersion as a response measure would consider the prevailing environmental conditions (it mimics the action of wave induced entrained so is most beneficial in calm conditions) and the type, proximity and depth (as applicable) of sensitivities in the area. Mechanical dispersion will be considered for petroleum activity sourced spills at the discretion of the OSC/IMT or by the relevant Control Agency. It is unlikely that vessels would be specifically allocated for mechanical dispersion but vessels undertaking primary strategies may be used opportunistically.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Protection and Deflection	Booming in nearshore waters and at shorelines	✓ 1	✓ 2	Considered if operational monitoring shows or predicts contact with sensitive shorelines. *Caley Condensate* Modelling shows high probability of contact, above impact and response thresholds for all LOWC scenarios. The effectiveness of this response will be dependent on local bathymetry, sea state, currents, tidal variations and wind conditions at the time of implementation. It is typically more effective in areas with low to moderate tidal ranges on low energy coastline types such as sandy beaches. Moderate to high tidal ranges generally include stronger currents and larger/longer intertidal areas that make it less effective and more difficult to keep booms in place. Protection and deflection are feasible in locations where access to the coastline allows vehicles and vessels to undertake operations. Activities would focus on areas of high protection value in low energy environments based upon real-time operational surveillance, provided the environmental and metocean conditions are favourable for an effective implementation. Consequently, this strategy may not be applicable across all areas or receptors identified as priority for protection. *Marine Diesel* Modelling shows low probability of contact with shorelines. Shoreline protection and deflection activities can result in physical disturbance to intertidal and shoreline habitats. Given the relatively small volumes predicted to come ashore, and the high rates of natural biodegradation of marine diesel, it would be better to focus on high priority areas for protection. This strategy is considered to be a secondary response strategy where it is safe and practical to implement and where priority protection areas are at risk of impact from marine diesel.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Shoreline clean-up	Activities include physical removal, surf washing, flushing, bioremediation, natural dispersion	✓ 1	✓ 2	Considered if operational monitoring shows or predicts contact with sensitive shorelines. *Caley Condensate* Shoreline clean-up has the ability to reduce stranded oil on shorelines and/or reduce remobilisation of oil. However, this response has potential to cause more impacts than benefits, especially if oiling is light. Shoreline assessments as part of operational monitoring provide site-specific guidance on the applicability and likely benefits of different clean-up techniques. Intrusive activities such as physical removal of waste using manual labour or mechanical aids requires careful site-specific planning to reduce secondary impacts of habitat disturbance, erosion and spreading oil beyond shorelines. Secondary impacts can be minimised through the use of trained personnel to lead operations. Logistically, clean-up operations will require site access, decontamination, waste storage, personal protective equipment, catering and transport services to support personnel working on shorelines. Flushing may be considered if the oil enters high priority/slow recovery habitats such as mangroves. Natural dispersion will occur as the hydrocarbon is remobilised from rock shelves and hard substrates, while residual hydrocarbons will biodegrade. *Marine Diesel* Modelling shows less than 20% probability of shoreline accumulation at more than 10 g/m^2. Shoreline clean-up activities can result in physical disturbance to shoreline habitats. Given the relatively small volumes predicted to come ashore, and the high rates of natural biodegradation of marine diesel, it would be better to focus on high priority areas for clean-up. This strategy is considered to be a secondary response strategy where it is safe and practical to implement and where protection priority areas are at risk of impacts from marine diesel.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Caley Condensate	MDO	
Oiled wildlife response	Activities include hazing, pre-emptive capture, oiled wildlife capture, cleaning and rehabilitation	✓ 1	✓ 1	Can be used to deter and protect wildlife from contact with oil. Mainly applicable for marine and coastal fauna (e.g., birds) where oil is present at the sea surface or accumulated at coastlines. Surveillance can be carried out as a part of the fauna specific operational monitoring. Wildlife may become desensitised to hazing method. Hazing may impact upon animals (e.g., stress, disturb important behaviours such as nesting or foraging). Permitting requirements for hazing and pre-emptive capture.
Scientific Monitoring	The monitoring of environmental receptors to determine the level of impact and recovery form the oil spill and associated response activities	✓ 1	✓ 1	Monitoring activities include: + water and sediment quality + biota of shorelines (sandy beaches, rocky shores and intertidal mudflats) + mangrove monitoring + benthic habitat monitoring (seagrass, algae, corals, non-coral benthic filter feeders) + seabirds and shorebirds + marine megafauna (incl. whale sharks and mammals) + marine reptiles (incl. turtles) + seafood quality + fish, fisheries and aquaculture The type and extent of scientific monitoring will depend upon the nature and scale of oil contact to sensitive receptor locations as determined through operational monitoring. Pre-defined initiation criteria exist for scientific monitoring plans associated with marine and coastal sensitivities.

6.6 Identify priority protection areas and initial response priorities

Combined spill modelling results were used to predict the Environment that may be Affected (EMBA) for Bedout Multi-Well Drilling operations (refer Section 3.1 of the Bedout Multi-Well Drilling EP (SO-00-BI-20003). The EMBA is the largest area within which effects from hydrocarbons spills associated with this activity, could extend. Within the EMBA, Santos has determined Hot Spots (key areas of high ecological value that have the greatest potential to be impacted by a Bedout Multi-Well Drilling operational spill) for which detailed oil spill risk assessment has been conducted (refer Section 7.6.5.1 of the Bedout Multi-Well Drilling EP). From these Hot Spot areas, priority protection areas for spill response have been identified (as per Section 7.5.6.4 of the Bedout Multi-Well Drilling EP (SO-00-BI-20003)). Priority protection areas are emergent features (i.e., coastal areas and islands) that would be targeted by nearshore spill response operations such as protection and deflection and shoreline clean-up.

Table 6-24 to **Table 6-27** list the key sensitivities and associated locations within the protection priority areas identified for each worst case spill scenario. The ranking of these sensitivities (also referred to as receptors) are listed, which is consistent with the rankings in *Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara* (DoT, 2017). Using a combination of sensitivities, and their associated rankings; together with the modelled maximum total volumes ashore and minimum time to shoreline contact, an initial response priority is provided in **Table 6-24** to **Table 6-27**. This information is designed to aid decision making in the preliminary stages of the response operation, so that initial resources are used for best effect.

For example, for the Bedout South surface LOWC, Eighty Mile Beach has the third shortest time to shoreline contact at more than 10 g/m^2 (modelled to be 4.3 days) and highest shoreline loadings of all priority protection areas. Therefore, the response priority for this scenario would be to protect the highest ranked sensitivities, being the intertidal mudflats (from Cape Missiessy to Cape Keraudren and Mandora Salt Marsh), turtles (flatback turtles at scattered locations along shoreline – listed in tables below) and Ramsar Wetland values. As the spill progresses, additional priority protection areas are likely to be impacted; modelling predicts time to impact ranges from 0.6 days at Bedout Island[12] to 74.6 days for Ashmore Reef AMP. This allows the IMT and response teams time to source additional resources to protect these key sensitivities, so the initial response priority is lower as the time to impact extends and loadings decrease.

[12] Bedout Island is a Protection Priority and has the fastest arrival time at 10g/m² (0.6 days), however shoreline loading potential is significantly lower than that of Eighty Mile Beach.

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Table 6-24: Initial response priorities, Bedout West – subsea loss of well control and surface loss of well control (Caley Condensate)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 2,371.9 Surface LOWC: 2,595.6	Subsea LOWC: 13.2 days Surface LOWC: 12.7 days	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Wide range of seabirds observed	2	1	N/A	N/A			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium

[13] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017).

[14] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017).

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [13]	DoT Ranking (Dissolved oil) [14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Socio-economic Tourism - charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Clerke Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 2,220.7 Surface LOWC: 2,334.7	Subsea LOWC: 12.4 days Surface LOWC: 12.1 days	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Second largest breeding colony on red-tailed tropicbirds (Migratory) in Australia Wide range of seabirds observed	2	1	Bedwell Island	Nesting: Sept to Feb			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [13]	DoT Ranking (Dissolved oil) [14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socio-economic Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Ningaloo Coast North	World Heritage Area	5	5	N/A	N/A	Subsea LOWC: 1,452 Surface LOWC: 2,051	Subsea LOWC: 20.9 days Surface LOWC: 18.2 days	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)	4	3	North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Medium
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar to Jul			Medium
	Birds 33 species seabirds and avifauna (Including Critically Endangered Eastern Curlew)	5	4	Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island	Nesting: Sep to Feb			High
	Coral and other subsea benthic primary producers	3	4	Largest fringing reef in Australia	Coral spawning: Mar & Oct			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	2	2	Numerous campsites and snorkelling sites along western Cape Range shorelines, Coral Bay, Waroora Station	Year-round			Medium
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	Subsea LOWC: 1,371 Surface LOWC: 1,412.4	Subsea LOWC: 12.2 days Surface LOWC: 12.2 days	Medium
	Turtles Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerheads and hawksbill	4	3	Green turtles on the western side of Barrow Island and flatback turtle nesting on the eastern side. Turtle Bay north beach, North and west coasts and John Wayne Beach have loggerhead and hawksbill turtle nesting	Year round, peaking Oct to Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Migratory birds (important habitat); tenth of top 147 bird sites, highest population of migratory birds in Barrow Island Nature Reserve (south-southeast of island). Double Island has important bird nesting sites (shearwaters and sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sep to Feb			Low
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	<u>Socio-economic</u> Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations Petroleum Activities such as Barrow Island petroleum production	5	5	Reverse Osmosis plant and port on eastern side of island (Port of Barrow Island)	N/A			Medium
Dampier Archipelago	<u>Mangroves</u>	3	3	Widespread and present in lagoons Important stands west Intercourse and Enderby	N/A	Subsea LOWC: 1,631 Surface LOWC: 962.4	Subsea LOWC: 11.2 days Surface LOWC: 17.8 days	Medium
	<u>Turtles</u> Hawksbill (Vulnerable) and flatback (Vulnerable) turtles	4	3	Hawksbill turtle nesting north-west of Rosemary Island and Delambre. Flatback turtle nesting at Legendre, Huay and Delambre	Turtle nesting and breeding Nov – Mar with peak in late Dec/early Jan			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Humpback whale (vulnerable) migration area	3	2	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Breeding on Goodwyn, Keast Islands and Nelson Rocks.				Medium
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Recreational fishing/ charter boats, tourism related to water-based activities and nature National Heritage Aboriginal sites Camping beaches Shipping fairway and proximity to major port	4	4	Widespread	Year-round			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	Subsea LOWC: 939 Surface LOWC: 922.5	Subsea LOWC: 11.7 days Surface LOWC: 12 days	Medium
	<u>Turtles</u> Loggerhead (Endangered) and green (Vulnerable) (significant rookeries); hawksbill (Vulnerable), flatback (Vulnerable) turtles	4	3	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium
	<u>Marine mammals</u> Pygmy blue whale (Vulnerable) and humpback whale (Vulnerable) migration area	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Low
	<u>Birds</u> Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sep to Feb			Medium

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Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Pearling (inactive/pearling zones) Very significant for recreational fishing and charter boat tourism (Marine Management Area) Social amenities and other tourism Nominated place (national heritage)	3	2	Widespread	Year-round			Low
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site, significant Green turtle (Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence	4	3	Loggerhead – South Island	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan	Subsea LOWC: 756 Surface LOWC: 867.7	Subsea LOWC: 17.9 days Surface LOWC: 16.9 days	High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Seabird nesting	2	1	Widespread	Nesting: Sept-Feb			Low
	Humpback whale (Vulnerable) migration	3	2	N/A	Jun to Jul			Medium
	Exmouth gulf prawn fishery (Muiron is western boundary); significant for recreational fishing and charter boat tourism	1	2		Prawn fishery – April to November Tourism and recreation: year-round			Low
Bedout Island	Turtles Foraging - loggerhead (Endangered), Green turtle (Vulnerable) and Hawksbill (Vulnerable). No known nesting	4	3	N/A	N/A	Subsea LOWC: 268.5 Surface LOWC: 302.6	Subsea LOWC: 6.7 days Surface LOWC: 7.1 days	High
	Coral and other subsea benthic primary producers	3	4	Fringing island	Coral spawning: Mar & Oct			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Globally significant Brown Booby breeding location – migratory species	2	1	N/A	Breeding: May to Nov			Medium
Lowendal Island	Mangroves	3	3	Offshore	N/A	Subsea LOWC: 212.2 Surface LOWC: 114	Subsea LOWC: 20.4 days Surface LOWC: 19.1 days	Medium
	Coral and other subsea benthic primary producers	3	4	Deep-water benthic (soft sediment) habitats Dugong Reef and Batman Reef (eastern side of Island)	Coral spawning: Mar and Oct			Low
	Turtles Important hawksbill, loggerhead and green turtle nesting	4	3	Beacon, Parakeelya, Kaia and Pipeline, Varanus Pipeline, Harriet and Andersons Beaches	Nesting all year, peak Oct to Jan Significant flatback rookery, nesting season for flatback turtles peaks Dec to Jan			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Approximately 89 species of avifauna, 12 to 14 migratory and threatened seabirds	2	1		Year-round			Medium
	Marine mammals Dugong foraging	3	2	Seagrass beds	N/A			Low
	Socio-economic and heritage Social amenities and other tourism, very significant for recreational fishing and charter boat tourism	2	2	Widespread	N/A			Low
Eighty Mile Beach	Ramsar wetland	5	5	220 km of beach and intertidal mudflats from Cape Missiessy to Cape Keraudren and Mandora Salt Marsh 40 km to the east	N/A	Subsea LOWC: 141.5 Surface LOWC: 127	Subsea LOWC: 33.5 days Surface LOWC: 19.1 days	High
	Mangroves	3	4	Mandora Saltmarsh area	N/A			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Turtles Flatback turtle nests (Vulnerable) at scattered locations along shoreline	3	2	N/A	Turtle nesting year-round, peak Oct to Feb			High
	Birds 97 wetland species, 42 of which are listed under international agreements.	4	3	Intertidal areas	Migration: Aug to Nov			High
	Socio-economic and heritage Tourism – camping and nature, recreational fishing. Wetlands significant to three local Aboriginal groups, several Aboriginal heritage sites present	1	1	N/A	N/A			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [13]	DoT Ranking (Dissolved oil) [14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Ashmore Reef AMP	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar and Oct	Subsea LOWC: 35 Surface LOWC: 175.4	Subsea LOWC: 70.7 days Surface LOWC: 28.4 days	Low
	Birds Important seabird rookery, important staging point/feeding area for migratory birds including curlew sandpiper (Critically Endangered)	4	3	N/A	Migration: Aug to Nov			Medium
	Turtles Critical nesting and interesting habitat for green turtles (Vulnerable), significant foraging populations of green, loggerhead turtles (Endangered) and hawksbill turtles (Vulnerable)	4	3		Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Small dugong population (<50 individuals) Migratory pathway for pygmy blue whales	3	2	N/A	Pygmy blue whale migration: Apr to Aug			Medium
	Socio-economic and heritage Staging area for traditional Indonesian fishers Commercial tourism – recreation and scientific research							
Exmouth Gulf Coast	Mangroves	3	3	East coast of gulf Bay of Rest	NA	Subsea LOWC: 34.9 Surface LOWC: 15.2	Subsea LOWC: 37.3 days Surface LOWC: 45.6 days	Medium
	Intertidal mud/sand flats Exmouth Gulf East (Directory of Important Wetlands in Australia)	4	4	Giralia Bay to Tubridgi Point Yannarie salt flats – eastern shore of gulf	N/A			High
	Seagrass Regionally significant seagrass meadows	2	3	Giralia to Locker Point	N/A			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	<u>Turtles</u> Internesting – Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)	3	2	Northwest section of gulf – Bundegi	Year round			Medium
	<u>Marine mammals</u> Dugongs Humpback whale calf resting area – critical resting area for southern migration			Dugongs: within gulf, particularly southern and eastern end of gulf adjacent to seagrass and mangrove areas				Medium
	<u>Socio-economic and heritage</u> Significant prawn fishery Pearling and aquaculture Shipwreck (Fairy Queen)	1	2	Seagrass beds	N/A			Low

Table 6-25: Initial response priorities, Bedout North – subsea loss of well control and surface loss of well control (Caley Condensate)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	<u>Turtles</u> Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 3,159.5 Surface LOWC: 3,580.5	Subsea LOWC: 7.6 days Surface LOWC: 6.9 days	Medium
	<u>Marine mammals</u> Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	<u>Birds</u> Wide range of seabirds observed	2	1	N/A	N/A			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium

[15] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017)

[16] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	<u>Socio-economic</u> Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Clerke Reef MP	<u>Turtles</u> Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 2,798.3 Surface LOWC: 2,920.9	Subsea LOWC: 13.6 days Surface LOWC: 9.1 days	Medium
	<u>Marine mammals</u> Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Second largest breeding colony on red-tailed tropicbirds (Migratory) in Australia Wide range of seabirds observed	2	1	Bedwell Island	Nesting: Sep to Feb			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [15]	DoT Ranking (Dissolved oil) [16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socio-economic Tourism - charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Ningaloo Coast North	World Heritage Area	5	5	N/A	N/A	Subsea LOWC: 631.2 Surface LOWC: 884	Subsea LOWC: 31.6 days Surface LOWC: 32.3 days	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)	4	3	North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Pygmy blue whales (Endangered) foraging area, dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Medium
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar to Jul			Medium
	Birds 33 species seabirds and avifauna (Including Critically Endangered Eastern Curlew)	5	4	Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island	Nesting: Sep to Feb			High
	Coral and other subsea benthic primary producers	3	4	Largest fringing reef in Australia	Coral spawning: Mar & Oct			High
	Tourism - significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	2	2	Numerous campsites and snorkelling sites along western Cape Range shorelines, Coral Bay, Waroora Station	Year-round			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	Subsea LOWC: 473.5 Surface LOWC: 554.6	Subsea LOWC: 24.6 days Surface LOWC: 18.6 days	Medium
	Turtles Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts – John Wayne beach, loggerheads and hawksbill	4	3	Green turtles on the western side of Barrow Island and flatback turtle nesting on the eastern side. Turtle Bay north beach, North and west coasts and John Wayne Beach have loggerhead and hawksbill turtle nesting	Year round, peaking Oct to Jan			High
	Birds Migratory birds (important habitat); 10th of top 147 bird sites, highest population of migratory birds in Barrow Island Nature Reserve (south-southeast of island). Double Island has important bird nesting sites (shearwaters and sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sep to Feb			Low

Santos

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct			Medium
	Socio-economic Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations Petroleum Activities such as Barrow Island petroleum production	5	5	Reverse Osmosis plant and port on eastern side of island (Port of Barrow Island)	N/A			Medium
Dampier Archipelago	Mangroves	3	3	Widespread and present in lagoons Important stands west Intercourse and Enderby	N/A	Subsea LOWC: 900 Surface LOWC: 454.4	Subsea LOWC: 21.2 days Surface LOWC: 16.8 days	Medium
	Turtles Hawksbill (Vulnerable) and flatback (Vulnerable) turtles	4	3	Hawksbill turtle nesting north-west of Rosemary Island and Delambre. Flatback turtle nesting at Legendre, Huay and Delambre	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	<u>Marine mammals</u> Humpback whale (vulnerable) migration area	3	2	N/A	Humpback whale migration: Jun to Jul			Low
	<u>Birds</u> Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Breeding on Goodwyn, Keast Islands and Nelson Rocks.				Medium
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	<u>Socio-economic</u> Recreational fishing/ charter boats, tourism related to water-based activities and nature National Heritage Aboriginal sites Camping beaches Shipping fairway and proximity to major port	4	4	Widespread	Year-round			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	Subsea LOWC: 487.3 Surface LOWC: 473.6	Subsea LOWC: 17.1 days Surface LOWC: 18.3 days	Medium
	Turtles Loggerhead (Endangered) and green (Vulnerable) (significant rookeries); hawksbill (Vulnerable), flatback (Vulnerable) turtles	4	3	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium
	Marine mammals Pygmy blue whale (Vulnerable) and humpback whale (Vulnerable) migration area	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Low
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sep to Feb			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Pearling (inactive/pearling zones) Very significant for recreational fishing and charter boat tourism (Marine Management Area) Social amenities and other tourism Nominated place (national heritage)	3	2	Widespread	Year-round			Low
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site, significant green turtle (Vulnerable) nesting site, low density hawksbill nesting (Vulnerable), occasional flatback (Vulnerable) presence	4	3	Loggerhead – South Island	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan	Subsea LOWC: 400.9 Surface LOWC: 537.7	Subsea LOWC: 23.2 days Surface LOWC: 24.3 days	High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Seabird nesting	2	1	Widespread	Nesting: Sep to Feb			Low
	Humpback whale (Vulnerable) migration	3	2	N/A	Jun to Jul			Medium
	Exmouth gulf prawn fishery (Muiron is western boundary); significant for recreational fishing and charter boat tourism	1	2		Prawn fishery – April to Nov Tourism and recreation: year-round			Low
Bedout Island	Turtles Foraging – loggerhead (Endangered), green turtle (Vulnerable) and hawksbill (Vulnerable). No known nesting	4	3	N/A	N/A	Subsea LOWC: 278.4 Surface LOWC: 263.6	Subsea LOWC: 14.1 days Surface LOWC: 6.3 days	High
	Coral and other subsea benthic primary producers	3	4	Fringing island	Coral spawning: Mar & Oct			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Globally significant Brown Booby breeding location – migratory species	2	1	N/A	Breeding: May to Nov			Medium
Lowendal Island	Mangroves	3	3	Offshore	N/A	Subsea LOWC: 39.3 Surface LOWC: 35.6	Subsea LOWC: 37.1 days Surface LOWC: 28.8 days	Medium
	Coral and other subsea benthic primary producers	3	4	Deep-water benthic (soft sediment) habitats Dugong Reef and Batman Reef (eastern side of Island)	Coral spawning: Mar and Oct			Low
	Turtles Important hawksbill, loggerhead and green turtle nesting	4	3	Beacon, Parakeelya, Kaia and Pipeline, Varanus Pipeline, Harriet and Andersons Beaches	Nesting all year, peak Oct to Jan Significant flatback rookery, nesting season for flatback turtles peaks Dec to Jan			Medium
	Birds Approximately 89 species of avifauna, 12 to 14 migratory and threatened seabirds	2	1		Year round			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Dugong foraging	3	2	Seagrass beds	N/A			Low
	Socio-economic and heritage Social amenities and other tourism, very significant for recreational fishing and charter boat tourism	2	2	Widespread	N/A			Low
Eighty Mile Beach	Ramsar wetland	5	5	220 km of beach and intertidal mudflats from Cape Missiessy to Cape Keraudren and Mandora Salt Marsh 40 km to the east	N/A	Subsea LOWC: 75 Surface LOWC: 118	Subsea LOWC: 31.7 days Surface LOWC: 25.3 days	High
	Mangroves	3	4	Mandora Saltmarsh area	N/A			Medium
	Turtles Flatback turtle nests (Vulnerable) at scattered locations along shoreline	3	2	N/A	Turtle nesting year-round, peak Oct to Feb			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [15]	DoT Ranking (Dissolved oil) [16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds 97 wetland species, 42 of which are listed under international agreements.	4	3	Intertidal areas	Migration: Aug to Nov			High
	Socio-economic and heritage Tourism – camping and nature, recreational fishing Wetlands significant to three local Aboriginal groups, several Aboriginal heritage sites present	1	1	N/A	N/A			Low
Ashmore Reef AMP	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar and Oct	Subsea LOWC: 282.3 Surface LOWC: 799.4	Subsea LOWC: 61.3 days Surface LOWC: 50.4 days	Low
	Birds Important seabird rookery, important staging point/feeding area for migratory birds including curlew sandpiper (Critically Endangered)	4	3	N/A	Migration: Aug to Nov			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [15]	DoT Ranking (Dissolved oil) [16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Turtles Critical nesting and interesting habitat for Green turtles (Vulnerable), significant foraging populations of Green, Loggerhead turtles (Endangered) and Hawksbill turtles (Vulnerable)	4	3		Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High
	Marine mammals Small dugong population (<50 individuals) Migratory pathway for pygmy blue whales	3	2	N/A	Pygmy blue whale migration: Apr to Aug			Medium
	Socio-economic and heritage Staging area for traditional Indonesian fishers Commercial tourism – recreation and scientific research							Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Exmouth Gulf Coast	Mangroves	3	3	East coast of gulf Bay of Rest	NA	Subsea LOWC: 5.1 Surface LOWC: NC	Subsea LOWC: 61.3 days Surface LOWC: NC	Medium
	Intertidal mud/sand flats Exmouth Gulf East (Directory of Important Wetlands in Australia)	4	4	Giralia Bay to Tubridgi Point Yannarie salt flats – eastern shore of gulf	N/A			High
	Seagrass Regionally significant seagrass meadows	2	3	Giralia to Locker Point	N/A			Low
	Turtles Internesting – loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)	3	2	Northwest section of gulf – Bundegi	Year round			Medium
	Marine mammals Dugongs Humpback whale calf resting area – critical resting area for southern migration			Dugongs: within gulf, particularly southern and eastern end of gulf adjacent to seagrass and mangrove areas				Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[15]	DoT Ranking (Dissolved oil)[16]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Socio-economic and heritage Significant prawn fishery Pearling and aquaculture Shipwreck (Fairy Queen)	1	2	Seagrass beds	N/A			Low

Table 6-26: Initial response priorities, Bedout South – subsea loss of well control and surface loss of well control (Caley Condensate)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 416.7 Surface LOWC: 777.4	Subsea LOWC: 38.4 days Surface LOWC: 17.3 days	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Wide range of seabirds observed	2	1	N/A	N/A			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium

[17] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017)

[18] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	<u>Socio-economic</u> Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Clerke Reef MP	<u>Turtles</u> Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 329.3 Surface LOWC: 994.9	Subsea LOWC: 33.5 days Surface LOWC - 30 days	Medium
	<u>Marine mammals</u> Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Second largest breeding colony on red-tailed tropicbirds (Migratory) in Australia Wide range of seabirds observed	2	1	Bedwell Island	Nesting: Sep to Feb			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socio-economic Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Ningaloo Coast North	World Heritage Area	5	5	N/A	N/A	Subsea LOWC: 149.2 Surface LOWC: 354.8	Subsea LOWC: 46.1 days Surface LOWC: 31.7 days	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)	4	3	North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Pygmy blue whales (Endangered) foraging area, dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Medium
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar to Jul			Medium
	Birds 33 species seabirds and avifauna (Including Critically Endangered Eastern Curlew)	5	4	Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island	Nesting: Sep to Feb			High
	Coral and other subsea benthic primary producers	3	4	Largest fringing reef in Australia	Coral spawning: Mar & Oct			High
	Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	2	2	Numerous campsites and snorkelling sites along western Cape Range shorelines, Coral Bay, Waroora Station	Year-round			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	Subsea LOWC: 208 Surface LOWC: 284.8	Subsea LOWC: 29.3 days Surface LOWC: 24.7 days	Medium
	Turtles Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts – John Wayne beach, loggerheads and hawksbill	4	3	Green turtles on the western side of Barrow Island and flatback turtle nesting on the eastern side. Turtle Bay north beach, North and west coasts and John Wayne Beach have loggerhead and hawksbill turtle nesting	Year round, peaking Oct to Jan			High
	Birds Migratory birds (important habitat); tenth of top 147 bird sites, highest population of migratory birds in Barrow Island Nature Reserve (south-southeast of island). Double Island has important bird nesting sites (shearwaters and sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sep to Feb			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct			Medium
	<u>Socio-economic</u> Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations Petroleum Activities such as Barrow Island petroleum production	5	5	Reverse Osmosis plant and port on eastern side of island (Port of Barrow Island)	N/A			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Dampier Archipelago	Mangroves	3	3	Widespread and present in lagoons Important stands west Intercourse and Enderby	N/A	Subsea LOWC: 296.3 Surface LOWC: 716.3	Subsea LOWC: 15.1 days Surface LOWC: 11.7 days	Medium
	Turtles Hawksbill (Vulnerable) and flatback (Vulnerable) turtles	4	3	Hawksbill turtle nesting north-west of Rosemary Island and Delambre. Flatback turtle nesting at Legendre, Huay and Delambre	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium
	Marine mammals Humpback whale (vulnerable) migration area	3	2	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Breeding on Goodwyn, Keast Islands and Nelson Rocks.				Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Recreational fishing/ charter boats, tourism related to water-based activities and nature National Heritage Aboriginal sites Camping beaches Shipping fairway and proximity to major port	4	4	Widespread	Year-round			Low
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	Subsea LOWC: 213.2 Surface LOWC: 480.1	Subsea LOWC: 18.4 days Surface LOWC: 16.9 days	Medium
	Turtles Loggerhead (Endangered) and green (Vulnerable) (significant rookeries); hawksbill (Vulnerable), flatback (Vulnerable) turtles	4	3	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium

Santos

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Marine mammals Pygmy blue whale (Vulnerable) and humpback whale (Vulnerable) migration area	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul			Low
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sep to Feb			Medium
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Pearling (inactive/pearling zones). Very significant for recreational fishing and charter boat tourism (Marine Management Area). Social amenities and other tourism. Nominated place (national heritage)	3	2	Widespread	Year-round			Low

<table>
<tr><th>Protection Priority Area</th><th>Key sensitivities</th><th>DoT Ranking (Floating oil) [17]</th><th>DoT Ranking (Dissolved oil) [18]</th><th>Key locations</th><th>Relevant key periods</th><th>Maximum total accumulated oil ashore (tonnes) >100 g/m²</th><th>Minimum arrival time accumulated oil ashore >100 g/m² (days)</th><th>Initial response priority</th></tr>
<tr><td rowspan="5">Muiron Islands</td><td>Turtle nesting – major loggerhead (Endangered) site, significant Green turtle (Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence</td><td>4</td><td>3</td><td>Loggerhead – South Island</td><td>Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan</td><td rowspan="5">Subsea LOWC: 93.7

Surface LOWC: 216.9</td><td rowspan="5">Subsea LOWC: 32.4 days

Surface LOWC: 25.6 days</td><td>High</td></tr>
<tr><td>Coral and other subsea benthic primary producers</td><td>3</td><td>4</td><td>N/A</td><td>Coral spawning: Mar & Oct</td><td>Medium</td></tr>
<tr><td>Seabird nesting</td><td>2</td><td>1</td><td>Widespread</td><td>Nesting: Sep to Feb</td><td>Low</td></tr>
<tr><td>Humpback whale (Vulnerable) migration</td><td>3</td><td>2</td><td>N/A</td><td>Jun-Jul</td><td>Medium</td></tr>
<tr><td>Exmouth gulf prawn fishery (Muiron is western boundary); significant for recreational fishing and charter boat tourism</td><td>1</td><td>2</td><td></td><td>Prawn fishery – Apr to Nov
Tourism and recreation: year-round</td><td>Low</td></tr>
</table>

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil) [17]	DoT Ranking (Dissolved oil) [18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Bedout Island	Turtles Foraging – loggerhead (Endangered), green turtle (Vulnerable) and hawksbill (Vulnerable). No known nesting	4	3	N/A	N/A	Subsea LOWC: 404.4 Surface LOWC: 400.5	Subsea LOWC: 1.4 days Surface LOWC: 0.6 days	High
	Coral and other subsea benthic primary producers	3	4	Fringing island	Coral spawning: Mar & Oct			Low
	Birds Globally significant brown booby breeding location – migratory species	2	1	N/A	Breeding: May to Nov			Medium
Lowendal Island	Mangroves	3	3	Offshore	N/A	Subsea LOWC: 29.8 Surface LOWC: 131.8	Subsea LOWC: 31 days Surface LOWC: 22.9 days	Medium
	Coral and other subsea benthic primary producers	3	4	Deep-water benthic (soft sediment) habitats Dugong Reef and Batman Reef (eastern side of Island)	Coral spawning: Mar and Oct			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Turtles Important hawksbill, loggerhead and green turtle nesting	4	3	Beacon, Parakeelya, Kaia and Pipeline, Varanus Pipeline, Harriet and Andersons Beaches	Nesting all year, peak Oct to Jan Significant flatback rookery, nesting season for flatback turtles peaks Dec to Jan			Medium
	Birds Approximately 89 species of avifauna, 12 to 14 migratory and threatened seabirds	2	1		Year-round			Medium
	Marine mammals Dugong foraging	3	2	Seagrass beds	N/A			Low
	Socio-economic and heritage Social amenities and other tourism, very significant for recreational fishing and charter boat tourism	2	2	Widespread	N/A			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Eighty Mile Beach	Ramsar wetland	5	5	220 km of beach and intertidal mudflats from Cape Missiessy to Cape Keraudren and Mandora Salt Marsh 40 km to the east	N/A	Subsea LOWC: 4,506.0 Surface LOWC: 16,561.4	Subsea LOWC: 7.3 days Surface LOWC: 4.3 days	High
	Mangroves	3	4	Mandora Saltmarsh area	N/A			Medium
	Turtles Flatback turtle nests (Vulnerable) at scattered locations along shoreline	3	2	N/A	Turtle nesting year-round, peak Oct to Feb			High
	Birds 97 wetland species, 42 of which are listed under international agreements.	4	3	Intertidal areas	Migration: Aug to Nov			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Socio-economic and heritage Tourism – camping and nature, recreational fishing. Wetlands significant to three local Aboriginal groups, several Aboriginal heritage sites present	1	1	N/A	N/A			Low
Ashmore Reef AMP	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar and Oct	Subsea LOWC: 40.5 Surface LOWC: 51.6	Subsea LOWC: 73.2 days Surface LOWC: 74.6 days	Low
	Birds Important seabird rookery, important staging point/feeding area for migratory birds including curlew sandpiper (Critically Endangered)	4	3	N/A	Migration: Aug to Nov			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[18]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Turtles Critical nesting and interesting habitat for Green turtles (Vulnerable), significant foraging populations of Green, Loggerhead turtles (Endangered) and Hawksbill turtles (Vulnerable)	4	3		Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High
	Marine mammals Small dugong population (<50 individuals), migratory pathway for pygmy blue whales	3	2	N/A	Pygmy blue whale migration: Apr to Aug			Medium
	Socio-economic and heritage Staging area for traditional Indonesian fishers. Commercial tourism – recreation and scientific research							Medium

Table 6-27: Initial response priorities during a surface marine diesel oil spill (surface spill)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Bedout West: NC Bedout North: 1.6 Bedout South: NC	Bedout West: NC Subsea LOWC: 9.4 days Surface LOWC: NC	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Humpback whale migration: Jun to Jul			Low
	Birds Wide range of seabirds observed	2	1	N/A	N/A			
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socio-economic Tourism - charter boats, diving and snorkelling. Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	N/A			Low

<table>
<tr><th>Protection Priority Area</th><th>Key sensitivities</th><th>DoT Ranking (Floating oil)</th><th>DoT Ranking (Dissolved oil)</th><th>Key locations</th><th>Relevant key periods</th><th>Maximum total accumulated oil ashore (tonnes) >100 g/m²</th><th>Minimum arrival time accumulated oil ashore >100 g/m² (days)</th><th>Initial response priority</th></tr>
<tr><td rowspan="3">Bedout Island</td><td><u>Turtles</u>
Foraging - loggerhead (Endangered), Green turtle (Vulnerable) and Hawksbill (Vulnerable). No known nesting</td><td>4</td><td>3</td><td>N/A</td><td>N/A</td><td rowspan="3">Bedout West: NC

Bedout North: NC

Bedout South: 52.8</td><td rowspan="3">Bedout West: NC

Subsea LOWC: NC

Surface LOWC: 0.8 days</td><td>High</td></tr>
<tr><td>Coral and other subsea benthic primary producers</td><td>3</td><td>4</td><td>Fringing island</td><td>Coral spawning: Mar & Oct</td><td>Low</td></tr>
<tr><td><u>Birds</u>
Globally significant Brown Booby breeding location – migratory species</td><td>2</td><td>1</td><td>N/A</td><td>Breeding: May to Nov</td><td>Medium</td></tr>
<tr><td rowspan="2">Eighty Mile Beach</td><td><u>Ramsar wetland</u></td><td>5</td><td>5</td><td>220 km of beach and intertidal mudflats from Cape Missiessy to Cape Keraudren and Mandora Salt Marsh 40 km to the east</td><td>N/A</td><td rowspan="2">Bedout West: NC

Bedout North: NC

Bedout South: 1.4</td><td rowspan="2">Bedout West: NC

Bedout North: NC

Bedout South: 6.4 days</td><td>High</td></tr>
<tr><td><u>Mangroves</u></td><td>3</td><td>4</td><td>Mandora Saltmarsh area</td><td>N/A</td><td>Medium</td></tr>
</table>

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Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Turtles Flatback turtle nests (Vulnerable) at scattered locations along shoreline	3	2	N/A	Turtle nesting year-round, peak Oct to Feb			High
	Birds 97 wetland species, 42 of which are listed under international agreements.	4	3	Intertidal areas	Migration: Aug to Nov			High
	Socio-economic and heritage Tourism – camping and nature, recreational fishing. Wetlands significant to three local Aboriginal groups, several Aboriginal heritage sites present	1	1	N/A	N/A			Low

6.7 Net environmental benefit analysis

The IMT uses a NEBA, also referred to as a spill impact mitigation assessment (SIMA), to inform the incident action planning process (**Section 8**), so the most effective response strategies with the least detrimental environmental impacts can be identified, documented and executed.

The Environmental Team Lead will use the information in **Section 6.6** to identify and prioritise initial response priorities and apply the NEBA to identify which response strategies are preferred for the situation, oil type and behaviour, environmental conditions, direction of plume and priorities for protection.

As a component of the incident action planning process, NEBA is conducted by the Control Agency with responsibility for the spill response activity. Where there are different activities controlled by different IMTs, as in a cross-jurisdictional response between Santos and DoT, consultation will be required during the NEBA process such that there is consistency in the sensitivities prioritised for response across the Control agencies.

A strategic NEBA has been developed for all response strategies identified as applicable to credible spills identified in this OPEP, with the benefit or potential impact to each sensitivity identified (refer **Table 6-28** to **Table 6-29**). While not all spill response activities included in the strategic NEBA would be under the control of Santos during a spill incident, they have been included to assist the planning conducted by DoT.

In the event of a spill, NEBA is applied with supporting information collected as part of the Operational Monitoring Plan (**Section 10**) to achieve the following:

- Identify sensitivities within the area potentially affected by a spill at that time of the year (noting that the sensitivity of some key receptors, such as birdlife and turtles, varies seasonally).
- Assist in prioritising and allocating resources to sensitivities with a higher protection and response priority (**Table 6-24** to **Table 6-27**).
- Assist in determining appropriate response strategies with support of real time metocean conditions, oil spill tracking and fate modelling.

When a spill occurs, NEBA is applied to the current situation, or operationalised. Operational NEBA Templates are filed within the Environment Team Leader folder on the Santos ER Intranet site. To complete the Operational NEBA:

- All ecological and socioeconomic sensitivities identified within the spill trajectory area are recorded.
- Potential effects of response strategies on each sensitivity are assessed in terms of their benefit or otherwise to the socio-economic sensitivities.
- All persons involved and data inputs have been considered for the analysis.

The Operational NEBA Form documents the decisions behind the recommendation to the Incident Commander on which resources at risk to prioritise, and the positives and negatives of response strategies to deploy. The Operational NEBA provides guidance to the IAPs and is revisited each Operational Period.

Table 6-28: Strategic net environmental benefit analysis matrix – Caley Condensate loss of well control (all scenarios)

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Imperieuse Reef MP											
Turtle habitat – green, hawksbill											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Marine mammals – humpback whale migration											
Seabirds											
Tourism – charter boats, diving, snorkelling, recreational fishing											
Clerke Reef MP											
Turtle habitat – green, hawksbill											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersa nt	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Marine mammals – humpback whale migration											
Seabirds – significant breeding for migratory species at Bedwell Island											
Tourism – charter boats, diving, snorkelling, recreational fishing											
Ningaloo Coast North											
Turtle nesting – loggerhead, green											
Mangroves – Mangrove Bay and Yardie Creek										N/A	

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersa nt	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Coral and other subsea benthic primary producers – largest fringing reef in Australia, lagoonal, intertidal and subtidal corals, seagrass and macroalgae bed								N/A	N/A	N/A	
Whale sharks and manta rays											
Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)											
Seabird nesting – incl. breeding areas at Mangrove Bay, Mangrove Point, Point Maud, Mildura wreck and Fraser Island											

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersa nt	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Humpback/pygmy blue whale migration											
Barrow Island											
Turtle nesting – particularly flatback (western side) and green turtles (eastern side)											
Mangroves and mudflats (shorebird foraging) – Bandicoot Bay										N/A	
Coral and other subsea benthic primary producers – incl. Biggada Reef								N/A	N/A	N/A	
Seabird nesting – incl. Double Island											
Migratory shorebirds – particularly Bandicoot Bay											

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Aboriginal listed sites incl. pearling camps											
Dampier Archipelago											
Turtles – hawksbill and flatback											
Mangroves										N/A	
Marine mammals – humpback whale migration											
Seabird breeding											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Fishing/charter boat, camping tourism National Heritage, Aboriginal sites											

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersa nt	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Montebello Islands											
Turtle nesting – North West and Eastern Trimouille Islands (hawksbill); Western Reef, Southern Bay and North West Island (green)											
Mangroves – particularly Stephenson Channel										N/A	
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Seabird nesting											
Migratory shorebirds											
Humpback/pygmy blue whale migration											
Fishing/charter boat tourism											

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Muiron Islands											
Turtle nesting – major loggerhead site, significant Green turtle nesting site											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Mangroves										N/A	
Seabird nesting											
Humpback whale migration											
Tourism – significant fishing/charter boat tourism											
Bedout Island											
Turtle foraging – loggerhead, green, hawksbill											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Seabird nesting											
Lowendal Islands											
Turtle nesting – hawksbill, loggerhead and green											
Mangroves										N/A	
Dugong foraging											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Seabirds											
Tourism – charter boats, significant recreational fishing											
Eighty Mile Beach											
Ramsar wetland											
Turtle nesting – hawksbill, loggerhead and green											
Mangroves										N/A	

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersa nt	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Migratory shorebirds – foraging habitat											
Tourism – camping and fishing Aboriginal heritage sites											
Ashmore Reef AMP											
Turtle nesting and internesting – green turtles. Foraging for green, loggerhead and hawksbill turtles											
Seabirds – important rookery and staging for migratory species											
Small dugong population, pygmy blue whale migration											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	

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Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Tourism – recreation and scientific research Staging area for traditional Indonesian fishers,											
Exmouth Gulf Coast											
Turtles – loggerhead, green and hawksbill internesting											
Dugongs, humpback whale calf resting area											
Intertidal mud/sand flats										N/A	
Mangroves										N/A	
Seagrass										N/A	
Prawn fishery, pearling and aquaculture										N/A	

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Legend											
		Beneficial impact.									
		Possible beneficial impact depending on the situation (e.g., time frames and metocean conditions to dilute entrained oil).									
		Negative impact.									
N/A		Not applicable for the environmental value or not applicable for hydrocarbon type									

Table 6-29: Strategic net environmental benefit analysis matrix – marine diesel oil spills (all scenarios)

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Chemical Dispersants	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Imperieuse Reef MP										
Turtle habitat – green, hawksbill										
Coral and other subsea benthic primary producers							N/A	N/A	N/A	
Marine mammals – humpback whale migration										

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Chemical Dispersants	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Seabirds										
Tourism – charter boats, diving, snorkelling, recreational fishing										
Bedout Island										
Turtle foraging – loggerhead, green, hawksbill										
Coral and other subsea benthic primary producers							N/A	N/A	N/A	
Seabird nesting										
Eighty Mile Beach										
Ramsar wetland										
Turtle nesting – hawksbill, loggerhead and green										
Mangroves									N/A	
Migratory shorebirds – foraging habitat										

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Chemical Dispersants	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Tourism – camping and fishing Aboriginal heritage sites										

Legend	
	Beneficial impact.
	Possible beneficial impact depending on the situation (e.g., time frames and metocean conditions to dilute entrained oil).
	Negative impact.
N/A	Not applicable for the environmental value or not applicable for hydrocarbon type.

6.8 Oil spill response as-low-as-reasonably-practicable assessment

For each response strategy included within this OPEP an environmental performance outcome has been determined and key control measures and performance standards have been identified such that the response can meet the required performance outcome. For each response strategy, an ALARP assessment has been conducted to demonstrate that the control measures mitigate the risk of an oil spill to ALARP.

Appendix B details the ALARP assessment framework and the results of the ALARP assessment conducted to inform the control measures and performance standards contained within this OPEP.

7 External Notifications and Reporting Procedures

For oil spill incidents, the OSC (of the MODU or Company Site Representative) will notify the Perth-based IMT for delegation of further notifications to relevant Regulatory Authorities and for further spill response assistance for Level 2/3 spills.

7.1 Regulatory notification and reporting

The Incident Commander (IC) is to delegate the following regulatory reporting requirements. Typical delegated parties will be the Safety Team Leader and the Environmental Team Leader.

Contact details for the Regulatory agencies outlined in **Table 7-1** are provided within the Incident Response Telephone Directory (SO-00-ZF-00025.020).

Table 7-1 outlines the external regulatory reporting requirements specifically for oil spill incidents outlined within this OPEP in Commonwealth and State jurisdictions, noting that regulatory reporting may apply to smaller Level 1 spills that can be responded to using onsite resources as well as larger Level 2/3 spills.

State water notifications to WA DoT will apply to spills in State waters or spills originating in Commonwealth waters and moving to State waters.

Table 7-1 outlines Santos oil spill reporting requirements associated with carrying out a Petroleum Activity in State and Commonwealth waters. There are also additional requirements for Vessel Masters to report oil spills from their vessels under relevant marine oil pollution legislation (e.g., MARPOL). This includes, where relevant, reporting oil spills to AMSA (Rescue Coordination Centre) and WA DoT (MEER unit).

The Incident Response Telephone Directory (SO-00-ZF-00025.02) contains a more detailed list and contact details for incident response support and is updated every 6 months with up-to-date revisions available within the IMT room and online (intranet procedures and emergency response pages).

7.2 Activation of external oil spill response organisations and support agencies

Table 7-2 outlines notifications that should be made to supporting agencies to assist with spill response activities outlined within this plan. This list contains key oil spill response organisations that have pre-established roles in assisting Santos in an oil spill response. It is not an exhaustive list of all providers that Santos may use for assisting an oil spill response.

The Incident Response Telephone Directory (SO-00-ZF-00025.02) contains a more detailed list and contact details for incident response support and is updated every six months with up-to-date revisions available within the IMT room and online (intranet procedures and emergency response pages).

7.3 Environmental performance

Table 7-3 lists the Environmental Performance Standards and Measurement Criteria for external notifications and reporting.

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Table 7-1: External notification and reporting requirements (commonwealth, state and international waters)

Agency or Authority	Type of Notification/ Timing	Legislation/Guidance	Reporting Requirements	Responsible Person/Group	Forms
NOPSEMA Reporting Requirements for Commonwealth water spills					
NOPSEMA (Incident Notification Office)	Verbal notification within two hours Written report as soon as practicable, but no later than three days	*Petroleum and Greenhouse Gas Storage Act 2006* Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 (as amended 2014)	A spill associated with Bedout Multi-Well Drilling activities in Commonwealth waters that has the potential to cause moderate to significant environmental damage[1]	Notification by IMT Environmental Team Leader (or delegate)	Incident reporting requirements: https://www.nopsema.gov.au/environmental-management/notification-and-reporting/
National Offshore Petroleum Titles Administrator and WA Department of Mines, Industry Regulation and Safety (DMIRS)	Written report to National Offshore Petroleum Titles Administrator and DMIRS within seven days of the initial report being submitted to NOPSEMA	Guidance Note (N-03000-GN0926) Notification and Reporting of Environmental Incidents	Spill in Commonwealth waters that is reportable to NOPSEMA	Notification by IMT Environmental Team Leader (or delegate)	Provide same written report as provided to NOPSEMA
DMIRS Reporting Requirements for State water spills					
WA DMIRS	Verbal phone call within two hours of incident being identified Follow up written notification within three days	Guidance Note on Environmental Non-compliance and Incident Reporting	A spill associated with Bedout Multi-Well Drilling activities in State waters that has the potential to cause an environmental impact that is categorised as moderate or more serious than moderate[1]	Notification by IMT Environmental Team Leader (or delegate)	Environmental and Reportable Incident/ Non-compliance Reporting Form http://www.dmp.wa.gov.au/Environment/Environment-reports-and-6133.aspx

Agency or Authority	Type of Notification/ Timing	Legislation/Guidance	Reporting Requirements	Responsible Person/Group	Forms
DFAT Reporting Requirements for International waters spills					
Department for Foreign Affairs and Trade	Verbal notification within 24 hours of modelling suggesting trans-national migration of oil into Indonesian or Timor-Leste.	Not applicable	NOPSEMA, DISER and DFAT will form an inter-agency panel; the Australian Government Control Crisis Centre	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
AMSA and DoT spill reporting requirements					
AMSA Rescue Coordination Centre (RCC)[2]	Verbal notification within two hours of incident	Under the MoU between Santos and AMSA	Santos to notify AMSA of any marine pollution incident[1]	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
WA Department of Transport (WA DoT)[2] (MEER Duty Officer)	+ Verbal notification within two hours + Follow up with Pollution Report (**Appendix C**) as soon as practicable after verbal notification + If requested, submit Situation Report (**Appendix D**) within 24 hours of request	Emergency Management Regulations 2006 State Hazard Plan: Maritime Environmental Emergencies Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements	Santos to notify of actual or impending Marine Pollution Incidents (MOP) that are in, or may impact, State waters Emergency Management Regulations 2006 define MOP as an actual or impending spillage, release or escape of oil or an oily mixture that is capable of causing loss of life, injury to a person or damage to the health of a person, property or the environment[1]	Notification by IMT Environmental Team Leader (or delegate) MEER Duty Officer contacted per Incident Telephone Directory	WA DoT POLREP (**Appendix C**): https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf WA DoT SITREP (**Appendix D**): https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf

Agency or Authority	Type of Notification/ Timing	Legislation/Guidance	Reporting Requirements	Responsible Person/Group	Forms
Protected areas, fauna and fisheries reporting requirements					
Commonwealth Department of Agriculture, Water and the Environment (Director of monitoring and audit section)	Email notification as soon as practicable	*Environment Protection and Biodiversity Conservation Act 1999*	If Matters of National Environmental Significance (MNES) are considered at risk from a spill or response strategy, or where there is death or injury to a protected species	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
Department of Biodiversity Conservation and Attractions (Pilbara Regional Office)	Verbal notification within two hours	DBCA consultation	Santos to notify AMSA of any marine pollution incident[1] Notify if spill has the potential to impact or has impacted wildlife in State waters (to activate the Oiled Wildlife Adviser)	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
Department of Biodiversity Conservation and Attractions (State Duty Officer and Pilbara Regional Office)	Verbal notification within two hours	Western Australian Oiled Wildlife Response Plan	Notify if spill has the potential to impact or has impacted wildlife in State waters (to activate the Oiled Wildlife Adviser)	Notification by IMT Environmental Team Leader (or delegate)	Not applicable

Agency or Authority	Type of Notification/ Timing	Legislation/Guidance	Reporting Requirements	Responsible Person/Group	Forms
Parks Australia (Director of National Parks)	Verbal notification as soon as practicable	*Environment Protection and Biodiversity Conservation Act 1999*	An oil spill which occurs within a marine park or are likely to impact on an Australian Marine Park	Notification by IMT Environmental Team Leader (or delegate)	Not applicable, but the following information should be provided: Titleholder's details Time and location of the incident (including name of marine park likely to be affected) Proposed response arrangements as per the OPEP Details of the relevant contact person in the IMT
Department of Primary Industry and Regional Development (DPIRD) Fisheries	Verbal phone call notification within 24 hours of incident	As per consultation with DPIRD Fisheries	Reporting of marine oil pollution[1]	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
Australian Fisheries Management Authority	Verbal phone call notification within 24 hours of incident	For consistency with DPIRD Fisheries notification	Reporting of marine oil pollution[1]	Notification by IMT Environmental Team Leader (or delegate)	Not applicable

[1] *For clarity and consistency across Santos' regulatory reporting requirements, Santos will meet the requirement of reporting a marine oil pollution incident to AMSA by reporting oil spills assessed to have an environmental consequence of moderate or higher in accordance with Santos' environmental impact and risk assessment process outlined in* ***Section 5*** *of the Bedout Multi-Well Drilling EP (SO-00-BI-20003).*

[2] *Santos reporting requirements only listed. For oil spills from vessels, Vessel Masters also have obligations to report spills from their vessels to AMSA Rescue Coordination Centre (RCC) and, in State waters, WA DoT MEER.*

Table 7-2: List of spill response support notifications

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
AMOSC Duty Manager	As soon as possible but within two hours of incident having been identified	Verbal Service Contract	Santos is a Participating Company in AMOSC and can call upon AMOSC personnel and equipment (including oiled wildlife). Under the AMOSPlan, Santos can also call upon mutual aid from other trained industry company personnel and response equipment AMOSC's stockpiles of equipment include dispersant, containment, recovery, cleaning, absorbent, oiled wildlife and communications equipment. Equipment is located in Geelong, Fremantle, Exmouth and Broome	**Step 1.** Obtain approval from Incident Commander to mobilise AMOSC. **Step 2.** Notify AMOSC that a spill has occurred. Put on standby as required – activate if spill response escalates in order to mobilise spill response resources consistent with the AMOSPlan. **Step 3.** E-mail confirmation and a telephone call to AMOSC will be required for mobilisation of response personnel and equipment, and callout authorities will be required to supply their credentials to AMOSC. A signed service contract must also be completed by a call out authority and returned to AMOSC prior to mobilisation.	IMT Environment Team Leader (or delegate) will notify AMOSC (upon approval from Incident Commander)
Babcock Helicopters	Within two hours of incident having been identified	Verbal	Helicopters/pilots available for aerial surveillance. Contract in place	Phone call.	IMT Logistics Team Leader (or delegate)
Duty Officers/ Incident Commanders **(Woodside, BHP, Chevron)**	Within two hours of incident having been identified	Verbal	Mutual aid resources (through AMOSC mutual Aid Arrangement)	Phone call.	Incident Commander (or delegate)

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
Exmouth Freight & Logistics	Within two hours of incident having been identified	Verbal	Assistance with mobilising equipment and loading vessels	Phone call.	IMT Logistics Team Leader (or delegate)
North West Alliance – Waste	As required for offshore and shoreline clean-up activities	Verbal	Santos has contract arrangements in place with North West Alliance to take overall responsibility to transport and dispose of waste material generated through clean-up activities	Phone call to the Primary Contact Person. In the event the Primary Contact Person is not available, the Secondary Contact Person will be contacted.	IMT Logistics Team Leader (or delegate)
Astron	Scientific Monitoring Plan initiation criteria are met (**Section 18**)	Verbal and written	Astron has been contracted by Santos to provide Standby Services for Scientific Monitoring Plans (SMPs) 1 to 11. This includes provision of personnel and equipment. Astron annually reviews the SMPs for continual improvement	**Step 1.** Obtain approval from Incident Commander to activate Astron for Scientific Monitoring. **Step 2.** Verbally notify Astron followed by the submission of an Activation Form (Environment Team Leader Folder) via email. **Step 3.** Provide additional details as requested by the Astron Monitoring Coordinator on call-back. **Step 4**. Astron initiates Scientific Monitoring Activation and Response Process.	IMT Environment Team Leader (or delegate)
Intertek Geotech (WA) Environmental Services and Ecotoxicology	When characterisation of oil is activated (**Section 10.6**)	Verbal	Oil analysis including gas chromatography/mass spectrometry fingerprinting	Phone call.	IMT Environment Team Leader (or delegate)

Santos

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
Oil Spill Response Limited, OSRL Duty Manager	Within two hours of incident having been identified	Verbal OSRL Mobilisation Authorisation Form	Santos has a Service Level Agreement with OSRL, which includes the provision of support functions, equipment and personnel to meet a wide range of scenarios At minimum OSRL will provide technical support to the IMT and place resources on standby Further details available on the OSRL webpage.	**Step 1**. Contact OSRL Duty Manager in Singapore and request assistance from OSRL. **Step 2**. Send notification to OSRL as soon as possible after verbal notification. **Step 3**. Upon completion of the OSRL incident notification form, OSRL will plan and place resources on standby.	Designated call-out authorities (including Incident Commanders)
RPS Group	As soon as possible but within two hours of incident having been identified	Verbal and written	Santos has an agreement in place with RPS Group to allow rapid marine hydrocarbon spill modelling capability to be activated at any time during activities, which will be undertaken for any spill greater than Level 1. AMOSC can also run modelling on behalf of Santos, if required, as part of contracting arrangements with RPS Group	Contact RPS Group Duty Officer.	IMT Environment Team Leader (or delegate)

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
Wild Well Control (WWC)	Within four hours of a loss of well control incident having been identified	Loss of well control only Verbal	Well intervention services. Under contract.	**Step 1**. Following Santos management confirmation of a LOWC, IMT Drilling Team Leader is to call the Wild Well Control 24-hour emergency hotline number to notify WWC of the incident. **Step 2**. As soon as practical after initial notification and once the scale of the subsea loss of containment is confirmed, an emergency mobilisation authorisation form (saved in ECM) must be filled out, signed off by the authorised Santos Manger sent through to WWC. The form is located on the Santos Intranet Procedures Index under Emergency Procedures (http://ausintranet.enerylimited.com/dept_data/Procedure_data/index.htm). Email as directed by WWC point of contract provided by the emergency hotline attendant.	IMT Drilling Team Leader

Table 7-3: Environmental performance – external notification and reporting

Environmental Performance Outcome	Make notifications and reports within regulatory and defined timeframes.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
External notifications and reporting plan	**Response Preparedness**		
	Incident Response Telephone Directory (SO-00-ZF-00025.02)	Incident Response Telephone Directory is revised every six months	Document revision history
	OPEP Communications Test	OPEP contact details for regulatory and service provider notifications are checked annually	Test records
	Response Implementation		
	External notifications and reporting tables	External notification and reporting undertaken as per **Table 7-1** and **Table 7-2**	Incident Log

8 Incident Action Planning

Santos incident response personnel use the incident action planning process to guide the incident response and to develop IAPs. All stakeholders involved in the incident achieve unity of effort through application of the disciplined planning process.

The incident action planning process is built on the following phases:

1. Understand the situation.
2. Establish incident priorities, objectives and tasks.
3. Develop a plan (IAP).
4. Prepare and disseminate the plan.
5. Execute, evaluate and revise the plan for the next operational period.

The Santos IMT will use the IAP process to determine and document the appropriate response priorities, objectives, strategies and tasks to guide the incident response which are reviewed and updated as more information becomes available.

The Santos IAP process is built on the phases described in **Figure 8-1**.

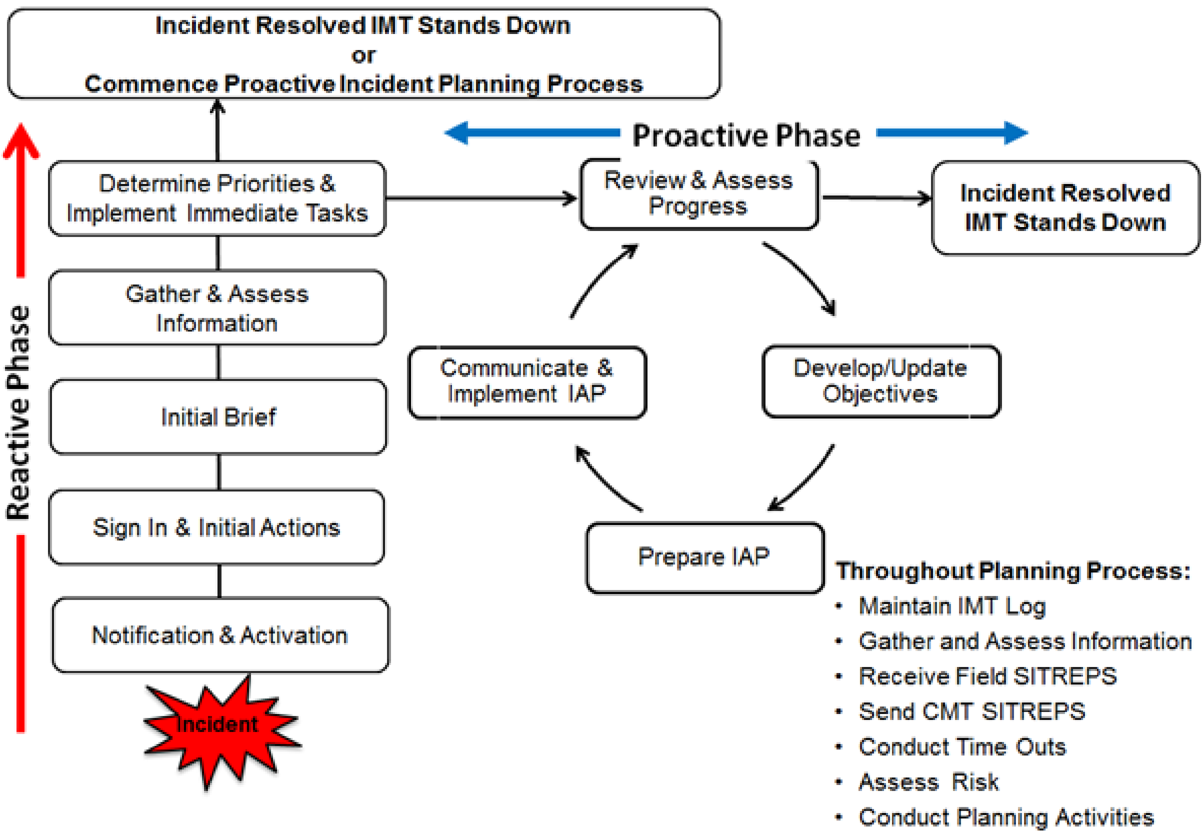

Figure 8-1: Incident Action Plan process

8.1 Reactive phase planning

The initial phase of the incident action planning process can be considered a reactive phase (indicatively lasting up to 48 hours) where information on the incident is being progressively established through reports coming in from the field. During this phase there is no formal Incident Action Plan to follow (given the incident has just begun and details are still being established) however the OPEP (this document) has been prepared to contain all first strike oil spill response actions required to be followed during this phase in lieu of a formal IAP.

First strike response actions are summarised in **Section 2** and provide links to relevant oil spill strategy sections within the OPEP which contain a more detailed list of implementation actions and considerations as well as statements of performance (performances standards) that must be followed to ensure the initial response meets regulatory requirements and environmental performance outcomes.

For each credible oil spill scenario covered by this OPEP the first strikes response actions, have been informed by a pre-assessment of applicable oil spill response strategies, priority response locations and a strategic NEBA also referred to as a SIMA. This pre-planning is included in **Section 6**. During the reactive phase the strategic NEBA is to be reviewed and, using the specific information gathered from the spill, operationalised into an operational NEBA (**Section 6.7**). This assessment helps verify that the response strategies pre-selected for each spill scenario are providing the best environmental outcome for the incident response.

8.2 Developing an Incident Action Plan

At the end of the reactive phase where the incident specifics have been determined, a more formal phase of spill response is entered whereby a documented IAP is developed to guide the incident response activities for the next operational period. An operational period is defined as the period scheduled for execution of actions specified in the IAP. The next operational period is nominally a daily period but, for long running incidents, may be extended further where the pace of the incident response has settled and the level of new information has decreased.

As IAPs and response strategies are implemented their performance is monitored. The performance measurement results are fed back into the IMT to provide the IMT with greater situational awareness to enable the effective formulation of following IAPs. Those response strategies that are effective are continued or increased, while those strategies that are ineffective are scaled back or ceased.

The performance against the objectives of the IAP must be documented in the Incident Log by the IMT. This provides the IMT with information required to assist in formulating the following IAP and provides evidence of Santos' response to the incident for regulatory and legal investigations that will follow the termination of the incident.

IAP performance is monitored through IMT communication with in-field response personnel both verbally and through logs/reports/photos sent throughout the response (e.g., surveillance personnel, team leaders, laboratory chemists) who report on the effectiveness of the response strategies.

IAP forms and processes are documented in the *Incident Command and Management Manual* (SO-00-ZF-00025) and in the 'Emergency Response' folder sets at *L:\Resource\Emergency Response\Incident-Exercise Number-Name*. Begin the response by copying and saving *Incident-Exercise Number-Name* folder set with a unique incident name and Id number on the lead folder; this is the Incident Log. Access subfolders to display all forms required to conduct incident action planning. Each functional position within the IMT and CMT has subfolders carrying forms and processes unique to the functional position.

8.3 Environmental performance

Table 8-1 lists the Environmental Performance Standards and Measurement Criteria for incident action planning.

Table 8-1: Environmental performance – incident action planning

Environmental Performance Outcome	Manage incident via a systematic planning process		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Incident Action Planning	**Response Preparedness**		
	IMT Exercise and Training Plan	Incident Action Planning and NEBA is practiced by the IMT during exercises	Exercise records
	Response Implementation		
	Incident Action Plan	Incident Action Plan is completed for each operational period and approved by the Incident Commander	Incident Log Incident Action Plan/s
		Monitor effectiveness of response strategies being implemented and use information in the development of IAPs	Incident Log Incident Action Plan/s
	NEBA	An operational NEBA will be undertaken for each operational period of the incident	NEBA Incident Action Plan

9 Source Control Plan

The initial and highest priority response to an oil spill incident following the health and safety of onsite personnel is to prevent or limit further loss of hydrocarbons to the environment.

For major hydrocarbon release incidents during Bedout Multi-Well Drilling activities, the MODU Operator's Emergency Response Plan and the Santos-MODU Operator Emergency Response Bridging Plan outline the initial actions to be taken by onsite personnel to control the source of a hydrocarbon spill and limit the volume released to the environment.

For vessels with a SOPEP, the SOPEP will provide the relevant initial actions to control the source of the spill.

For the ongoing response to a LOWC incident, the Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) is to be consulted as the overarching source of information for implementing a relief well response.

The sections below provide an outline of source control activities noting that the MODU Operator's Emergency Response Plan, Vessel SOPEP and Source Control Planning and Response Guideline (DR-00-OZ-20001), where applicable, will provide a higher level of detail for specific incidents.

9.1 Hydrocarbon storage or fuel tank rupture

Table 9-1 provides the environmental performance outcome, initiation criteria and termination criteria for source control response to a fuel tank rupture. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-1: Fuel tank rupture – source control environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment	
Initiation criteria	Notification of a spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✗	✓
Termination criteria	Release of oil to the marine environment has ceased and the workplace environment is deemed environmentally safe and free of hydrocarbons	

9.1.1 Implementation guidance

Implementation guidance is summarised in **Table 9-2**. In the event MDO is released from a vessel due to a tank rupture, the relevant vessel specific procedures will be applied. For support vessel collisions, the vessel's SOPEP will be followed to control the source, reduce the loss of hydrocarbons and prevent escalation of the incident.

Table 9-2 lists the environmental performance standards and measurement criteria for this strategy.

Table 9-2: Implementation guidance – fuel tank rupture

	Action	Consideration	Responsibility	Complete
Initial Actions	The vessel's SOPEP, as applicable under MARPOL, or procedure for responding to a ruptured tank will be followed as applicable.	Notwithstanding vessel specific procedures for source control, the following activities would be immediately evaluated for implementation providing safe to do so: + Reduce the head of cargo by dropping or pumping the tank contents into an empty or slack tank. + Consider pumping water into the leaking tank to create a water cushion to prevent further cargo loss. + If the affected tank is not easily identified, reduce the level of the cargo in the tanks in the vicinity of the suspected area if stability of the vessel will not be compromised. + Evaluate the transfer of cargo to other vessels. + Trim or lighten the vessel to avoid further damage to intact tanks. + Attempt repair and plugging of hole or rupture.	Vessel Master	❑

9.2 Loss of well control

Table 9-3 provides the environmental performance outcome, initiation criteria and termination criteria for controlling the source of a well leak.

Table 9-3: Loss of well control – source environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment	
Initiation criteria	LOWC	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✗
Termination criteria	The primary well is contained and killed to prevent any further release of hydrocarbon to the environment	

Santos identified the worst-case credible oil spill scenarios for assessment as:

+ a subsea LOWC with the release of 13,102,831 STB (2,083,121 m^3) liquid condensate (Caley Condensate) and 22,971 MMscf (650 million sm^3) gas at the seabed
+ a surface LOWC with the release of 12,889,832 STB (2,049,258 m^3) liquid condensate (Caley Condensate) and 22,614 MMscf (650 million sm^3) gas at the sea surface.

9.2.1 Relief well implementation guidance

Relief well drilling is the primary source control strategy to control a LOWC (subsea and surface) during Bedout Multi-Well Drilling activities. The installation of a subsea Capping Stack is not considered applicable (refer **Table 6-23**).

The Source Control Planning and Response Guideline (DR-00-OZ-20001) outlines the overarching process for planning and mobilising personnel and equipment into the field for the purpose of drilling a relief well.

A high-level summary of relief well Implementation actions is provided in **Table 9-4**.

Table 9-4: Implementation guidance – loss of well control

	Action	Responsibility	Complete
Initial Actions	Implement the Source Control Planning and Response Guideline (DR-00-OZ-20001).	IMT Drilling Team Leader	❑
	Notify Santos Drilling and Completions Team to assemble a Source Control Team and immediately begin preparations.	IMT Drilling Team Leader	❑
	Notify well control service provider personnel for mobilisation.	IMT Drilling Team Leader and Drilling & Completions Source Control Team	❑
	Source MODU through nearby drilling operations if available or procure from nearest operator through mutual aid agreement MoU.	Drilling & Completions Source Control Team	❑
	Refine, as necessary, the relief well pre-planned work described in **Section 9.2.2** to reflect the actual depths and asses the suitability of well locations.	Drilling & Completions Source Control Team	❑
	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Team Leader	❑
	Deploy equipment and personnel to site to begin spud and drill.	IMT Drilling Team Leader	❑
Ongoing actions	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Team Leader	
	Deploy equipment and personnel to site to begin spud and drill.	IMT Drilling Team Leader	❑
	Monitor progress of relief well drilling and communicate to IMT.	IMT Drilling Team Leader	❑

9.2.2 Relief well planning

Relief well planning is embedded into the Santos Drilling & Completions Management Process (DCMP). The following industry accepted guidelines have been adopted to assist relief well planning requirements:

+ SPE Calculation of Worst Case Discharge Rev 1, 2016: This is used as part of the prospect screening review to generate a credible rate for oil spill modelling, as well as providing an input for the dynamic kill modelling as part of the Well Specific Source Control Plan.
+ United Kingdom Oil and Gas Relief Well Guidelines, Issue 2, 2013: This methodology is used to confirm a well complexity analysis and tailor required content for the Well Specific Source Control Plan to the appropriate level of detail.

All wells drilled during Bedout Multi-Well Drilling activities will have well-specific source control plans (SCPs). SCPs will be developed as required for individual wells or as campaign specific SCPs should a series of similar wells be drilled together or in succession. The SCP is a Santos controlled document and is encompassed in the well operation management plan (WOMP) that relates to the specific drilling activity.

All SCPs will contain relief well planning information, specifically:

+ MODU positioning assessment for relief well drilling locations
+ Relief well tangible equipment requirements and availability
+ relief well trajectory analysis and casing design
+ dynamic well kill hydraulic simulation results.

These reports are static reports developed prior to higher-risk campaign-specific activities (drilling activities). While they contain planning that would be relevant to drilling a relief well for any well release (e.g., MODU positioning locations), time-variable information, such as MODU availability, is only assessed for the duration of the campaign.

To ensure Santos has current MODU availability, Santos maintains a register of MODU activity within the region and updates this on a monthly basis. The relief well rig capability register includes information about:

+ rig name
+ rig contract status (Operator and contract duration)
+ current location
+ maximum water depth capability
+ rig type (Floating vs jack-up; mooring type; Rig Design/Class)
+ available drilling envelope
+ blowout preventer specifications
+ blowout preventer/lower marine riser package connector specifications
+ mud pumps specifications/capability
+ choke and kill line internal diameters
+ storage capability (i.e., diesel, base-oil, brine, drill-water, potable water, bulks)

+ NOPSEMA safety case (yes/no).

In order to facilitate and expedite the use of regional MODU for relief well drilling an Australian Petroleum Production & Exploration Association (APPEA) Memorandum of Understanding: Mutual Assistance is in place. This agreement provides the mechanism to facilitate the transfer of drilling units and well-site services between operators in Australian and Timor-Leste administered waters in order to respond urgently to emergency source control events.

A Safety Case Revision will be required for the relief well rig to undertake the activity; this cannot be submitted before the event. The Safety Case Revision will be based on existing documents, specifically the Safety Case Revision approved for the drilling of the original well and the Safety Case in force for the relief well rig. A Safety Case Revision would be submitted within 14 days from the well leak, however the critical path time allowed for the actual writing of the document is three days. The remaining estimated time would be used for gathering post-event data, mobilising the workforce and conducting a hazard identification. It is not practicable to reduce the critical path days with additional pre-planning as document revision, final review and approval will still be required after completing the hazard identification.

9.2.3 Relief well schedule

An indicative relief well drilling schedule is provided in **Table 9-5**. This is based on control of the well by 11 weeks (77 days). This period is used as a base case well control timeframe by Santos across its wells and is based on indicative mobilisation durations, relief well planning and operations. It could take up to 34 days to have a MODU onsite ready to spud.

This time-line has been assessed as ALARP based on the current controls/measures in place; however, Santos is actively working with industry to evaluate measures to improve on the ALARP response time model through the APPEA Drilling Industry Steering Committee Source Control Response Industry (SCRI) Working Group. The SCRI working group is an APPEA Drilling Industry Steering Committee initiative which has been established to drive collaboration and continuous improvement in source control emergency response planning. The Working Group will explore and act on opportunities to align and strengthen the Titleholders' source control emergency response capability through "mutual aid" initiatives and drive continuous improvement by implementing fit-for-purpose and effective source control emergency response strategies.

Table 9-5: Schedule for mobile offshore drilling unit arriving onsite

LOWC Relief Well		
Task	**Duration (in days)**	**Controls**
Event reported – begin sourcing of rig for relief well drilling	1	+ On-site communications + Active IMT on call including Operations/Drilling Team Lead
Relief well MODU confirmed. Relief well MODU suspends operations and prepares to mobilise to relief well location.	10	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + Regional MODU tracking + APPEA MoU: Mutual Assistance
Continue preparations for relief well and rig mobilisation	21	+ Stood-up Relief Well Team (as per Santos Offshore Source Control Emergency Response Plan) + Pre-complete well-specific or campaign specific source control plan complete with relief well study + Relief Well Drilling Specialists services contract (Wild Well Control) + Drilling services contracted + Pre-verified access to relief well equipment (e.g., casing and wellhead) + APPEA MoU: Mutual Assistance
Rig mobilisation to well offset location (dependent on current and prevailing weather)	2	+ Vessel and rig move services contracted
Total days prior to arrival, ready to spud/commence relief well operations	**34**	
Drill relief well and complete dynamic well kill operations	43	
Total days from LOWC to well kill	**77**	

9.3 Environmental performance

Table 9-6 indicates the environmental performance outcomes, controls and performance standards for the Source Control response strategy.

Table 9-6: Environmental performance – source control

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine/onshore environment.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Response Preparedness		
Source control – relief well drilling	Source Control Planning and Response Guideline (DR-00-OZ-20001)	The Source Control Planning and Response Guideline (DR-00-OZ-20001) is in place and up to date during the activity	Source Control Planning and Response Guideline (DR-00-OZ-20001)
	Relief Well Rig Capability Register	Relief Well Rig Capability Register is maintained during the activity	Relief Well Rig Capability Register
	Arrangements for source control emergency response personnel	Arrangements for access to source control personnel are maintained during the activity	Contract/ Memorandums of Understanding for source control personnel
Source control - vessel collision	Vessel Spill Response Plan (SOPEP/SMPEP)	Support vessels have a SOPEP or shipboard marine pollution emergency plan (SMPEP) that outlines steps taken to combat spills	Audit records. Inspection records
		Spill exercises on support vessels are conducted as per the vessels SOPEP or SMPEP	Spill exercise close out reports
	Response Implementation		
Source control – relief well drilling	Drilling and Completions Source Control Team	Drilling and Completions Source Control Team mobilised within 24 hours of the well release	Incident Log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within five days of the well release	Incident Log
	Well Control Specialists	Well control specialists mobilised within 72 hours of the well release	Incident Log
	Relief Well MODU	MODU for relief well drilling to be onsite by Day 34 from the start of a well release.	Incident Log

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine/onshore environment.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Relief Well	Relief well completed within 77 days of well leak incident	Incident Log
	Source Control Planning and Response Guideline (DR-00-OZ-20001)	Relief well drilling implemented in accordance to the Source Control Planning and Response Guideline (DR-00-OZ-20001) during a well release	Incident Log
Source control - vessel collision	As per the vessel SOPEP	Actions to control spill associated with a vessel incident followed in accordance with SOPEP	Vessel logs

10 Monitor and Evaluate Plan

Understanding the behaviour and likely trajectory of an oil spill is critical to evaluate the appropriate response strategy. There are a number of methods that can be used to monitor and evaluate, including:

+ vessel surveillance
+ aerial surveillance
+ tracking buoys
+ oil spill trajectory modelling
+ satellite imagery
+ initial oil characterisation
+ operational water quality monitoring
+ shoreline assessments.

10.1 Vessel surveillance

Table 10-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-1: Vessel surveillance – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2/3 spill - may be deployed in a Level-1 incident (to be determined by OSC)	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Vessel-based surveillance is undertaken at scheduled intervals during daylight hours and continues for 24 hours after the source is under control and a surface sheen is no longer observable, OR + NEBA is no longer being achieved, OR + Agreement is reached with Jurisdictional Authorities to terminate the response	

Direct observations from field support or other vessels can be used to assess the location and visible extent of the hydrocarbon incidents, and to verify modelling predictions and trajectories. Due to the proximity of observers to the water's surface, vessel surveillance is limited in its coverage in comparison to aerial surveillance and may also be compromised in rough sea state conditions or where fresh hydrocarbons at surface poses safety risks.

10.1.1 Implementation guidance

Table 10-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-3** provides a list of resources that may be used to implement this strategy.

Mobilisation times for the minimum resources that are required to commence initial vessel surveillance operations are listed in **Table 10-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-9 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Santos

Table 10-2: Implementation guidance – vessel surveillance

Action		Consideration	Responsibility	Complete
Initial Actions	Notify nearest available Support Vessel to commence surveillance.	Current Santos on hire vessels or Vessels of Opportunity (VOO) can be used. Automatic Identification System (AIS) vessel tracking is available through ER intranet page.	On-Scene Commander Operations Lead	❑
	Source additional contracted vessels if required for assistance.		Logistics Team Leader	❑
	Record surface slick location and extent, weather conditions, and marine fauna. Complete vessel surveillance forms, located in **Appendix E** and provide to On-Scene Commander (Level 1 spills) or IMT (Level 2-3 spills).	Photographic images are to be taken where possible and included with surveillance forms. Trained observers will not be available immediately – photos and locations will provide initial information that can be interpreted by IMT.	Vessel Observers	❑
	Relay surveillance information (spill location, weather conditions, marine fauna sightings and visual appearance of the slick to the IMT within 60 minutes of completing vessel surveillance.	Initial reports to the IMT may be verbal (followed by written transmission) if the vessel is out of range or has no facilities for transmitting forms.	Vessel Master and/or On-Scene Commander	❑
Ongoing Actions	Review surveillance information to validate spill fate and trajectory.		Planning Team Leader/ GIS	❑
	Use available data to conduct operational NEBA and confirm that pre-identified response options are appropriate.		Environment Unit Lead	❑
	Use monitor and evaluate data to periodically reassess the spill and modify the response (through the IAP), as required	Surveillance data is useful in updating the Common Operating Picture	Planning Section Chief	❑

Table 10-3: Vessel surveillance resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Contracted vessels and vessels of opportunity	Santos Contracted Vessel Providers – incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited. Vessels of opportunity identified through AIS Vessel Tracking.	Availability dependent upon Santos and Vessel Contractor activities. Santos on-hire vessels include Ningaloo Vision Supply Vessel and Varanus Island Field Support Vessel.	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS Vessel Tracking Software.	Pending availability and location. Expected within 12 hours.

Table 10-4: Vessel surveillance – first strike response timeline

Task		Time from IMT call-out
IMT begins sourcing Santos-contracted vessel or VOO for on-water surveillance		<90 minutes
VOO onsite for surveillance		<12 hours (daylight dependent)
Minimum Resource Requirements		
One vessel. No specific vessel or crew requirements.		
Approximate Steam Time		
Deployment Location	Approximate Distance to Operational Area[19] (nautical miles)	Approximate steam time[20] (hours)
Port Hedland	76	8
Broome	198	20
Dampier/Karratha	165	17
Varanus Island	213	22

[19] As measured to geometric centre point of operational area

[20] At average rate of 10 nautical miles per hour

10.2 Aerial surveillance

Table 10-5 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-5: Aerial surveillance – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2/3 spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Aerial surveillance undertaken at scheduled intervals during daylight hours and continues for 24 hours after the source is under control and a surface sheen is no longer observable, OR + As directed by the relevant Control Agency	

Aerial surveillance is used to record the presence and size of the hydrocarbon spill at surface as well as other environmental observations including weather conditions, marine fauna and sensitive receptors in the area. Aerial surveillance provides superior coverage over vessel surveillance for estimating the spatial extent of a spill but is generally required only for larger Level 2/3 spills.

10.2.1 Implementation guidance

Table 10-6 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-7** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial aerial surveillance operations are listed in **Table 10-8**. The On-Scene Commander and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-6: Implementation guidance – aerial surveillance

	Action	Consideration	Responsibility	Complete
Initial Actions	Contact contracted aviation provider- provide details of incident and request mobilisation to spill site for initial surveillance.	If aviation asset is available near spill location, utilise where possible to gather as much information about the spill. If aviation asset not available at spill location IMT is to seek available resources through existing contractual arrangements. It is possible that the initial surveillance flight will not include a trained aerial surveillance observer. Initial flights can be conducted using a standard crew and initial surveillance should not be delayed waiting for trained personnel. Ensure all safety requirements are met prior to deployment. There should be an attempt to obtain the following data during initial surveillance: + name of observer, date, time, aircraft type, speed and altitude of aircraft + location of slick or plume (global positioning system [GPS] positions, if possible) + spill source + size of the spill, including approximate length and width of the slick or plume + visual appearance of the slick (e.g., colour) + edge description (clear or blurred) + general description (windrows, patches etc.) + wildlife, habitat or other sensitive receptors observed	Operations Team Leader Logistics Team Leader	❑

Action	Consideration	Responsibility	Complete
	+ basic metocean conditions (e.g., sea state, wind, current) + photographic/video images.		
Source available Santos Aerial Observers, arrange accommodation/logistics and deploy to Forward Operations/Air base location.	Santos Aerial Observer list available from First Strike Resources on Santos Offshore ER Intranet page.	Operations Team Leader Logistics Team Leader	❑
Develop flight plan (frequency and flight path) to meet IMT expectations and considering other aviation ops. Expected that two overpasses per day of the spill area are completed.	Flight plan to confirm with OSC that aircraft are permitted in the vicinity of the spill. Flights are only to occur during daylight and in weather conditions that do not pose significant safety risks.	Operations Team Leader / Aviation Superintendent	❑
Pre-flight briefing.		Aerial Observers Contracted aircraft provider/ pilots	❑
Aerial Observers to commence surveillance	Consider procedure for interacting with marine fauna.	Operations Team Leader	❑
Determine the spill extent by completing Aerial Surveillance Log (**Appendix F**) and Aerial Surveillance Surface Slick Monitoring Template. Calculate volume of oil (**Appendix G**). Take still and/or video images of the slick.	Thickness estimates are to be based on the Bonn Agreement Code (Santos Procedure Index).	Aerial Observer	❑
Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (**Appendix H**).		Aerial Observer	❑
Record shoreline habitat type and degree of oiling by completing the Shoreline Aerial Reconnaissance Log (**Appendix I**).	Thickness estimates are to be based on the Bonn Agreement Code (Santos Procedure Index).	Aerial Observer	❑

Action		Consideration	Responsibility	Complete
	Relay all surveillance records: logs, forms, photographic images, video footage to the IMT	Where possible, a verbal report via radio/telephone en route providing relevant information should be considered if the aircraft has long transits from the spill location to base	Aerial Observer Planning Team Leader Operations Team Leader	❑
Ongoing Actions	Update flight schedule for ongoing aerial surveillance as part of broader Aviation Subplan of IAP	Frequency of flights should consider information needs of IMT to help maintain the Common Operating Picture and determine ongoing response operations	Operations Team Leader/ Aviation Superintendent Planning Team Leader	❑
Ongoing Actions	Mobilise additional aircraft and trained observers to the spill location to undertake ongoing surveillance activities		Logistic Team Leader	❑
Ongoing Actions	Update common operating picture with surveillance information and provide updates to spill trajectory modelling provider		Planning Team Leader GIS Team Leader	❑

Table 10-7: Aerial surveillance resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Rotary Wing Aircraft & flight Crew	Santos contracted provider/s (primary provider currently Babcock)	Two contracted (one primary + one back-up) + additional as required	Karratha (primary base) Learmonth Onslow	Wheels up within 1 hour for Emergency Response. Spill surveillance <6 hours (daylight dependent)
Aerial Surveillance Crew	Santos aerial observers AMOSC Industry Mutual aid	Seven Santos staff Seven AMOSC staff Five AMOSC Core Group 54 additional trained industry personnel	Perth & Varanus Island (VI) (Santos aerial observers) Australia wide	Santos trained personnel - next day mobilisation to airbase <24 hours
Drones and pilots ** secondary response to assist shoreline and vessel-based surveillance	AMOSC OSRL – third-party unmanned aerial vehicle (UAV) provider Local WA hire companies	Two Two qualified remote pilots, however response is on best endeavour 10+	Geelong Perth Perth and regional WA	<48 hours OSRL – depending on the port of departure, one to two days if within Australia

Table 10-8: Aerial surveillance – first strike response timeline

<table>
<tr><th colspan="2">Task</th><th>Time from IMT call-out</th></tr>
<tr><td colspan="2">Santos helicopter activated for aerial surveillance</td><td><3 hours</td></tr>
<tr><td colspan="2">Helicopter onsite for aerial surveillance</td><td><6 hours (daylight dependent)</td></tr>
<tr><td colspan="2">Trained Aerial Observers mobilised to airbase</td><td><24 hours</td></tr>
<tr><td colspan="3">Minimum Resource Requirements</td></tr>
<tr><td colspan="3">+ Santos contracted helicopter and pilots
+ Santos trained Aerial Observers</td></tr>
<tr><td colspan="3">Approximate Flight Time</td></tr>
<tr><td>Nearest Airport</td><td>Approximate Distance[21] (NM)</td><td>Approximate flight time[22] (hours:minutes)</td></tr>
<tr><td>Port Hedland</td><td>120</td><td>1:00</td></tr>
<tr><td>Karratha</td><td>220</td><td>1:50</td></tr>
<tr><td>Learmonth</td><td>390</td><td>3:15</td></tr>
</table>

[21] As measured to geometric centre point of operational area

[22] At average flight speed of 120 knots

10.3 Tracking buoys

Table 10-9 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-9: Tracking buoys – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2 or 3 spill May be deployed for a Level 1 spill if deemed beneficial by the OSC	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Tracking buoy deployment will continue for 24 hours after the source is under control and a surface sheen is no longer observable, OR + As directed by the relevant Control Agency	

10.3.1 Implementation guidance

Table 10-10 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-11 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-10: Implementation guidance – tracking buoys

	Action	Consideration	Responsibility	Complete
Initial Actions	Organise vessel to mobilise two tracking buoys from MODU.	Personnel and vessel safety is priority. Current Santos on hire vessels or VOOs can be used. AIS vessel tracking is available through ER intranet page.	OSC/Operations Team Leader	❑
	Deploy two tracking buoys at leading edge of slick.	Note deployment details and weather conditions in incident log.	Vessel Master	❑
	Inform IMT that tracking buoys have been deployed and provide deployment details. Monitor movement of tracking buoys.	Refer login details of tracking buoy monitoring website on Santos ER intranet site.	OSC Planning Team Leader/GIS	❑
	Use tracking buoy data to maintain Common Operating Picture.	Data tracked online.	IMT Planning Team Leader/ GIS	❑
	Relay information to spill fate modelling supplier for calibration of trajectory modelling.		IMT Planning Team Leader/ GIS	❑
Ongoing Actions	Assess the need for additional tracking buoys in the spill scenario and identify/nominate preferred deployment locations.	Incident Action Plan to provide guidance regarding any additional deployments of tracking buoys.	Planning Team Leader	❑
	Mobilise additional tracking buoys if required from other Santos operations (Santos presently has 12 Tracker Buoys located on the North West Shelf) or from AMOSC stockpiles.		Logistics Team Leader	❑
	Direct the deployment of the Tracker Buoys – for continuous releases over multiple days use a rolling deployment/collection of buoys to provide better coverage of plume direction.		Operations Team Leader	❑

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	Action	Consideration	Responsibility	Complete
	Deploy tracking buoys.		Vessel Master	❑
	Monitor movement of tracking buoys.		Planning Team Leader/GIS	❑
	Relay information to spill trajectory modelling supplier for calibration of trajectory modelling.		Planning Team Leader/GIS	❑

Table 10-11: Tracking buoys resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Tracking buoys x 12	Santos	2 2 4 4	MODU Exmouth Varanus Island Dampier	MODU buoys – <2 hours for incident Exmouth buoys (when Ningaloo Vision in shipyard) – <12 hours pending vessel availability VI/Dampier buoys – 24 to 48 hours pending vessel availability Additional buoys available from Dampier if required
AMOSC tracking buoys	AMOSC	12 AMOSC	Broome x 2 Fremantle x 6 Geelong x 4	Response via duty officer within 15 minutes of first call- AMOSC personnel available within 1 hour of initial activation call. Equipment logistics varies according to stockpile location (refer to **Table 10-12**)

Table 10-12: Australian Marine Oil Spill Centre equipment mobilisation timeframes

	Perth	Darwin	Exmouth	Dampier	Broome
Geelong	40 hrs 3395 km	44 hr 3730 km	64 hrs 4520 km	70 hrs 4840 km	68 hrs 4970 km
Perth	NA	48 hrs 4040 km	15 hrs 1250 km	19 hrs 1530 km	27 hrs 2240 km
Exmouth	15 hrs 1250 km	38 hrs 3170 km	NA	7 hrs 555 km	16 hrs 1370 km
Broome	27 hrs 2240 km	22 hrs 1870 km	16 hrs 1370 km	11 hrs 855 km	NA

Table 10-13: Tracking buoy – first strike response timeline

Task	Time from IMT call-out
Tracking buoys deployed from drilling rig	<2 hours
OR	
Tracking buoys deployed from Dampier using vessels of opportunity	<12 hours
Minimum Resource Requirements	
+ Two tracking buoys for initial deployment	

10.4 Oil spill trajectory modelling

Table 10-14 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-14: Oil spill trajectory modelling – environmental performance outcome, initiation criteria and termination criteria

<table>
<tr><td>Environmental Performance Outcome</td><td colspan="2">Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">Notification of a Level 2 or 3 spill</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>Caley Condensate</td><td>MDO</td></tr>
<tr><td>✓</td><td>✓</td></tr>
<tr><td>Termination criteria</td><td colspan="2">+ Spill fate modelling will continue for 24 hours after the source is under control and a surface sheen is no longer observable, or until no longer beneficial to predict spill trajectory and concentrations, OR
+ As directed by the relevant Control Agency</td></tr>
</table>

Oil spill trajectory modelling uses computer modelling (e.g., OILMAP, SIMAP) to estimate the movement, fate and weathering potential of spills. Santos has engaged RPS Group to provide forecast spill fate modelling. RPS Group use SIMAP and OILMAP modelling systems that comply with Australian Standards (ASTM Standard F2067 “Standard Practice for Development and Use of Oil Spill Models”). RPS Group also provide the capacity for forecast air quality monitoring to enable an assessment of potential health and safety risks associated with VOCs released from a surface slick.

A particular advantage of spill trajectory modelling is that the transport and weathering of spilled hydrocarbons can be forecast, at all times of the day and night, at any location, and under any type of metocean conditions. By contrast, aerial surveillance and vessel-based monitoring will be constrained to daytime use, and have limits imposed by the operating environment. Aerial surveillance and vessel-based monitoring are, however, essential for model validation, verification and calibration of any modelling or first principle predictions.’

10.4.1 Implementation guidance

Table 10-15 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-16 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-15: Implementation guidance – oil spill trajectory modelling

	Action	Consideration	Responsibility	Complete
Initial Actions	Initiate oil spill trajectory modelling (OSTM) by submission of an oil spill trajectory modelling request form (Santos Procedure Index). Request for three-day forecast trajectory modelling.		Environment Team Leader	❑
	Determine requirement for gas/VOC modelling and request initiation.	hydrocarbon releases have human health and safety considerations for responders (volatile gases and organic compounds). This to be considered for any tactics that monitor/recover oil – especially at close proximity to release site.	Safety Team Leader Environmental Team Leader	❑
	Operational surveillance data (aerial, vessel, tracker buoys) to be provided to modelling provider to verify and adjust fate predictions of the spill and improve predictive accuracy.		Planning Team Leader/GIS	❑
	Login to the RPS Group data sharing website and maintain connection. Download modelling results.	Data should be stored digitally and backed up on to independent digital storage media. All datasets should be accompanied by a metadata summary and documented quality assurance and control procedures.	Planning Team Leader/GIS	❑
	Place RPS Group modelling data into GIS/Common Operating Picture.	RPS Group is to provide at least daily updates to the IMT of trajectory model outputs to inform response planning. More frequent updates can be provided if weather conditions are highly variable or change suddenly.	Planning Team Leader/GIS	❑

Action		Consideration	Responsibility	Complete
	In the event that chemical dispersants are considered applicable strategy for spill scenario, request modelling provider to model how dispersant addition effects the distribution and concentration of floating oil, subsea oil and shoreline loading.	Planning and Operations to provide inputs for modelled simulation based on potential/planned dispersant operations. Outputs from dispersant addition modelling to inform NEBA.	Planning Team Leader Operations Team Leader	❑
	Identify location and sensitivities at risk based on the trajectory modelling and inform IMT. Conduct NEBA on proposed response strategies.		Environment Team Leader	❑
Ongoing Actions	Request spill trajectory modelling be provided daily throughout the duration of the response and integrate data into Common Operating Picture.		Planning Team Leader/ GIS	❑
	Use results from other monitor and evaluate activities, and/or data derived from hydrocarbon assays of the source hydrocarbon or from other reservoirs in the region (that may be available) as input data (if or when available) to improve model accuracy.		Planning Team Leader/ GIS	❑

Table 10-16: Oil spill trajectory modelling resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
RPS OST modellers and software	RPS under direct contract to Santos, also available through AMOSC	Daily OSTM reports	Perth – digital	Two to four hours from activation

Table 10-17: Oil spill trajectory modelling – first strike response timeline

Task	Time from IMT call-out
RPS OSTM activated by IMT	<2 hours
OSTM provided to IMT	<4 hours
Minimum Resource Requirements	
+ Contracted OST modellers and software + OSTM Activation Form	

10.5 Satellite imagery

Table 10-18 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-18: Satellite imagery – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2 or 3 spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Satellite monitoring will continue until no further benefit is achieved from continuing; or as advised by relevant Control Agency.	

Satellite imagery is considered a supplementary source of information that can improve awareness but is not critical to the response and usage is at the discretion of the IMT.

Suitable imagery may be available via satellite imagery suppliers. This can be done through existing AMOSC and OSRL contracts. The most appropriate images for purchase will be based on the extent and location of the oil spill. Synthetic aperture radar and visible imagery may both be of value.

10.5.1 Implementation guidance

Table 10-19 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-20** provides a list of resources that may be used to implement this strategy. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-19: Satellite imagery implementation guide

	Action	Consideration	Responsibility	Complete
Initial Actions	Assess requirement for satellite imagery.		Planning Team Leader	❑
	Notify AMOSC and OSRL Duty Officer to initiate request for available satellite imagery.	Formal written activation of resources from AMOSC and OSRL by designated call-out authorities (Santos Duty Managers/Incident Commanders) is required.	Planning Team Leader	❑
	Assess suitability and order imagery.		Planning Team Leader	❑
	Integrate satellite imagery into common operating picture and provide to trajectory modelling provider for model validation.		GIS Team Leader Planning Team Leader	❑
Ongoing Actions	Review surveillance information to validate spill fate and trajectory.		Planning Team Leader	❑
	Use monitor and evaluate data to periodically reassess the spill and modify the response (through the IAP), as required.	Use surveillance data when updating the Common Operating Picture.	Planning Team Leader	❑

Table 10-20: Satellite imagery resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Satellite Imagery	Kongsberg Satellite Services – activated through AMOSC Global Dispersant Stockpile – activated through OSRL	Dependent upon overpass frequency (TBC on activation)	Digital	Kongsberg Satellite Services: one hour if satellite images available

10.6 Initial oil characterisation

Table 10-21 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-21: Initial oil characterisation - environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2 or 3 spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Oil sample and analysis to terminate once enough data has been collected to profile the oil characteristics and dispersant amenability throughout weathering and to provide oil for toxicity testing, OR + As directed by the relevant Control Agency	

10.6.1 Overview

Given MDO is a common fuel type with known properties and Caley Condensate is a hydrocarbon that has been previously assayed, the general physical and chemical characteristics of these hydrocarbons are known and have been presented in **Appendix A**. Nevertheless, sampling and analysis of the released hydrocarbon will provide the most accurate information on the hydrocarbon properties at the time of release.

The composition and physical properties of the hydrocarbon will also evolve over time through weathering processes that change its composition and properties, such as the viscosity, density, water content and pour point. The rate of change of the hydrocarbon properties will affect the likely time-window of opportunities for particular responses and the associated logistical requirements of these responses, such as use of chemical dispersants, recovery and pumping equipment suitability, hydrocarbon storage and hydrocarbon disposal requirements.

10.6.2 Implementation guidance

Table 10-22 provides guidance to the IMT on the actions and responsibilities for this strategy. **Table 10-23** provides a list of resources that may be used to implement this tactic. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

10.6.3 Oil sampling and analysis

Onsite dispersant testing

Using AMOSC dispersant shake test kits, samples of oil are to be tested by onsite vessels/crew for dispersant efficacy using the included dispersants by way of a simple shake test of efficacy. Photos of sample jars and observations are to be reported back to the IMT for evaluation. These tests are not a substitute for laboratory testing and test spraying but provide an early indication of efficacy on the oil and the relative effectiveness of the dispersants included within the test kits.

Laboratory analysis

Using onsite VOOs, oil samples (2 L per sample) are to be taken daily where possible from fresh oil, and from the weathered oil locations and dispatched to a laboratory for analysis. Samples are to be collected for 14 days post release where oil is available for sampling.

Laboratory analysis of the chemical and physical properties of the recovered oil, including gas chromatography/mass spectrometry for the purpose of fingerprinting the oil constituents, is to be undertaken. Fingerprinting of the released hydrocarbon potentially allows contamination to be traced back to the source where this is otherwise unclear or in dispute.

Ecotoxicology assessment of the oil is to be conducted at an ecotoxicology laboratory following the revised Australian and New Zealand Water Quality Guidelines. The quantity of oil required for analysis will be confirmed by the laboratory but is expected to be in the order of 6 to 10 L of oil. Testing results will provide the concentrations at which toxicity endpoints consistent with revised Australian and New Zealand Water Quality Guidelines are met for each test. Overall species protection concentrations, including 90%, 95% and 99% species protection trigger levels are then to be generated using a species sensitivity distribution fitted to the data (e.g., by using the Burrlioz software program).

Table 10-22: Implementation guidance – initial oil characterisation

	Action	Consideration	Responsibility	Complete
Initial Actions	Source available vessels (on hire or VOO) for oil sampling.	Can be multi-tasked – e.g., for vessel surveillance or tracking buoy deployment.	Operations Team Leader Logistics Team Leader	❑
	Source sampling equipment. Confirm sampling methodology. Confirm laboratory for sample analysis. Develop health and safety requirements/controls.	Refer **Table 10-23** for resource availability. Appendix A and D of CSIRO oil spill monitoring handbook provide suitable procedure.	Environment Team Leader Safety Team Leader	❑
	Vessel directed to sampling location.	Sampling of oil at thickest part of slick – typically leading edge.	Operations Team Leader	❑
	Vessel crew to undertake sampling and delivery of samples to Exmouth or Dampier for dispatch to laboratory. Environmental Team Leader to confirm analysis of oil with lab.	Exmouth and/or Dampier Logistics personnel to assist with logistics of sending oil samples to laboratory for analysis.	Operations Team Leader Environmental Team Leader Logistics Team Leader	❑
Ongoing Actions	Continue sample collection for 14 days post release where oil is available.	Initial monitoring by crew of available vessels – Once mobilised to site Santos scientific monitoring provider to continue sampling of oil in conjunction with operational water quality monitoring once mobilised to site.	Operations Team Leader Environment Team Leader Logistics Team Leader	❑

Table 10-23: Initial oil characterisation – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Dispersant efficacy kits (shake test)	AMOSC/Santos	3	Exmouth, Varanus Island, Dampier	Within 12 hours
Oil fingerprinting kits	AMOSC/Santos	3	Exmouth, Varanus Island, Dampier	Within 12 hours
Bulk oil sampling bottles	Intertek/Santos	As required	Perth Exmouth, Varanus Island, Dampier	Within 12 hours
Santos contracted vessel providers – incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited Vessels of Opportunity identified through AIS vessel tracking system	Availability dependent upon Santos and Vessel Contractor activities.	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS vessel tracking system	Pending availability and location. Expected within 12 hours	Santos-contracted vessel providers – incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited Vessels of Opportunity identified through AIS Vessel Tracking
National Association of Testing Authorities accredited laboratory/ personnel for analysis	Intertek	NA	Perth	24+ hours

Table 10-24: Initial oil characterisation – first strike response timeline

Task	Time from IMT call-out
Oil sample collection	<12 hours (daylight dependent)
Oil samples arrive at lab for analysis	<36 hours
Minimum Resource Requirements	
+ One vessel; no special requirements; oil sampling can be done concurrently with other tasks + One dispersant efficacy shake test kit + One oil fingerprinting kit + Sampling jars for bulk oil collection	

10.7 Operational water quality monitoring

10.7.1 Operational water sampling and analysis

Table 10-25 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-25: Operational water quality sampling and analysis – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Notification of a Level 2 or 3 spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Operational water sampling and analysis will continue for 24 hours following control of the source provided oil is no longer detectable, OR + As directed by the relevant Control Agency, OR + Vessel surveillance will terminate if there are unacceptable safety risks associated with volatile hydrocarbons at the sea surface.	

Operational sampling of oil and oil in water will be undertaken at discrete locations, providing visual observations, real time fluorometry/ dissolved oxygen readings and providing oil and water samples for laboratory analysis. The intent of this sampling is to confirm the distribution and concentration of oil, validating spill trajectory modelling and providing and informing the selection and implementation of other response strategies, including scientific monitoring.

Table 10-26 presents the water quality sampling and analysis plan considerations.

This monitoring is complimentary to scientific water quality monitoring (SMP1) delivered through the Oil Spill SMP in terms of methodology and required skillset and can be provided through Santos' Scientific Monitoring Provider (**Section 18**).

10.7.1.1 Implementation guidance

Refer to

Table 10-27 for the Operational Water Quality Sampling and Analysis implementation guide. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-26: Operational Water Quality Sampling and Analysis Plan considerations

Considerations for Operational Water Quality Sampling and Analysis	
Scope of work	The work scope for operational water quality monitoring will be driven by the IMT, confirming objectives for each operational period.
Survey design	The operational water sampling activities will be conducted by experienced environmental scientists and managed through the IMT Incident Action Planning process. The exact nature of the sampling activities will depend upon the objectives for each operational period; however, the sampling design and methodology will consider the following points: + Sampling locations will be moved with the slick and/or plume based on the observed or predicted location and movement of oil on water and subsea plumes. This will be informed by vessel/aerial surveillance, satellite tracking buoys and spill fate modelling. + At each discrete location, sampling will be conducted along a depth profile which captures the three-dimensional distribution of the oil. For a subsea release or where surface oil is present in shallow water (<5 m) this should involve a depth profile from the seabed to surface waters. Profiles should ensure that the full gradient of oil in water concentration can be determined. + Oil and oil in water samples are to be collected using suitable pumping or sampling apparatus. For samples at depth a Niskin bottle(s) or similar device that allows remote closing and discrete sampling at depth is to be used. Alternatively, water samples can be pumped from defined depths using a hose suspended vertically using a suitable pump for water sampling (e.g., a peristaltic pump). + Samples are to be collected in clean, fully labelled glass jars, filled to the top and refrigerated/ kept cool and in darkness during storage and transport. Handling, storage and documentation requirements to be confirmed with laboratory but holding time <7 days is expected requirement. + Oil and oil in water samples will be replicated at each site to allow intra-site variability to be assessed and appropriate quality assurance and control samples incorporated into replicates. + Concurrent with collection of water samples a conductivity-temperature-depth meter shall be deployed at each site along the same depth profile from which water samples are collected. The conductivity-temperature-depth meter will require fluorometry and dissolved oxygen sensors as part of the sensor package to record the presence of oil (fluorometry) and the activity of hydrocarbon degrading bacteria (dissolved oxygen). + Water samples also to be provided to an independent National Association of Testing Authorities-accredited laboratory in Perth for hydrocarbon suite analysis including polycyclic aromatic hydrocarbons.

Considerations for Operational Water Quality Sampling and Analysis	
Analysis and reporting	+ All data collected on oil properties provided in spreadsheets (including GPS location, depth of sampling, timing, on water observations, in-situ readings and water sample label details) to IMT on an ongoing basis during spill response operations. + Daily field reports of results provided to the IMT. + Analytical analysis of oil properties following laboratory evaluation. + Final report detailing all data collected on oil properties throughout the monitoring program including relevant interpretation.

Table 10-27: Implementation guidance – operational water quality sampling and analysis

Action		Consideration	Responsibility	Complete
Initial Actions	Activate Santos Monitoring Service Provider for Operational Water Quality Monitoring.		Environment Team Leader	❑
	Obtain spill trajectory modelling and provide to Monitoring Service Provider.		Environment Team Leader Planning Team Leader GIS Support	❑
	Develop Monitoring Action Plan (Including Sampling and Analysis Plan) for operational water quality monitoring. Plan to also consider oil characterisation sampling (**Section 10.5**)– Monitoring Service Provider to take over this sampling once mobilised.	Sites to be selected using oil spill trajectory modelling and distribution of oil from surveillance tactics. Refer **Table 10-26** for considerations for Sampling and Analysis Plan.	Monitoring Service Provider Environment Team Leader	❑
	Develop health and safety plan including potential exposure to volatile gases/VOCs.	Refer Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016).	Monitoring Service Provider Safety Team Leader	❑
	Monitoring Service Provider to assemble team/s and water quality monitoring equipment.		Monitoring Service Provider	❑
	Organise Vessels, accommodation and transport requirements to mobilise monitoring team/s to site.	Monitoring Service provider to outline requirements in resource request form.	Logistics Team Leader	❑
	Sampling and analysis undertaken. Daily communication and confirmation of sampling plan with OSC and IMT. Daily activity/data reports provided to IMT. Oil/water samples dispatched to nominated laboratories for analysis.		Monitoring Service Provider On-Scene Commander Operations Team Leader Environment Team Leader Logistics Team Leader	❑

Action		Consideration	Responsibility	Complete
Ongoing Actions	Monitoring results to be conveyed to IMT through Common Operating Picture and provided to spill trajectory modeller to validate predictions.		Planning Team Leader GIS Support Environment Team Leader	❑

Table 10-28: Operational water quality sampling and analysis – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Water quality monitoring personnel	Monitoring Service Provider (currently Astron/BMT)	Approx. 15 (based on capability reports)	Perth based	Personnel and equipment within 72 hours from approval of work scope – pending vessel availability
Water quality sampling equipment and water quality meters	Third-party suppliers via Monitoring Service Provider (currently Astron/BMT)	Multiple providers	Australia based	
Contracted water quality monitoring vessels	Santos Contracted Vessel Providers – incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited	Availability dependent upon Santos and Vessel Contractor activities; suitable vessels identified through AIS Vessel Tracking	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS Vessel Tracking Software	<72 hours

Table 10-29: Operational water quality sampling and analysis – first strike response timeline

Task	Time from IMT call-out
IMT activates monitoring service provider.	<4 hours
Operational water quality monitoring personnel, equipment and vessel deployed to spill site.	<72 hours
Minimum Resource Requirements	
+ Water quality monitoring vessel/s – refer Santos Offshore ER Intranet for vessel specification. + Water quality monitoring team (through monitoring service provider). + Water quality monitoring equipment (through monitoring service provider).	

10.7.2 Continuous fluorometry surveys

Table 10-30 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy

Table 10-30: Continuous fluorometry surveys – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Level 2/3 spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Continuous fluorometry surveys will continue for 24 hours following control of the source provided oil is no longer detectable, OR + As directed by the relevant Control Agency.	

In addition to operational water sampling and sensor deployment at discrete locations, a continuous fluorometry survey(s) may be run across the expected slick/plume extent, as well as vertically through the water column. This allows a far greater area of coverage than discrete sampling, aiding in the mapping of entrained and dissolved oil movement.

Continuous fluorometry surveys are also used to evaluate the effectiveness of dispersant application by detecting changes in the distribution of oil before and after the application of dispersants whether that be on surface on subsea.

Sub surface gliders containing fluorometers built into the body of the glider may be used for this monitoring and would be preferential for monitoring a continuous subsea release (subsea LOWC from all locations). This will allow continuous monitoring of entrained oil covering a large area and will provide near real-time three-dimensional data on the distribution of entrained oil to enable decision making within the IMT. Similarly, other sources of monitoring data (e.g., spill fate modelling) can be used in near real-time to inform the path of the sub surface glider. Sub surface gliders are particularly suited to subsea releases where oil may be distributed below surface layers.

Fluorometers towed behind vessels will be used as an alternative or complementary approach for a subsea release and would be preferred for surface spills and to monitor the effect of dispersant application at surface.

10.7.3 Implementation guidance

Table 10-31 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-32** provides a summary of resources that may be used to implement this strategy. **Table 10-33** details the minimum first strike requirements to be mobilised on activation. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Section 10.9 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Santos

Table 10-31: Continuous fluorometry surveys – implementation guidance

	Action	Consideration	Responsibility	Complete
Initial Actions	Activate Monitoring Service Provider and engage to provide towed fluorometry services (personnel and equipment) as part of Operational Water Sampling and Analysis – refer Table 10-27 for actions.		Monitoring Service Provider Environment Team Leader	❑
	Activate OSRL monitoring and determine availability of subsea gliders and towed fluorometry equipment.	OSRL can provide specialist technical advice on operation of towed fluorometers. Consider: Engaging OSRL for review and input into monitoring action plan for towed fluorometry.	Incident Commander Environment Team Leader	❑
	Determine suitability of subsea gliders for monitoring.	Sub surface gliders containing fluorometers built into the body of the glider may be used for this monitoring and would be preferential for monitoring a continuous subsea release (well leak scenario).	Environment Team Leader	❑
	If gliders and pilot/s available and suitable for incident, engage provider to develop Monitoring Action Plan.	Arrange joint meeting with spill modelling provider and OSRL/glider operator to develop monitoring design and ongoing data transfer protocols to meet objective of model validation.	Environment Team Leader	❑
	Source vessels and other logistics to support monitoring.		Logistics Team Leader Operations Team Leader	❑
	Conduct monitoring as per monitoring action plan with deployment area guided by other operational monitoring studies and dispersant application areas.	The scope of monitoring will be dictated by the response strategies being employed. Where dispersants application is being undertaken fluorometry surveys will have to be coordinated with application activities so subsea oil distribution can be assessed before and after dispersant addition in order to determine effectiveness. Appendix F of CSIRO oil spill	Operations Team Leader Planning Team Leader Environment Team Leader	❑

Action		Consideration	Responsibility	Complete
		monitoring handbook provide standard operating procedures for monitoring dispersant effectiveness using fluorometry equipment.		
Ongoing Actions	Provide daily data reports and spatial outputs IMT.		Monitoring Provider	❑
	Monitoring results to be incorporated into Common Operating Picture.		Planning Team Leader GIS Support	❑

Table 10-32: Continuous fluorometry surveys – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Towed fluorometers	OSRL	Towed Fluorometers: seven Turner C3 fluorometers globally	4 in Southampton, 2 in Singapore and 1 in Fort Lauderdale	<72 hours
Glider mounted fluorometers	OSRL	Subsea glider: Qty subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the Glider	Gliders based in Perth OSRL towed fluorometers out of Singapore, Southampton and Fort Lauderdale	<72 hours dependent upon availability
Water quality monitoring personnel to operate towed fluorometers	Monitoring Service Provider (currently Astron/BMT)	Approx. 15 (based on capability reports)	Perth based	<72 hours
Glider (remote) pilot/s and deployment crew	Third-party provider via OSRL	Subsea glider: Qty subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the glider	Perth based pilot and deployment crew	<72 hours dependent upon availability

Table 10-33: Operational water quality sampling and analysis – first strike response timeline

Task	Time from IMT call-out
IMT activates OSRL and Monitoring Service Provider.	<4 hours
Monitoring Service Provider water quality monitoring personnel deployed to site.	<72 hours
Towed fluorometers deployed to site.	<72 hours
Glider and pilot/s and deployment crew deployed (if gliders available and appropriate).	<72 hours (if gliders available and appropriate)
Minimum Resource Requirements	
+ Water quality monitoring vessel/s – refer Santos Offshore ER Intranet for vessel specification. + Water quality monitoring team (through monitoring service provider). + OSRL towed fluorometer (Turner C3).	

10.8 Shoreline and coastal habitat assessment

Table 10-34 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 10-34: Shoreline and coastal habitat assessment – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making	
Initiation criteria	Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by OSC)	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	As directed by the relevant Control Agency	

To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character (topography, complexity, exposure, etc), degree and distribution of oiling (if present), presence of sensitive receptors (habitats, fauna, etc) and information on shoreline processes and access routes that could aid or hamper response efforts. This detailed information can be collected from on-ground assessments.

DoT are the designated Control Agency for shoreline response for all spills identified in this OPEP and will direct resources provided through Santos for the purposes of on-ground shoreline assessments and shoreline response activities. Santos will provide additional information on shoreline character and oiling collected as part of aerial surveillance activities carried out under its control (refer **Section 10.2**).

Existing information on shoreline character, distribution of habitats/fauna and access/safety constraints can be obtained from:

+ Santos Energy GIS, including habitat/fauna distribution layers and aerial imagery
+ Oil Spill Response Atlas Web Map Application
+ Pilbara Region Oiled Wildlife Response Plan
+ WA Marine Oil Pollution Risk Assessment Web Map Application (rankings and general information on protection priorities).

10.8.1 Implementation guidance

The information provided below is included for planning purposes and represents how Santos would approach shoreline assessments. In the event of a spill with the potential for shoreline contact, DoT, will control shoreline assessments and ultimately personnel supplied through Santos will follow the direction of DoT; this may differ from that included below.

DoT provides guidance on shoreline assessments within their Oil Spill Contingency Plan.

Table 10-35 presents considerations for planning and conducting the assessments.

The implementation guide for Shoreline and Coastal Habitat and Assessment is found in **Table 10-36**.

Table 10-37 provides a list of resources that may be used to implement this strategy and **Table 10-38** details the minimum first strike mobilisation requirements for Santos on activation.

Table 10-39 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-35*: Shoreline and coastal habitat assessment considerations*

Considerations for Shoreline and Coastal Habitat Assessment	
Survey design	A shoreline assessment may include the following tasks: + Assessment of shoreline character, habitats and fauna, including: – shoreline structured biotic habitats – distribution of fauna – shoreline and processes (e.g., wave, tidal flows – shoreline substrate (e.g., mud, sand, pebble, rock) – shoreline form (e.g., width, shape and gradient) – access/safety constraints. + Assessment of shoreline oiling (if present): – surface distribution and cover – subsurface distribution – oil type, thickness, concentration and physical character – sampling of oil for laboratory analysis. + Recommendations for response: – applicable strategies based on oil type and habitat – potential access, safety and environmental constraints – likely resourcing (personnel and equipment) requirements. Ground surveys undertaken on foot, by vehicles or by small vessel will occur at prioritised areas to provide a close-range assessment of shoreline physical characteristics, coastal habitats/fauna, scale and character of oiling and safety/access constraints. Ground surveys should be undertaken by trained shoreline clean-up specialists and other trained oil spill responders as per those required for managing shoreline clean-up operations. This includes the use of AMOSC Core Group personnel across industry and State and National Response Teams as provided for under MEE and NatPlan. The deployment of ground survey teams will be directed by DoT as the HMA and Control Agency for coastal/shoreline pollution in WA. The deployments will be informed by the observed and predicted contact of oil and from existing baseline information on shoreline character. Shoreline surveys will be undertaken within segments that are recorded and/or mapped that share common traits based on coast geomorphology, habitat type, fauna presence, level of oiling or access. Information on shoreline character and habitat/fauna distribution for each segment should be recorded through the use of: + still or video imagery collected with simultaneous GPS acquisition + field notes together with simultaneous GPS acquisition + mud maps outlining key natural features, oil distribution, imagery locations of quantitative data (transects, oil samples) + transects (cross-shore, longshore) and vertical sediment profiles.

Considerations for Shoreline and Coastal Habitat Assessment	
	+ samples of oil and/or oiled sediments. The parameters that should be assessed are: + physical characteristics: rocky, sandy beach, flat, dune, other wetland + major habitat types: mangrove, salt marsh, saltpan flats, fringing reef, rubble shore, seagrass verge + coastal fauna and key habitats (e.g., nests) including quantification/distribution of oiled fauna + state of erosion and deposition: deposition, erosion, stable + human modified coastline (access tracks, facilities, etc) + oil character, if present, including appearance, surface thickness, depth (into sediments), distribution, area and percentage cover.
Analysis and reporting	Shoreline survey reports to be submitted to the Control Agency IMT at completion of assessments. All raw data collected will be included as appendices to the report and provided in a geospatial format for subsequent use in GIS mapping software.

Table 10-36: Shoreline and coastal habitat assessment – implementation guidance

	Action	Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to WA DoT have been made.	Refer to **Section 7** for reporting requirements.	Environment Team Leader	❑
	Collect and provide spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to Control Agency for assistance in identification of priority protection areas and NEBA.	Existing shoreline sensitivity mapping information for potential oil contacted locations is available on the Santos ER intranet site.	Environment Team Leader Planning Team Leader	❑
	Actions below are indicative only and are at the final determination of DoT as the Control Agency			
	Mobilise the AMOSC core group responders as required for industry support to DoT.	Refer to **Table 10-37**.	Incident Commander Operations Team Leader Logistics Team Leader	❑
	Assessment of shoreline character, habitats and fauna.	Refer to **Table 10-35**.	AMOSC Core group and DoT	❑
	Assessment of shoreline oiling (if present).	Refer to **Table 10-35**.	AMOSC Core group and DoT	❑
	Recommendations for response strategies.	Refer to **Table 10-35**.	AMOSC Core group and DoT	❑

Table 10-37: Shoreline and coastal habitat assessment – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos and WA industry AMOSC core group staff and responders	Santos Core Group Industry Core Group, AMOSC staff	12 (Santos core group) 60+ (industry core group ops)	Perth, Dampier, Varanus Island and other NW locations	<24 hours from time of shoreline contact prediction

Table 10-38: Shoreline assessment – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction and begins sourcing personnel for shoreline assessment team.	<4 hours
AMOSC core group (shoreline assessment personnel) mobilised to site.	<24 hours
Minimum Resource Requirements	
+ Minimum two AMOSC core group personnel.	

10.9 Environmental performance

Table 10-39: Environmental performance – monitor and evaluate

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Response preparedness		
Monitor and Evaluate – vessel and aerial surveillance	Maintenance of Master Services Agreements (MSAs) with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	MSA with aircraft supplier	MSA in place with helicopter provider throughout activity	MSA with aircraft suppliers
	Santos trained Aerial Observers	Santos maintains a pool of trained aerial observers	Exercise Records Training Records
	AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	Maintenance of AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	AMOSC Participating Member Contract
	Access to certified UAV providers	Maintenance of contract for access to UAV providers	Maintenance of contract with service provider
	Aircraft charter companies for fauna observations	Maintain a list of aircraft charter companies that could potentially provide fauna observation services	List of providers
	Response Implementation		
Monitor and Evaluate – vessel and aerial surveillance	Vessel surveillance	Minimum first strike resource requirements mobilised in accordance with **Table 10-4**	Incident log
		Daily observation reports submitted to IMT until termination criteria is met	Incident log
	Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	Vessels comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations	Completed vessel statement of conformance

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		2000 which includes controls for minimising the risk of collision with marine fauna	
		Aircraft comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising interaction with marine fauna	Aircraft contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure
	Aerial surveillance	Minimum first strike resource requirements mobilised in accordance with **Table 10-8**	Incident log
		Following initiation two passes per day of spill area by observation aircraft provided	Incident log
		Trained Aerial Observers supplied from Day 2 of response	Incident log
		Flight schedules are maintained throughout response	Incident Action Plan
		Observers completed aerial surveillance observer log following completion of flight	Aerial Observer Logs
	Response Preparedness		
Monitor and Evaluate – tracking buoys	Tracking buoys available	Maintenance of 12 tracker buoys throughout the activity	Computer tracking software Tracker buoy tests

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Response Implementation		
Monitor and Evaluate – tracking buoys	Tracking buoy mobilisation	Minimum requirements mobilised in accordance with **Table 10-11**	Incident log
	Response Preparedness		
Monitor and Evaluate – oil spill modelling	Maintenance of contract for emergency response modelling	Maintenance of contract for forecast spill trajectory modelling services throughout activity	Modelling services contract
	Response Implementation		
Monitor and Evaluate – oil spill modelling	Oil spill modelling	Oil Spill Modelling provider will be contacted immediately (within two hours) upon notification of a Level 2 or 3 spill	Incident Log
		Modelling delivered to IMT within two hours of request to service provider	Incident Log
	Response Preparedness		
Monitor and Evaluate – satellite imagery	Satellite imagery	Contract in place with third party provider to enable access and analysis of satellite imagery	Contract with service provider
	Response Implementation		
Monitor and Evaluate – satellite imagery	Satellite imagery	Data incorporated into common operating picture and provided to spill modelling provider	Incident Log and Incident Action Plan
	Response Preparedness		
Monitor and Evaluate – oil and oil in water monitoring	Maintenance of Monitoring Service Provider contract for water quality monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity	Contract with monitoring service provider
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Entrained oil monitoring equipment and services	Maintenance of arrangements to enable access to fluorometry services throughout activity	Arrangement with provider of fluorometry equipment
	Water quality monitoring vessels	Maintenance of vessel specification for Water quality monitoring vessels	Vessel specification
	Oil and water quality monitoring equipment	Oil and water quality monitoring kits pre-positioned at Exmouth, Dampier and Varanus Island	Evidence of deployment to site
	Response Implementation		
Monitor and Evaluate – oil and oil in water monitoring	Initial Oil Characterisation	Minimum requirements mobilised in accordance with **Table 10-23**	Incident Log
		Oil samples sent to laboratory for initial fingerprinting	Incident Log
		If applicable (not MDO), oil samples sent to laboratory for dispersant amenability	Incident Log
		Oil samples to be sent immediately for laboratory ecotoxicity testing of oil	Incident Log
		90, 95 and 99% Species protection triggers levels will be derived from ecotoxicity testing results (minimum five species' tests) within 24 hours of receiving all results	Incident Log
	Operational oil and oil in water monitoring	IMT activates monitoring service provider within four hours	Incident Log
		Operational water sampling and analysis surveys mobilised within 72 hours of approval	Incident Log

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		Fluorometry surveys mobilised within five days of initiation	Incident Log
		Daily report including fluorometry results provided to IMT	Incident Log
	Response Preparedness		
Monitor and Evaluate – shoreline assessments	AMOSC contract to facilitate mutual aid arrangements for access to Oil Spill Responders	Maintenance of AMOSC contract to facilitate mutual aid arrangements for access to Oil Spill Responders	AMOSC Participating Member Contract
	Response Implementation		
Monitor and Evaluate – shoreline assessments	Shoreline assessment	Minimum shoreline assessment requirements mobilised as per **Table 10-38**	Incident Log
		Shoreline Assessment strategies will be implemented under the direction of DoT as the HMA	Incident Log
		Santos will make available AMOSC Core Group Responders for shoreline and coastal habitat assessment positions to the Control Agency	Incident Log
		Shoreline assessment reports provided to the IMT daily detailing the assessed areas to maximise effective utilisation of resources	Incident Log
	Use of shallow draft vessels for shoreline and nearshore operations	Shallow draft vessels are used for shoreline and nearshore operations unless directed otherwise by the designated Control Agency (i.e., DoT)	Vessel specification documentation contained in IAP.

Environmental Performance Outcome	Implementation monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions	OSR Team Leader assess/select vehicles appropriate to shoreline conditions	IAP demonstrates requirement is met
	Conduct shoreline/ nearshore habitat/ bathymetry assessment	Unless directed otherwise by the designated Control Agency (i.e., DoT) a shoreline/nearshore habitat/bathymetry assessment is conducted prior to nearshore activities	IAP records assessment records
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/ roosting areas and turtle nesting habitat	Unless directed otherwise by the designated Control Agency (i.e., DoT) demarcation zones are mapped out in sensitive habitat areas	IAP demonstrates requirement is met
	Operational restriction of vehicle and personnel movement to limit erosion and compaction	Unless directed otherwise by the designated Control Agency (i.e., DoT) action plans for shoreline operations include operational restrictions on vehicle and personnel movement	IAP demonstrates requirement is met

11 Containment and Recovery Plan

Table 11-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 11-1: Containment and recovery – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities	
Initiation criteria	Notification of a condensate spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✗
Termination criteria	+ NEBA is no longer being achieved, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

11.1 Overview

Booms and skimming equipment can be used to create physical barriers on the water surface to contain and recover the oil to remove risk of oil contacting environmental, social and cultural sensitivities. This strategy is often used in the offshore environment in close proximity to the hydrocarbon source. Once contained, an attempt to recover the hydrocarbons from the surface waters can be undertaken.

Table 11-2 provides applicability criteria on when containment and recovery may be a suitable response option. Further definition of BAOACs is provided in **Table 13-2**.

Table 11-2: Containment and recovery application criteria

Criteria	Recommended	Not Recommended
Spill characteristics	+ Patchy slick + Extended operations + Surface concentrations >50 g/m^2 (BAOAC of 4) at a minimum, 100 g/m^2 (BAOAC of 5) is optimal	+ Situation dependent + Surface thickness <50 g/m^2 (BOAC <4)
Hydrocarbon type	+ Group 3 hydrocarbons and above + Persistent components of Group 1 and 2 hydrocarbons may be suitable	+ Minor to moderate spills of Group 1 and 2 hydrocarbons are likely to weather rapidly. High volatiles of these hydrocarbons may be a safety risk to personnel
Operating environment	+ Waves <1 m for nearshore containment and recovery systems (Santos Expandi Boom) + Waves <1.8 m for offshore systems (AMOSC/AMSA offshore boom) + Winds <25 knots	+ Wave heights exceed 1.8 m + Current >0.75 knots

11.2 Implementation guidance

Table 11-3 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 11-4** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial containment and recovery operations are listed in **Table 11-5**. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 11-3: Implementation guidance – containment and recovery

	Action	Consideration	Responsibility	Complete
	Containment and recovery			
Initial Actions	Identify and activate containment and recovery equipment stockpiles based on incident location. Initial equipment mobilisation from Karratha, Exmouth and Dampier.	Refer to **Table 11-4** for location of containment and recovery resources. Initial deployment from Karratha, Dampier or Exmouth pending vessel availability. Up to date stockpile information accessed through Santos' Emergency Response Intranet Site.	Logistics Team Leader Supply Team Leader Operations Team Leader	❑
Initial Actions	Identify suitable deployment vessels/crew. Mobilise resources port location – Karratha, Exmouth and Dampier.	Refer to **Table 11-4** for location of containment and recovery resources. Initial deployment from Karratha, Dampier or Exmouth pending vessel availability. Preference will be for vessels and crew that are exercised in regular Santos booming exercises.	Logistics Team Leader Supply Team Leader Operations Team Leader	❑
Initial Actions	Assess the spill trajectory modelling, other operational monitoring data to identify operational area for containment and recovery (C&R) deployments.	Refer to **Table 11-2** for guidance.	Operations Team Leader Planning Team Leader	❑
Initial Actions	Confirm conditions are suitable for containment and recovery activities.	Refer to **Table 11-2** for guidance.	Operations Team Leader Planning Team Leader	❑

	Action	Consideration	Responsibility	Complete
	Mobilise deployment personnel to nominated marine bases.	Each vessel conducting containment and recovery is to be manned with a trained AMOSC, Santos or OSRL Oil Spill Responder, who is the Team Leader tasked with controlling the operations and implementing them in a safe and responsible method. The Team Leader has the responsibility of evaluating the effectiveness of the containment and recovery operations and communicating the information to the IMT Operations Team Leader.	Operations Team Leader Logistics Team Leader	❑
	Coordinate aerial surveillance support to vessels to ensure they are being directed to priority locations for containment and recovery activities within operational zones.	Focus on containment and recovery activities to areas of slick of a sufficient thickness whereby containment and recovery activities will be effective. Refer to **Table 11-2** for guidance.	Planning Team Leader Operations Team Leader	❑
	Direct containment and recovery operations to designated operational zones.	The base case restrictions for containment and recovery is no application within 25 km of well site.	Operations Team Leader	❑
	Decanting (if selected)			
	Obtain decanting approval from AMSA (Commonwealth waters) or DoT (WA waters).	Under both MARPOL and POWBONS, decanting must be approved by the relevant Jurisdictional Authority where the discharge will occur. Approval should be sought to discharge water that has separated from oil into the apex of the already deployed containment boom system (with operational skimmer). This will increase the oil strong capacity of storage tanks.	Environment Team Leader	❑
	Ensure personnel onboard the vessels are familiar with decanting procedure approved by the relevant authority AMSA (Commonwealth waters) or DoT (WA waters).		Operations Team Leader	❑

Action		Consideration	Responsibility	Complete
	Commence decanting operations, ensuring that any discharged water is directed into the apex of the already deployed containment boom system (with operational skimmer).		Vessel Master/s	❑
Ongoing Actions	Containment and recovery			
	Coordinate the dispatch of operationally ready (all equipment and personnel on board) vessels via the IAP.	Equipment will be maintained and replaced if necessary through existing stockpiles.	Operations Team Leader	❑
	Maintain operational zones and provide updates to Vessel Masters on most suitable locations for containment and recovery operations.	Continue to utilise aerial surveillance data to inform the location of operational zones.	Operations Team Leader	❑
	Develop waste transfer process to secondary vessels/barge to enhance C&R vessel operational time, reduce port visits for waste unloading and reduce contamination.	Consider location and size/ type of waste collection vessel/barge and suitability of equipment and waste receptacles for dynamic lifts. Consider waste transfer to Dampier port rather than Exmouth which is a small multi-use port facility.	Operations Team Leader Planning Team Leader Logistics Team Leader	❑

Table 11-4: Containment and recovery – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos Expandi Boom (inshore/calm seas deployment) c/w accessories and powerpacks	Santos	Dampier container (two 200 m booms + accessories) VI Containers four 200 m boom and accessories	Dampier, Varanus Island	Within 12 hours (for Dampier or VI based deployment)
Santos Disc/Brush Skimmers (Desmi DBD16) (inshore/calm seas deployment) c/w hoses/powerpacks	Santos	Two (one each: Dampier and VI)	Dampier, Varanus Island	Within 12 hours (for Dampier or VI based deployment)
AMOSC Offshore containment and Recovery Boom AMOSC Heavy Oil Skimmers	AMOSC	Ro Boom (200 m) – 15 Current Buster Boom System – one Speed Sweep system – one LWS 500 Weir Skimmer – six GT 185 Weir Skimmer	Exmouth – two; Fremantle – six Geelong – seven Geelong – one Geelong – one Fremantle – three; Geelong – three Exmouth – one	Response via duty officer within 15 minutes of first call – AMOSC personnel available within 1 hour of initial activation call. Equipment logistics varies according to stockpile location (refer **Table 10-12**)
AMSA Offshore containment and Recovery Boom AMSA Heavy Oil Skimmers	AMSA	RO Boom (200 m) – eight Vikoma Hi Sprint Boom – four LWS 500 Weir Skimmer – eight DESMI Termite Skimmer – two	Karratha – four; Fremantle – four Karratha – two; Fremantle – two Fremantle – four; Karratha – four Fremantle – one; Karratha – one	Access to National Plan equipment through AMOSC. Equipment. Logistics varies according to stockpile location (refer **Table 10-12**)
AMOSC offshore waste storage	AMOSC	Lancer Barges – four Deck Bladders – five	Fremantle – two; Geelong – two Fremantle – two; Geelong – three	Response via duty officer within 15 mins of first call - AMOSC personnel available within 1 hour of initial activation call. Logistics varies according to stockpile location (refer **Table 10-12**)

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
AMSA offshore waste storage	AMSA	Vikoma Flexidam – eight Canflex Sea Slug – five Vikom Frost Barge – four Covertex tow tank – two	Fremantle – four; Karratha – four Fremantle – three; Karratha – two Fremantle – two; Karratha – two Karratha – two	Access to National Plan equipment through AMOSC. Logistics varies according to stockpile location (refer **Table 10-12**)
Liquid Waste Tanks	Via North West Alliance contract	As required	Perth, Karratha	<24 hours
Offshore Containment & Recovery Vessels and crew Waste transfer vessels/barges	Santos contracted vessel providers. Preference for vessels used in Santos deployment exercises	Varies – check through vessel contractors/Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability
Personnel (field responders) for OSR strategies	AMOSC Staff	8	Fremantle – two Geelong x 6	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site.
	AMOSC Core Group (Santos)	12	Perth/ NW Aus facilities – ten Port Bonython (SA) – two	From <12 hours (NW-based personnel) From <24 hours (Perth personnel)
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation.

Table 11-5: Containment and recovery – first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and begins sourcing C&R resources for applicable spills	<3 hours
Santos Offshore Core Group members mobilised to deployment port	<12 hours
C&R equipment (offshore boom/skimmer) mobilised to deployment port	<12 hours
Waste storage equipment mobilised to port	<24 hours
Suitable C&R vessels mobilised to port	<24 hours
AMOSC Staff/Industry Core Group mobilised to deployment port	<24 hours
C&R operation deployed to spill site (weather/daylight dependent)	<41 hours (weather/daylight dependent)*
Minimum Resource Requirements	
+ Two suitable C&R vessels (one boom deployment vessel + one tow vessel) – refer Santos Offshore ER Intranet for vessel specification + 200 to 400 m of offshore boom (AMOSC/AMSA) + One offshore skimmer appropriate to heavy oil and operating conditions (e.g., large weir) + Waste storage (comprising towable bladder, IBCs, Iso-tanks, inbuilt vessel storage tanks or combination allowing for 30+ m^3 liquid waste volume storage) + One to two Santos Core Group responders + Four AMOSC Industry Core Group/Staff including C&R Team Leader + Personal protective equipment	

**Assumes a 17-hour transit time to spill location (measured to geometric centre of operational area) by C&R vessels departing Dampier port and that weather/daylight allows operation to commence.*

11.3 Resource requirements

Containment and recovery is more effective when a sufficient oil thickness can be achieved by the containment booms (minimum of 50 g/m²). Whilst containment and recovery would not be suitable for Marine Diesel, it could be suitable for Caley Condensate under suitable weather conditions (winds greater than 25 knots and currents less than 0.75 knots).

The effectiveness of containment and recovery operations at the release locations is severely restricted by the dominant met ocean conditions with wind speeds exceeding 12 knots for over 40% of the time during winter and around 20 to 30% of the time during summer months. Additionally, currents are above 0.75 knots for a significant portion of the year (GHD, 2021). This means the effectiveness of containment and recovery operations will be severely limited by metocean conditions.

The high evaporation rates associated with the Caley Condensate also mean that it is unlikely to be safe to attempt to recover fresh oil in close proximity to the well (within 25 km of the release location). It is considered that the most effective use of Containment and Recovery would be at the weathered spill front under suitable metocean conditions. When wind and current speeds are high it can be expected that the oil will naturally entrain, which would preclude successful containment and recovery operations. Deterministic modelling (see **Section 6.4**) also showed that concentrations greater than 50 g/m² are likely to be spatially limited to a maximum extent of around 100 km from the LOWC location.

To help determine the likely encounter rate from containment and recovery operations, the Boom Encounter Rate Formula in the AMSA Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (2020) has been used.

Boom Encounter Rate (BER) Formula = (Length of Boom (LB) x 0.3) x Velocity of vessel (knots/hr) x Thickness of slick (mm)

LB = assumed as 200 m (based on typical available minimum boom lengths of 200 m)

Velocity = 1 knot

Thickness of slick = 50 g/m² or 0.047 mm

Note: percentage cover is assumed to be 100% during initial stages of the operation

BER = (200 x 0.3) x 1 x 0.047 = 2.82 m³ per operation/hour x 12 hours of operation = 30 m³/operation/day

Assuming a continuous spill front (above 50 g/m²) of 50 km and ideal metocean conditions for the duration of the spill we would expect a single operational unit (two vessels and 200 m of boom) to cover approximately 22 km in a 12-hour window recovering approximately 30 m³ per day. In the initial days following the spill (prior to the weathering of the oil) the slick is expected to remain within the 25 km buffer, therefore the response could be scaled up from week two. Coverage of the spill front is expected to be provided by four operations. Given that metocean conditions are unlikely to be suitable for effective containment and recovery and that additional operational units would provide limited additional benefit (30 m³ per day of recovery under ideal conditions), the use of additional units is not considered ALARP.

Worst case credible scenario requirements – Bedout North (surface LOWC)

Stochastic realisation #4 from the Bedout North surface LOWC scenario resulted in the highest total surface oil mass exceeding 50 g/m² of all LOWC scenarios. Deterministic analysis of this worst-case credible scenario was undertaken with the results used to inform containment and recovery response requirements. Deterministic modelling indicates that surface oil thickness exceeding 50 g/m² would be present in the marine environment for up to 90 days following the worst credible LOWC scenario.

The pour point of LAVRANS is predicted to reach 29 to 33°C (depending on weather conditions) after weathering. This exceeds the typical surface water temperatures (26 to 28°C) for waters associated with the Bedout Multi-Well Drilling EP which would suggest the oil would begin to gel or solidify, however the viscosity would remain relatively low. This can be attributed to the physical network structure which hardens the oil being interrupted by continual wave motion which breaks the waxy structure up (GHD, 2021).

The relatively low viscosity of LAVRANS means that C&R activities may have limited net environmental benefit. However, due to the wax content of Caley Condensate being slightly higher than that of LAVRANS (9.2% compared to 6%), provision for C&R activities has been retained. Should a Level 2/3 spill occur, four C&R operations would be deployed during week one (dependent on weather and metocean conditions). In field and laboratory assessment of oil (**Section 10.6.3**) would be used to determine the weathering/persistent characteristics of hydrocarbons in the marine environment. Depending on oil analysis results, C&R response continue throughout the duration of the LOWC event or be terminated due to the response providing negligible environmental benefit at significant financial and labour cost.

Depending on the spill location, equipment stockpiles in Dampier, Exmouth or VI would be deployed within a timeframe allowing operation on the second day following notification, pending vessel availability.

Vessel availability and the capacity to store and transfer oil volumes are key factors that could restrict ability to deploy operations and ability of operations to meet maximum recovery levels. Vessels may be tasked with dispersant spraying over containment and recovery operations if this is deemed more effective in meeting performance outcome of reducing floating oil volumes.

11.4 Decanting

Decanting is an important tool needed to make efficient use of waste management resources which are often a limiting factor in containment and recovery.

The reduction of overall waste in some circumstances can create an environmental benefit which outweighs the minimal impact caused by the release of water with very low concentrations of oil.

The POWBONS Act; section 8 allows for decanting for combating specific pollution incidents. Additionally, Annex 1 of MARPOL (Regulation 9) allows for decanting for combating specific pollution events to minimise the damage from pollution. Under both MARPOL and POWBONS decanting must be approved by the relevant Jurisdictional Authority. In WA State waters this is DoT (as the Hazard Management Agency under the *Emergency Management Act* 2005) and in Commonwealth waters this is AMSA.

11.5 Waste storage and transfer

In order to maximise the efficiency of offshore collection operations, existing storage capacities on vessels is required to be augmented primarily with on-deck storage. Waste containers and tanks are available through contract conditions with Santos' waste service provider (refer **Section 17**) and through AMOSC and AMSA. In the event that decanting approval is not obtained through AMSA/DoT, the complete collected oil and water will remain in the collection tanks and all will be treated as collected waste. In this event, the duration of containment and recovery operations will be reduced due to restricted available sullage.

For an ongoing response, at-sea waste transfer from containment and recovery vessels to a larger waste collection vessels or barge, can occur through dynamic lifting of waste receptacles or on-water bunkering procedures (for liquid oil). This has the potential to increase operational time of containment and recovery vessels and reduce frequency of waste transfers to port. By reducing the requirement for containment and recovery vessels to frequently return to port this system reduces the risk of spreading contamination and the frequency of vessel decontamination activities.

The collection, transport and final disposal of waste brought to port locations will be provided through Santos' waste service provider (refer **Section 17**).

11.6 Environmental performance

Table 11-6 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 11-6: Environmental performance – containment and recovery

Environmental Performance Outcome	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
Offshore Containment and Recovery	**Response Preparedness**		
	Access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
	Waste service provider contract	Contract for access to waste oil tanks in place during the activity	Waste service provider contract
	Offshore waste transfer concept of operations (to help maximise waste storage availability for C&R vessels)	Develop waste transfer concept of operations procedure	Waste transfer concept of operations procedure
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Offshore containment and recovery vessels	Maintenance of vessel specification for offshore containment and recovery vessels	Vessel specification
	Response Implementation		
	First strike resources	Minimum first strike resource requirements mobilised in accordance with **Table 11-5**	Incident Log
	Aerial surveillance reports (to direct operations to areas with greatest oil concentration)	Aerial surveillance reports communicated to C&R Team Leaders	Incident Log

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Environmental Performance Outcome	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
	Decanting to free up liquid oil waste container storage)	Application for offshore decanting is made to AMSA (Commonwealth waters) or DoT (State waters). When approved decanting of water occurs back into boomed area.	Incident Log
	Spill response activities selected and reviewed on basis of a Net Environmental Benefit Analysis	Prepare operational NEBA to determine if containment and recovery is likely to result in a net environmental benefit	Incident Log
		Operational NEBA for containment and recovery is conducted each operational period and considers oil thickness and weather constraints to effectiveness.	IAP/Incident Log

12 Mechanical Dispersion Plan

Table 12-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 12-1: Mechanical dispersion – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	To create mixing for oil and water to enhance natural dispersion	
Initiation criteria	Operational monitoring identifies thin oil patches at sea surface that are not naturally dissipating in sea surface and is posing risks to wildlife and shorelines by remaining on the surface	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ There is no longer a noticeable reduction of surface oil resulting from the activity, or + NEBA is no longer being achieved, + Unacceptable safety risks associated with gas and VOCs at the sea surface, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

12.1 Overview

This response strategy assists with the natural dispersion process; creating mixing through physical agitation, which encourages the oil to break into smaller particle sizes that are more easily biodegraded. The two common activities associated with mechanical dispersion are:

+ manoeuvring a vessel through the slick, using propeller wash to create mixing in the water body
+ spraying water from the fire hose of a vessel and moving the vessel through the water body to create additional mixing and breakup of the slick.

12.2 Implementation guidance

Table 12-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 12-3 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 12-2: Implementation guidance – mechanical dispersion

Action		Consideration	Responsibility	Complete
Initial Actions	The Operational NEBA will confirm the suitability and environmental benefit of conducting mechanical dispersion at appropriate locations.	Water depth, sea state, possible impacts to sensitive shorelines and/or wildlife before spill naturally disperses. This activity is to be conducted during daylight hours only and once the safety plan has been developed.	Operations Team Leader Environment Team Lead Planning Team Leader	❑
	Safety team lead to develop a safety plan for the activity with respect to potentially dangerous gasses and VOCs (including applicable controls).		Operations Team Leader Safety Team Leader	❑
	Notify vessel-based responders to trial mechanical dispersion.		Operations Team Leader	❑
	Response personnel on vessels to evaluate the effectiveness of the use of mechanical dispersion operations to reduce the volume of oil on the water surface. Communicate the information to the IMT Operations Team Leader for inclusion in Operational NEBA.		Vessel Master/s Santos AMOSC Core Group Responders	❑

Table 12-3: Mechanical dispersion resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Vessels undertaking other activities	Santos contracted vessel providers	Varies – check through vessel contractors/ Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

12.3 Environmental performance

Table 12-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 12-4: Environmental performance – mechanical dispersion

Environmental Performance Outcome	To create mixing for oil and water to enhance natural dispersion		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Response implementation		
Mechanical Dispersion	Mechanical Dispersion Plan Safety Plan Operational NEBA	Mechanical dispersion is to be conducted during daylight only, once the safety plan has been developed and Operational NEBA confirms suitability and environmental benefit	Incident Log IAP

13 Chemical Dispersant Application Plan

Table 13-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 13-1: Chemical dispersant application – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities	
Initiation criteria	Notification of a Level 2/3 condensate spills	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✗
Termination criteria	+ Application of chemical dispersants will cease when dispersant efficacy is no longer providing a net environmental benefit as assessed through the NEBA process, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

13.1 Overview

Surface application of dispersants is considered the primary dispersant application response strategy with SSDI as a secondary strategy for large (Level 2/3) spills of Caley Condensate (see **Section 6.5).** Dispersants are chemicals that are sprayed onto floating oil slicks by vessels and/or aircraft; or injected subsea directly to the source of the spill (e.g., uncontrolled well loss site). Dispersants are designed to separate the oil into small droplets and assist with dispersion in the water column to speed up the process of natural biodegradation. Chemical dispersants can be used to:

+ decrease the concentration and volume of surface oil reaching sensitive receptors
+ increase the rate of natural biodegradation
+ reduce the quantity of waste created.

13.2 Surface chemical dispersants

Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50 to 100 g/m^2 on the sea surface. EMSA (2010) recommends thin layers of spilled hydrocarbons should not be treated with dispersant. This includes BAOACs 1 to 3 (EMSA, 2010) (**Table 13-2**).

Table 13-2: Bonn Agreement oil agreement appearance codes

Code	Description	Layer Thickness (µm)	Litres per km²
1	Silvery sheen	0.04 to 0.30	40 to 300
2	Rainbow sheen	0.30 to 5.00	300 to 5,000
3	Metallic	5 to 50	5,000 to 50,000
4	Discontinuous true oil colour	50 to 200	50,000 to 200,000
5	Continuous true oil colour	More than 200	More than 200,000

13.3 Vessel-based dispersant operations

13.3.1 Implementation guidance

Table 13-3 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this tactic. **Table 13-4** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial aerial dispersant operations are listed in **Table 13-5**. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 13-3: Implementation guidance – vessel dispersant application

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports surface chemical dispersant application.	Oil type suits dispersant application. Surveillance to confirm oil spill thickness supports use of dispersants from vessels (e.g., BAOAC 4 to 5). Liaise with third party providers (e.g., AMOSC) as part of operational NEBA. Evaluate oil spill trajectory modelling when available.	Planning Team Leader Environment Team Leader	❑
	Source vessel/s for dispersant application and mobilise to nearest port for loading equipment and personnel (Exmouth or Dampier).	Vessel specification for dispersant vessels provided in ER Intranet – First Strike Resources.	Logistics Team Leader	❑
	Mobilise dispersant operations Team Leaders and Team Members (Santos Core Group and/or AMOSC staff/ Industry Core Group) to designated port.	Each vessel undertaking dispersant application (is to be manned with personnel trained in dispersant application (e.g., AMOSC staff, Santos or Industry Core Group member) who is the Team Leader tasked with controlling the operations and implementing in a safe and responsible method. For prolonged dispersant operations, OSRL responders via Singapore may also be used.	Logistics Team Leader	❑
	Mobilise vessel-based dispersant application equipment and dispersant shake test kits from the Santos storage locations in Exmouth (Exmouth Freight & Logistics) or Dampier Supply Base (two systems at each location) to the designated deployment port.	Exmouth Freight & Logistics to assist with local logistics and vessel loading of vessel spray systems and dispersant movement in Exmouth.	Logistics Team Leader	❑
	Mobilise AMOSC (Exmouth)/ AMSA (Karratha) dispersant stock to nominated vessel deployment location Exmouth and/or Dampier ports.	Check up to date dispersant stockpile inventories can be accessed via ER Intranet – First Strike Resources.	Logistics Team Leader	❑

Action		Consideration	Responsibility	Complete
	Use aerial surveillance to determine priority areas for dispersant application an define operational area for response.	Aerial surveillance reports of oil location and thickness.	Planning Team Leader Operations Team Leader	❑
	Identify safety requirements and controls associated with spraying dispersants and working over oil.		Safety Team Leader	❑
	First vessel onsite test spray oil – confirm effectiveness.	Effectiveness to be recorded with photos.	Operations Team Leader	❑
	Confirm operational NEBA supports surface chemical dispersant application.	Use forecast modelling, operational monitoring data and dispersant efficacy results in operational NEBA.	Operations Team Leader Environmental Team Leader Planning Team Leader	❑
	If dispersant application is shown to be effective and approved for ongoing use by the Incident Commander, continue vessel operations and defining operational area.	Use real-time or most recent visual surveillance observation data to develop operational zones for vessel dispersant operations. The base case restrictions for dispersant application are – no application: + Within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone) + Within State Marine Parks + Within State Waters + Within 10 km of water depths <10 m LAT + Within exclusion zones of offshore facilities + Not within 25 km of well site The above applies unless justified otherwise by the Operational NEBA, noting that no application in	Operations Team Leader Incident Commander Environmental Team Leader Planning Team Leader	❑

Action		Consideration	Responsibility	Complete
		Australian Marine Park (outside Multi-use zone) or State waters without relevant authority approval.		
Ongoing Actions	Reassess dispersant use, utilising the NEBA process for each operational period. Cease application if no net environmental benefit.		Operations Team Leader Incident Commander Environmental Team Leader Planning Team Leader	❑
	Continue to mobilise additional chemical dispersant stocks from AMOSC and AMSA.	Worst case requirements do not indicate OSRL dispersant stocks necessary but these are also available.	Logistics Team Leader	❑
	Maintain operational zones and provide updates to Vessel Masters on most suitable locations for application.		Operations Team Leader Environmental Team Leader Planning Team Leader	❑

Table 13-4: Vessel dispersant application – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos Vessel Dispersant Spray Systems	Santos owned	Two containers (each c/w three systems – dual arm, single arm & Afedo head)	Exmouth (Exmouth Freight & Logistics) Dampier (Toll Supply Yard)	Within 12 hours mobilised to port
AMOSC Vessel Dispersant Spray System	AMOSC	1) Afedo Spray systems 2) Vikospray 3) Boom vane 4) Global Dispersant spray system	1) Broome – two; Exmouth – one; Fremantle – five; Geelong – three 2) Exmouth – one; Geelong – three 3) Fremantle – one; Geelong – one 4) Fremantle – one	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**
AMSA Vessel Dispersant Spray System	AMSA	Ayles Fernie Boat Spray	Karratha – two; Fremantle – two	Access to National Plan equipment through AMOSC.
Dispersant	AMOSC	75 m³ (Exmouth) Slikgone NS 14 m³ (Broome) Ardrox 35 m³ + 250 m³ (Freo) Slikgone & Corexit 139 m³ (Geelong) Slikgone & Corexit	Exmouth Broome Fremantle Geelong	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**
	AMSA	20 m³ (Dampier) 100 m³ (Freo) 250+ m³ (other stockpiles)	Dampier Fremantle Other Aus stockpiles	Access to National Plan equipment through AMOSC.

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Dispersant spray system vessels	Santos contracted vessel providers Preference for vessels used in Santos deployment exercises	Varies – check through vessel contractors/ Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability
Personnel (field responders)	AMOSC Staff	Eight	Fremantle – two Geelong – six	Response via duty officer within 15 minutes of first call; timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	12	Perth/NW Aus facilities – ten Port Bonython (South Aus) – two	12+ hours
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location-dependent; confirmed at time of activation

Table 13-5: Vessel-based dispersant application – first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and begins sourcing vessel dispersant resources for applicable spills	<3 hours
Suitable Dispersant Vessels mobilised to nearest deployment port (Exmouth and/or Dampier)	<12 hours
Santos Offshore Core Group mobilised to deployment port (Exmouth and/or Dampier)	<12 hours
Vessel spray system equipment mobilised to deployment port	<12 hours
Dispersants mobilised to port	<12 hours
Vessel spray operation commenced at spill site (weather/daylight dependent)	<28 hours (weather/daylight dependent)
Minimum Resource Requirements	
+ Suitable dispersant application vessel - refer Santos Offshore ER Intranet for vessel specification + One vessel dispersant spray system + Dispersant (10 m^3) + Two Santos Core Group or Industry Core Group responders + Personal protective equipment	

13.4 Aerial dispersant operations

13.4.1 Implementation guidance

Table 13-6 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 13-7** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial aerial dispersant operations are listed in **Table 13-8**. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 13-6: Implementation guidance – aerial dispersant application

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports surface chemical dispersant application.	Oil type suits dispersant application. Surveillance to confirm oil spill thickness supports use of dispersants (e.g., BAOAC 4 to 5). Liaise with third party providers (e.g., AMOSC) as part of operational NEBA. Evaluate oil spill trajectory modelling when available.	Planning Team Leader Environment Team Leader	❑
	Mobilise initial resources for aerial application. After initial AMOSC notifications are complete, contact AMOSC Duty Officer and confirm requirements for the following resources: + Access to and mobilisation of required AMOSC dispersant stocks and associated equipment into Exmouth (AMOSC will arrange through their contracted transport provider). + Activation of the Fixed Wing Aerial Dispersant Capability (FWADC) (AMOSC will activate this on behalf of Santos). + Provision of trained spill responders to support operations (AMOSC Staff and Core Group).	Refer Joint Standard Operating Procedures for FWADC. AMOSC will deploy appropriate aircraft to a designated airstrip close to the spill location (e.g., Broome, Dampier, Learmonth or Exmouth Airports), and arrange for pilots, Air-Attack Supervisors, observation aircraft (one per two attack planes) and trained observers.	Logistics Team Leader Operations Team Leader Aviation Superintendent	❑
	Finalise Fixed Wing Air Operations Plan and Air Operations Plan in consultation with AMOSC, AMSA, Aerotech First Response and other stakeholders and AMSA.	Ensure flight schedule in Air Operations Plan considers requirements for other activities such as aerial surveillance sorties.	Operations Team Leader Aviation Superintendent Planning Team Leader	❑

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	Action	Consideration	Responsibility	Complete
	Using real-time or most recent visual surveillance observation data, develop operational zones for aerial dispersant operations.	Focus on applying dispersant to areas of slick that threaten priority receptors and are of a sufficient thickness whereby chemical dispersants will be effective. The base case restrictions for dispersant application are – no application: + within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone) + within State Marine Parks + within State Waters + within 10 km of water depths <10 m LAT + within exclusion zones of offshore facilities + not within 25 km of well site. The above applies unless justified otherwise by the Operational NEBA, noting that no application in Australian Marine Park (outside Multi-use zone) or State waters without relevant authority approval.	Operations Team Leader Planning Team Leader	❑
	Conduct aerial dispersant spraying reporting effectiveness to IMT.		Operations Team Leader Planning Team Leader	❑
Ongoing Actions	Conduct operational NEBA during each operational period to reassess effectiveness of application rates and dispersant efficacy.		Environmental Team Leader Planning Team Leader	❑
Ongoing Actions	Maintain operational zones and provide updates to pilots on most suitable locations for aerial application.		Operations Team Leader Planning Team Leader	❑

Table 13-7: Aerial chemical dispersants application – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Aerotech First Response fixed wing aircraft, pilots and ground crew	AMOSC - Fixed Wing Aerial Dispersant Contract	Six under FWADC contract Additional aircraft potentially available through Aerotech First Response	Operations from Learmonth or Onslow airbase Aircraft initially mobilised from six bases around Australia: + Jandakot (WA) + Batchelor (NT) + Parafield (SA) + Scone (NSW) + Ballarat (Vic) + Emerald (QLD)	Six air contractors to have wheels up in four hours from locations around Australia. Mobilisation times depend on the flight time from the location of the aircraft Supporting equipment mobilisation (dispersants etc) as per equip mob timeframes (**Table 10-12**)
Air attack (and synthetic aperture radar) helicopter	Santos contracted helicopter provider/s	Two (contracted) + additional subject to availability	Karratha (primary base) Learmonth Onslow	Wheels up within one hour for Emergency Response
Dispersant	AMOSC	75 m³ (Exmouth) Slikgone NS 14 m³ (Broome) Ardrox 35 m³ + 250 m³ (Fremantle) Slikgone & Corexit 139 m³ (Geelong) Slikgone & Corexit	Exmouth Broome Fremantle Geelong	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMSA	20 m^3 (Dampier) 100 m^3 (Freo) 250+ m^3 (other stockpiles)	Dampier Fremantle Other Aus stockpiles	Access to National Plan equipment through AMOSC
FWADC operational personnel incl. Air Attack Supervisor and Dispersant Coordinator	AMOSC and subcontractors via Fixed Wing Aerial Dispersant Contract	Eight AMOSC staff + contractors	AMOSC Fremantle – two AMOSC Geelong – six	Response via duty officer within 15 minutes of first call; timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
SAR vessel (can be double use vessel)	Santos contracted vessel providers.	Varies – check through vessel contractors/ Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

Table 13-8: Aerial dispersant operations – first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and activates Fixed Wing Aerial Dispersant Capability (FWADC)	<3 hours
AMOSC to mobilise Fixed Wing aircraft to nominated airbase	<12 hours
AMOSC to mobilise dispersants to nominated airbase	<24 hours
AMOSC to mobilise all FWADC capability personnel to nominated airbase	<48 hours
AMOSC/Santos to mobilise helicopter to nominated airbase to support air-attack surveillance	<48 hours
AMOSC/Santos to mobilise vessel to nominated port to provide synthetic aperture radar support	<48 hours
First FWADC test spray	<48 hours (weather/daylight dependent)
Minimum Resource Requirements	
+ one fixed wing aircraft (Aerotech First Response) + one helicopter + one synthetic aperture radar vessel + WA AMOSC dispersant stocks to deployment airbase + AMOSC contracted FWADC capability personnel: – Pilots – Air Attack Supervisor – Aerial Observer – Airbase Manager – Dispersant Coordinator – Dispersant Loading Crew	

13.5 Subsea dispersant injection operations

SSDI has been observed to break-up oil droplets forcing greater entrainment of the oil into the water column below the sea surface (Adams *et al.*, 2013). SSDI has additional benefits over surface dispersant application including its ability to reduce volatile organic compounds in the vicinity of a spill, making the area safer for responders. It typically requires smaller volumes of dispersant to be used as it has a higher encounter rate with the hydrocarbons than surface application. SSDI can also be used day and night; whereas surface application via vessel or aircraft can only occur during daylight hours. However, for the worst-case exploration subsea LOWC scenarios associated with Bedout Multi-Well Drilling activities, the high exit velocity of subsea plumes results in small, entrained oil droplets that are not materially affected by SSDI application. As such, surface dispersant application, which can be mobilised more rapidly has a material effect in reducing oil loads is considered to be the primary strategy for applying dispersants.

The effectiveness of SSDI is influenced by dispersant efficacy on the hydrocarbon, how close to the release the dispersants may be added and the dispersant to oil ratio (DOR). It is assumed the DOR would commence at 1:100 and would be modified based on the results of the effectiveness monitoring. Research conducted by Brandvik et al., 2014 indicated that DORs of 1:50 to 1:100 may be sufficient to cause substantial additional dispersion, particularly if the dispersant is injected close to or into the release point.

13.5.1 Implementation guidance

Table 15-1 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. Mobilisation times for the minimum resources that are required to commence initial SSDI operations are listed in **Table 13-10**. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 13-9: Implementation guidance – subsea dispersant injection

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports subsea chemical dispersant injection.	As described in **Section 6.5,** subsea dispersant application has been identified as secondary strategy for subsea LOWC scenarios only. The operational NEBA will identify if this strategy is activated. Use forecast modelling and any operational monitoring results in operational NEBA.	Operations Team Leader Incident Commander Environmental Team Leader Planning Team Leader	❑
	If viable and if the Operational NEBA supports SSDI, activate Subsea First Response Toolkit (SFRT) equipment and activate Oceaneering personnel for deployment.	As described in **Section 6.5,** SSDI is considered a secondary response strategy. The high exit velocity of subsea plumes results in small, entrained droplets that are not materially affected by the subsea application of chemical dispersants indicates minimal environmental benefit from SSDI (**Section 6.7).** Separate contracts in place for SFRT (AMOSC) and Oceaneering.	Designated call-out authority (Incident Commander) Source Control Team	❑
	If viable and if the Operational NEBA supports SSDI, contract suitable vessel capable of deploying SFRT equipment and dispersant.	Vessel capable of SFRT deployment are tracked.	Logistics Team Leader Source Control Team Leader	❑
	If viable and if the Operational NEBA supports, arrange road transport of SFRT from Jandakot to Dampier.		Logistics Team Leader Source Control Team Leader	❑
	Arrange equipment to be loaded on to vessel once in Dampier and authorise transit to field.		Logistics Team Leader Operations Team Leader Source Control Team Leader	❑

Action		Consideration	Responsibility	Complete
	If viable, conduct initial ROV survey at the release point to determine the nature of the release, behaviour of the oil, estimate the oil and gas flow rates and determine DOR for injection.	Information to be used to help determine injection method/s.	Operations Team Leader Source Control Team Leader	❑
	If viable, commence dispersant subsea injection adjusting DOR based on real-time monitoring.		Operations Team Leader Source Control Team Leader	❑
	Continue operational monitoring (including operational water quality monitoring and surveillance) near the release point to help determine dispersant effectiveness.	Consider using guidance provided in API Technical Report 1152 (API, 2013) to determine dispersant efficacy. Surveillance should have commenced prior to any dispersant being added to the release so that changes and efficacy can be determined. Once baseline data has been collated, commence injection to help determine DOR and modify accordingly.	Source Control Team Leader Operations Team Leader	❑
	If dispersant application is shown to be effective and approved by the Incident Commander, continue operations.		Source Control Team Leader Operations Team Leader Incident Commander	❑
Ongoing Actions	Reassess dispersant use, utilising the NEBA process for each operational period. Cease application if no net environmental benefit.	Continue to use forecast modelling, operational monitoring data and dispersant efficacy results in operational NEBA.	Planning Team Leader Environmental Team Leader	❑

Table 13-10: Subsea dispersant injection – first strike response timeline

Task	Time from IMT call-out
IMT Source Control Team activated	<24 hours
If viable response strategy, suitable SFRT-dispersant injection vessel/s mobilised to Dampier	<10 days
If viable response strategy, Oceaneering to mobilise personnel to Dampier/Broome	<10 days
If viable response strategy, AMOSC to mobilise SFRT and dedicated dispersant to Dampier	<10 days
If viable response strategy, load equipment, steam to site and commence SSDI	<12 days
Minimum Resource Requirements	
+ Suitable vessel and crew + SFRT + Dispersant (with SFRT) + Oceaneering personnel	

13.6 Dispersant efficacy testing

Dispersant efficacy testing performed on Caley Condensate indicates that available dispersants are effective in reducing the volume and concentration of surface oil (**Appendix A**). The actual effectiveness and environmental benefit of applying dispersants in a spill incident is to be reassessed throughout the incident using operational monitoring to evaluate the effectiveness and potential benefits and impacts. Effectiveness may vary depending upon the weathered state of the oil, the method of application and the prevailing environmental conditions. The environmental benefits associated with a decrease in the volume and concentration of surface oil may be negated by an increase in the concentration of oil dispersed under the sea surface which could potentially increase exposure of subsea receptors to dispersed oil and dispersants. In these circumstances, an operational NEBA will assist in assessing the exchange of risk from one receptor to another.

13.7 Dispersant selection

Chemical dispersants listed as approved in the National Plan for Maritime Environmental Emergencies Register of Oil Spill Control Agents (OSCA) or assessed as acceptable using the Santos Offshore Division Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) prior to application, are to be used. FINASOL OSR 52 has been pre- assessed as low risk using the Santos Offshore Division Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) and are therefore designated as acceptable for use.

The Santos Offshore Division Operations Chemical Selection, Evaluation and Approval Procedure requires the dispersant to be risk assessed and deemed environmentally acceptable. The criteria used for environmental acceptability includes aquatic toxicity, biodegradation and bioaccumulation potential data.

Where sufficient data is available, the chemical is risk assessed using the Offshore Chemical Notification Scheme (OCNS) Chemical Hazard and Risk Management (CHARM) or non-CHARM models depending on the model's applicability criteria. Chemicals that meet the selection criteria belonging to CHARM Colour-band Gold or Silver, or non-CHARM groups D or E are considered environmentally acceptable. According to the OCNS CHARM model, GOLD ranked chemicals have a maximum Hazard Quotient (HQ) of <1 and Silver, HQ ≥1 and <30. According to the OCNS non-CHARM model guidelines, the worst case initial OCNS grouping would be group B based on aquatic toxicity data of LC50 or EC50 > 1 to 10 ppm. To obtain a final OCNS grouping of D, the chemical would need to be readily biodegradable (>60% biodegradation in 28 days) and non-bioaccumulative (Log Pow <3 or BCF ≤100 and molecular weight ≥700). The best case initial OCNS grouping would be group E based on aquatic toxicity data of LC50/EC50 > 1000 ppm. The best case final OCNS grouping would remain E with the chemical readily biodegradable and non-bioaccumulative.

Where insufficient ecotoxicity data is available to assign a pseudo OCNS CHARM or non-CHARM group ranking; however, there is sufficient ecotoxicity data available to determine the environmental hazard of the chemical, environmental acceptability is based on volume/concentration, ultimate fate and ecotoxicity data (aquatic toxicity, biodegradability and/or bioaccumulation data where applicable; i.e., biodegradation and bioaccumulation potential are not applicable to inorganic substances).

During a response, chemical dispersant shall be tested on the released oil at a laboratory as part of the initial oil characterisation (refer **Section 10.6**) as well as through field testing using vessel-based spray systems/ dispersant shake test kits. Santos has already characterised the dispersant efficacy of Caley Condensate as demonstrated in **Appendix A**.

13.8 Dispersant effectiveness monitoring

The ongoing effectiveness of dispersant operations will be assessed through operational monitoring. Visual observations may be taken by vessel and/or aircraft and will be used to assess whether dispersant application is successful in dispersing hydrocarbons. The effectiveness of the aerial based chemical dispersion strategy is communicated to the IMT Operations Team Leader via the Air-Attack Supervisors. The IMT assesses the effectiveness of continued surface dispersant use against a NEBA assessment.

Operational water quality monitoring, either through continuous fluorometry surveys or discrete water sampling (**Section 10.7**), is to be used to assess the presence, distribution and concentration of dispersed oil with and without dispersant addition.

SSDI application is considered a secondary strategy to surface dispersant application (refer to **Table 6-23**). Prior to any application of subsea dispersants, an initial ROV survey would be conducted at the release point to determine the nature of the release. This information will inform the applicability of subsea chemical dispersion and initial choice of dispersant injection methods (e.g., number of nozzles, nozzle sizes) and DOR. In addition, subsea dispersant effectiveness monitoring should commence prior to the application of any dispersant, to ensure baseline data is captured. Subsea dispersant effectiveness will be monitored as part of the Operational Water Quality Monitoring Plan, which will inform the NEBA assessment.

13.9 Dispersant application area

The base case for surface dispersant application is that no application is to occur:

+ within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application permitted in the Multiple Use Zone)
+ within State Marine Parks
+ within State Waters

+ within 10 km of water depths <10 m LAT
+ within exclusion zones of offshore facilities
+ within 25 km or well site[23]

13.10 Surface dispersant supply and logistics requirements

Deterministic oil spill modelling has been conducted to assess the effect of dispersants on the worst case spill scenarios (Caley Condensate) associated with Bedout Multi-Well Drilling activities (**Section 6.4.1**). From the deterministic dispersant mitigated scenario modelling, the Bedout South surface LOWC scenario required the highest volume of surface dispersant application. This scenario has been selected to determine surface dispersant application requirements.

Worst case credible scenario requirements – Bedout South (surface LOWC)

Based on the deterministic dispersant application modelling a total of 17,078 m³ of dispersant was required to be applied via nine aircraft and 11 vessels over 78 days of application. While dispersant use will vary depending on weather conditions and actionable oil, approximately 219 m³ per day is considered an appropriate amount for planning.

Dispersant supply and logistics

Supply stocks sufficient to cover dispersant requirements for the first week of a spill are shown in **Table 13-11**. Santos has a detailed dispersant supply and logistics plan that ensures dispersant requirements can be met for the duration of the worst case LOWC scenario. Dispersant stockpiles are made available via AMOSC membership or AMSA MoU with most supplies within Australia being available within 48 to 55 hours. Santos can supply all required road logistics to meet these timeframes through its contracted logistics provider. Santos can also provide air logistics for all other stockpiles throughout Australia and internationally.

Due to the significant volume of dispersant required over the 78-day application period, dispersant stocks would have to be imported from international stockpiles. Additionally, response specific manufacturing would be required in order to meet demand, with manufacturing commencing during week five of the response.

Dispersant availability is checked bi-annually against Santos' worst-case requirements across all operation, project and drilling activities.

[23] Santos confirmed during modelling that leaving a 25 km buffer around the LOWC location allows for a significant proportion of Caley Condensate to evaporate (62% within 48 hours under moderate (5m/s) wind conditions) (GHD, 2021). The 25 km buffer represents the approximate distance that surface oil will travel from the LOWC location under moderate wind conditions within a 48-hour period. This approach allows for response techniques to be more effective on the remaining proportion of hydrocarbons within the marine environment.

Table 13-11: Surface dispersant supply stock locations and volumes

Stock Location	Volume (m^3)	Transit time (to Exmouth)
Dampier Port	20	6 hours
Exmouth Harold E. Holt Base	75	30 minutes
Fremantle Port	100	18 hours
Fremantle	35	14 hours
Darwin Port	20	35 hours
Adelaide Port	10	42 hours
Broome	15	15 hours
Melbourne Port	10	55 hours
Geelong Port	137	55 hours
Loyang Offshore Supply Base, Singapore	547	1 day
Sydney Port	100	55 hours

13.11 Subsea dispersant injection logistics

The most likely LOWC scenario at the Bedout well would be a surface discharge; however, if a subsea LOWC was to occur, the site would require a detailed assessment to determine the most suitable intervention methods for the incident. This may be achieved through the use of remotely operated vehicles (ROVs) via the Subsea First Response Toolkit, which is stationed in Fremantle and Jandakot and managed by AMOSC. The SFRT includes debris clearance equipment and subsea dispersant equipment, including a dedicated dispersant stockpile (500 m^3 of Dasic Slickgone NS) and ancillary equipment (e.g., pumps, flying leads, coiled tubing head, dispersant wands).

The volumes of dispersant required will depend on the DOR used at the injection point. It has been assumed that the well leak would require a DOR of 1:100. To achieve a DOR of 1:100, IPIECA-IOGP (2015a) recommend for a flow rate of 20,000 bbl./day, a dispersant pump rate of 22 L/min is required. Scaling this dispersant application rate up in line with the higher flow rate for the Bedout West subsea LOWC scenario (169, 628 bbl/day) results in a dispersant pump rate of 184.1 L/min. The maximum credible flow rate for the Bedout Multi-Well Drilling LOWC is estimated to be 169, 628 bbl/day (26,968.6 m^3/day), therefore a dispersant flow rate of 184.1 L/min (265.1 m^3/day) is expected to be required.

If required, the equipment would be mobilised via road to Dampier. Suitable vessels would be contracted to move the SFRT to site, which may be sourced via the North West Shelf Region or Singapore. It is estimated that SSDI would commence by Days 8 to 12, depending on vessel availability. Santos tracks the availability of SFRT vessels via shipbroker reports.

13.12 Environmental performance

Table 15-2 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 13-12: Environmental performance – surface dispersant application

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities		
Response Strategy	**Control Measures**	**Response Strategy**	**Measurement Criteria**
Chemical Dispersant Application	**Response Preparedness**		
	Arrangements to enable access to dispersants, equipment and personnel	Maintenance of access to dispersant, application equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			AMOSC SFRT Participant
			OTA Agreement with Oceaneering
			OSRL Associate Member Contract and Global Dispersant Supply Supplementary Agreement
	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Dispersant application vessels	Maintenance of vessel specification for dispersant application vessels	Vessel specification
	Nominated first-strike dispersant application vessel c/w trained crew, dispersant equipment and dispersants onboard (use of existing supply vessel servicing Exmouth floating production, storage and offloading vessels (FPSOs)	Complete feasibility review to determine if existing supply vessel can be equipped and used as nominated surface dispersant first strike response vessel (to be completed by end of 2020)	Correspondence records

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities		
Response Strategy	**Control Measures**	**Response Strategy**	**Measurement Criteria**
	Response Implementation		
	Mobilisation of minimum resource requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 13-5**, **Table 13-8** and **Table 13-10**	Incident log
	Chemical Dispersant Application Plan	Only chemical dispersants that are listed as approved on the National Plan Oil Spill Control Agent (OSCA) list or are evaluated as acceptable as per the Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) are to be used	Incident Log
		Analysis of dispersant amenability provided to IMT within 24 hours of oil delivery to Laboratory	Incident Log
		If amenable to surface dispersants, and required oil volume can be collected, oil and dispersant samples to be sent immediately for laboratory ecotoxicity testing of oil and chemically dispersed oil	Incident Log
		If dispersant application is approved by the Incident Commander for aerial application, a test spray run via the National Plan Fixed Wing Aerial Dispersant Contract will be conducted to assess dispersant effectiveness	Incident Log IAP
		If dispersant application is approved by the Incident Commander for vessel application, a test spray will be conducted to assess dispersant effectiveness	Incident Log IAP

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities		
Response Strategy	**Control Measures**	**Response Strategy**	**Measurement Criteria**
		If dispersant application is approved by the Incident Commander for subsea injection, ROV monitoring of the site will commence to help determine injection method/s	Incident Log IAP
		If dispersant application is approved by the Incident Commander for subsea injection, operational monitoring of dispersant efficacy will be conducted	Incident Log IAP
		Prepare operational NEBA to determine if chemical dispersant application is likely to result in a net environmental benefit. NEBA will consider: + forecast spill modelling of oil comparing simulations with and without effect of chemical dispersants + laboratory dispersant efficacy testing results + operational monitoring results (surveillance and shoreline assessment) showing distribution of floating, stranded oil and location of sensitive fauna and habitats + operational water quality monitoring results showing distribution and concentration of subsea oil (once available) + scientific monitoring water sampling results (SMP1) (once available) + consultation with DoT	Incident Log IAP

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities		
Response Strategy	**Control Measures**	**Response Strategy**	**Measurement Criteria**
		NEBA undertaken each operational period by the relevant Control Agency to determine if response strategy is continuing to have a net environmental benefit. NEBA included in development of following period Incident Action Plan	IAP Incident Log
		Surface **Dispersant Application Area will be defined as part of the IAP. The base case for dispersant application is that no dispersants to be applied:** + within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application permitted in the Multiple Use Zone) + within State Marine Parks + within State Waters + within 10 km of water depths <10 m LAT + within exclusion zones of offshore facilities + within 25 km of well site	IAP
		Surface dispersant will only be applied in the Dispersant Application Area and target oil above BAOAC 4 and 5	IAP Incident Log

Santos

14 Shoreline Protection and Deflection Plan

Table 14-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 14-1: Shoreline protection and deflection – objectives, initiation criteria and termination criteria

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities	
Initiation criteria	+ Level 2 or Level 3 spills where shorelines with identified or potential protection priorities will potentially be contacted, and + Approval has been obtained from DoT IC or delegate (as the Control Agency) to initiate response strategy	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ NEBA has determined that this strategy is unlikely to result in an overall benefit to the affected shoreline/s, and + Agreement is reached with Jurisdictional Authorities to terminate the response strategy	

14.1 Overview

Protection and deflection tactics are utilised to divert hydrocarbons away from sensitive shoreline receptors and are more effective if they are deployed ahead of spill contact. They are typically used to protect smaller, high priority sections of shoreline.

The effectiveness of this response will be dependent on spill characteristics, hydrocarbon type, and the operating environment. Deployment is subject to safety constraints such as the potential grounding of vessels.

Protection and deflection is part of an integrated nearshore/shoreline response to be controlled by DoT as the relevant Control Agency. Santos will undertake first-strike protection and deflection activities as required. Upon assumption of Control Agency responsibilities, DoT will direct resources (equipment and personnel) provided by Santos for the purposes of shoreline protection. Santos will provide all relevant information on shoreline character and oiling collected as part of surveillance activities carried out under its control (refer **Section 10**).

The information provided below is included for planning purposes and represents Santos' first-strike response for protection and deflection activities. In the event of a spill with the potential for shoreline contact, the ongoing response objectives, methodology, deployment locations and resource allocation will be controlled by DoT, as the Control Agency and therefore may differ from that included below.

Information gathered during operational monitoring including shoreline assessments and assessed through an Operational NEBA will guide the selection of protection and deflection locations and techniques.

Shoreline protection and deflection techniques include:

+ nearshore booming, which can involve different booming arrangements including:
  - exclusion booming: boom acts as a barrier to exclude the spill from areas requiring protection
  - diversion booming: booms divert the spill to a specific location where it may be removed (e.g., sandy beach)
  - deflection booming: booms deflect the spill away from an area requiring protection.
+ berms, dams and dykes – uses sandbags or embankments to exclude oil from sensitive areas
+ shoreside recovery – uses nearshore skimmers to collect oil corralled by nearshore booms (also used during shoreline clean-up)
+ passive recovery – uses sorbent booms or pads to collect oil and remove it from the environment. This can be used as a pre-impact tactic where sorbents are laid ahead of the spill making contact with the shoreline
+ non-oiled debris removal – removes debris from the shoreline before it is impacted to reduce overall waste volumes from shoreline clean-up.

The effectiveness of these techniques will be dependent on local bathymetry, sea state, currents/tides and wind conditions and the available resources.

14.2 Implementation guidance

Table 14-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 14-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial protection and deflection operations, unless directed otherwise by DoT, are listed in **Table 14-4**. The Incident Commander of the DoT's IMT (once the DoT assumes control) is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 14-2: Implementation guidance – shoreline protection and deflection

	Action	Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to WA DoT have been made.	Refer to **Table 7-1** for reporting requirements.	Environment Team Leader	❑
	Collect and provide spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to Control Agency for confirmation of priority protection areas and NEBA.		Environment Team Leader Planning Team Leader	❑
	Where DoT has assumed roles as Control Agency, actions undertaken by DoT may differ to those below.			
	Conduct Operational NEBA to determine if protection and deflection is likely to result in a net environmental benefit using information from shoreline assessments (**Section 10.8**) and any tactical response plans for the area.	Pre-existing TRPs exist for 80 Mile Beach, Montebello Islands, Dampier, Roebuck Bay, Rowley Shoals, Ningaloo Coastline (including Muiron, Jurabi to Light House Bay Beaches, Mangrove Bay, Turquoise Bay and Yardie Creek) and Muiron Islands and are available on the Santos ER Intranet page [24].	Environment Team Leader	❑

[24] Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA

Action		Consideration	Responsibility	Complete
	If NEBA indicates that there is an overall environmental benefit, develop a Shoreline Protection Plan (IAP Sub-Plan) for each deployment area.	Shoreline Protection Plan should reference any existing TRPs and may include (but not be limited to): + priority nearshore and shoreline areas for protection (liaise with Control Agency for direction on locations) + locations to deploy protection and deflection equipment + permits required (if applicable) + protection and deflection tactics to be employed for each location + list of resources (personnel and equipment) required + logistical arrangements (e.g., staging areas, accommodation, transport of personnel) + timeframes to undertake deployment + access locations from land or sea + frequency of equipment inspections and maintenance (noting tidal cycles) + waste management information, including logistical information on temporary storage areas, segregation, decontamination zones and disposal routes + no access and demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat (utilise existing roads and tracks first)	Operations Team Leader Planning Team Leader Environment Team Leader	❑

	Action	Consideration	Responsibility	Complete
	If required identify vessels with relevant capabilities (e.g., shallow draft) for equipment deployment in consultation with Control Agency.	Ensure vessels have shallow draft and/or a suitable tender (with adequate towing capacity and tie-points) if they are required to access shorelines.	Operations Team Leader Logistics Team Leader	❑
	Deploy shoreline protection response teams to each shoreline location selected and implement response.	If passive recovery and/or non-oiled debris removal has been selected as a tactic, ensure deployment activities prioritise their implementation prior to hydrocarbon contact.	Operations Team Leader On-Scene Commander	❑
Ongoing Actions	Conduct daily re-evaluation of NEBA to assess varying net benefits and impacts of continuing to conduct shoreline protection and deflection activities.		Environment Team Leader	❑
	Report to the Operations Team Leader on the effectiveness of the tactics employed.		Shoreline Response Team Leader – AMOSC core group responder	❑
	Response teams to conduct daily inspections and maintenance of equipment.	Shoreline protection efforts will be maintained through the forward operation(s) facilities setup at mainland locations under direction of DoT. Response crews will be rotated on a roster basis, with new personnel procured on an as needs basis from existing human resource suppliers.	Shoreline Response Team Leader	❑

Table 14-3: Shoreline protection and deflection – resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
AMOSC nearshore boom and skimming equipment'	AMOSC	Beach Guardian (98 x 25 m lengths) Zoom Boom (199 x 25 m lengths) HDB Boom (two 200 m lengths) Curtain Boom (58 x 30 m lengths) Skimmers: Passive Weir GT 185 Desmi 250 Weir Ro-skim Weir boom	Broome – four; Exmouth – 20; Fremantle – 23; Geelong – 51 Broome – eight; Exmouth – 20; Fremantle – 30; Geelong – 141 Broome – two Fremantle – 18; Geelong – 40 Exmouth – one; Fremantle – one; Geelong – one Exmouth – one; Geelong – one Geelong – one Geelong – two	Response via duty officer within 15 minutes of first call; AMOSC personnel available within one hour of initial activation call. Equipment logistics varies according to stockpile location For mobilisation timeframes refer to **Table 10-12**
AMSA nearshore boom/skimmer equipment	AMSA	Canadyne inflatable Structureflex inflatable Versatech zoom inflatable Slickbar – solid buoyancy Structureflex – solid buoyancy Structureflex – land sea Skimmers: None for inshore HFO or heavy crude	Karratha – five Karratha – ten; Fremantle – 15 Karratha – five; Fremantle – 13 Karratha – two Karratha – three; Fremantle – ten Karratha – 30; Fremantle – 30, other locations around Australia	Access to National Plan equipment through AMOSC For mobilisation timeframes refer to **Table 10-12**

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos owned nearshore boom/skimming equipment	Santos	Beach Guardian (eight 25 m lengths) Zoom Boom (16 x 25 m lengths) Two Desmi DBD16 brush skimmer	Varanus Island Varanus Island One each: Dampier and VI	Within 12 hours for deployment by vessel from VI
Personnel (field responders) for OSR strategies	AMOSC Staff	Eight	Fremantle – two Geelong – six	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	12	Perth/NW Australia facilities – ten Port Bonython (South Australia) – two	12+ hours
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation

Table 14-4: Shoreline protection and deflection – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirm if protection of shoreline sensitivity/s is required and begins sourcing resources	<4 hours
Santos Offshore Core Group mobilised to protection site or deployment port location	<12 hours
Protection booming equipment mobilised to protection site or deployment port location	<12 hours
Waste storage equipment mobilised to protection site or deployment port location	<12 hours
Boom deployment vessel / remote island transfer vessel mobilised to protection site or deployment port location	<12 hours
AMOSC Staff and Industry Core Group mobilised to protection site or deployment port location	<24 hours
Protection/deflection operation deployed to protection location	<24 hours (weather/daylight dependent)
Minimum Resource Requirements	
NB: Resource requirements for protection and deflection will be situation/receptor specific. TRPs, if developed for the area/receptor will outline suggested resource requirements. TRPs are held by Santos and DoT and have been developed for 80 Mile Beach, Montebello Islands, Dampier, Roebuck Bay, Rowley Shoals, Ningaloo Coastline (including Muiron, Jurabi to Light House Bay Beaches, Mangrove Bay, Turquoise Bay and Yardie Creek) and Muiron Islands and are available on the Santos ER Intranet page [25]. Indicative first strike resources for a single site protection area are: + One small vessel suitable for boom deployment + Shoreline (e.g., Beach Guardian) and nearshore booms (e.g., Zoom Boom) plus ancillary equipment (e.g., anchors, stakes) sufficient for protection of shoreline resource (refer TRP if applicable) + One skimmer appropriate for oil type + Waste storage equipment + One Protection and Deflection Team (six AMOSC Core Group members) + Personal protective equipment	

[25] Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA

14.3 Environmental performance

Table 14-5 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 14-5: Environmental performance – shoreline protection and deflection

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Shoreline Protection and Deflection	**Response Preparedness**		
	Access to protection and deflection equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to protection and deflection equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
	Small vessel providers for nearshore booming operations	Maintenance of a list of small vessel providers for Exmouth, Dampier and Broome regions	List of small vessel providers
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 14-4** unless directed otherwise by DoT	Incident log
	Shoreline Protection and Deflection Plan	Santos IMT to confirm protection priorities in consultation with DoT	IAP/Incident Log
		Prepare operational NEBA to determine if shoreline protection and deflection activities are likely to result in a net environmental benefit	Records indicate operational NEBA completed prior to shoreline protection and deflection activities commencing
		IAP Shoreline Protection and Deflection Sub-plan developed to provide oversight and management of shoreline protection and deflection operation	Records indicate IAP Shoreline Protection and Deflection Sub-plan prepared prior to shoreline protection and deflection operations commencing

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		NEBA undertaken each operational period by the relevant Control Agency to determine if response strategy is continuing to have a net environmental benefit. NEBA included in development of following period Incident Action Plan	IAP/Incident Log
		Ensure operational NEBA considers waste management, to ensure environmental benefit outweighs the environmental impact of strategy implementation which may include secondary contamination	Incident Log IAP
	Spill response activities selected on basis of a Net Environmental Benefit Analysis	A NEBA is undertaken for every operational period	Incident Log contains NEBA
	Use of shallow draft vessels for shoreline and nearshore operations	Shallow draft vessels are used for shoreline and nearshore operations unless directed otherwise by the designated Control Agency (i.e., DoT)	Vessel specification documentation contained in IAP.
	Conduct shoreline/nearshore habitat/bathymetry assessment	Unless directed otherwise by the designated Control Agency (i.e., DoT) a shoreline/nearshore habitat/bathymetry assessment is conducted prior to nearshore activities	IAP records assessment records

15 Shoreline Clean-up Plan

Table 15-1: Shoreline clean-up – environmental performance outcome, initiation criteria and termination criteria

<table>
<tr><td>Environmental Performance Outcome</td><td colspan="2">Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">+ Level 2 or Level 3 spills where shorelines with identified or potential protection priorities that will be, or have been, contacted
+ NEBA indicates shoreline clean-up will benefit receptors, and
+ Approval has been obtained from DoT IC or delegate (as the Control Agency) to initiate response strategy</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>Caley Condensate</td><td>MDO</td></tr>
<tr><td>✓</td><td>✗</td></tr>
<tr><td>Termination criteria</td><td colspan="2">+ As directed by DoT</td></tr>
</table>

15.1 Overview

Shoreline clean-up aims to remove hydrocarbons from shorelines and intertidal habitat to achieve a net environmental benefit. Removal of these hydrocarbons helps reduce remobilisation of hydrocarbons and contamination of wildlife, habitat and other sensitive receptors. Shoreline clean-up is often a lengthy and cyclical process, requiring regular surveys to monitor the effectiveness of clean-up activities and assess if they are resulting in any adverse impacts.

Shoreline clean-up is part of an integrated nearshore/ shoreline response to be controlled by DoT as the relevant Control Agency. Santos will undertake first-strike activations as triggered, until such time as DoT assume control. Upon assumption of Control Agency responsibilities, DoT will direct resources (equipment and personnel) provided by Santos for the purposes of shoreline clean-up. The information obtained from Operational Monitoring (refer **Section 10**), will be used by the IMT in the development of the operational NEBA to inform the most effective clean-up tactics (if any) to apply to individual sites. Intrusive shoreline clean-up techniques have the potential to damage sensitive shorelines. The appropriateness of clean-up tactics will be assessed against natural attenuation for sensitive sites. Selection of shoreline clean-up methods and controls to prevent further damage from the clean-up activities are to be undertaken in consultation with the Control Agency and selected based on NEBA.

Spill modelling indicates if a worst-case spill were to occur as a result of Bedout Multi-Well Drilling activities, shoreline contact would occur and therefore clean-up of shorelines is likely to be required.

MDO is likely to be difficult to remove given its light nature and high weathering potential. It can be readily washed from sediments by wave and tidal flushing. The likely waste products from a diesel spill shoreline response would be contaminated sand and debris.

Modelling confirms that light, volatile components of Caley Condensate accounting for 62% of the hydrocarbon by volume will evaporate within 48 hours under moderate wind conditions (5 m/s). The low asphaltene content of Caley Condensate (less than 0.5% by mass) results in a low tendency for the hydrocarbons to take up water and form water in oil emulsions (**Appendix A**).

Shoreline clean-up techniques include:

+ Shoreline and Coastal Habitat Assessment – uses assessment processes (refer to **Section 10.8**) to assess shoreline character, assess shoreline oiling and develop recommendations for response. Typically, this should be the first step in any shoreline clean-up response.
+ Natural Recovery – oiled shorelines are left untreated and the oil naturally degrades over time.
+ Manual and Mechanical Removal – removes oil and contaminated materials using machinery, hand tools, or a combination of both.
+ Washing, Flooding and Flushing – uses water, steam, or sand to flush oil from impacted shoreline areas.
+ Sediment reworking and Surf washing – uses various methods to accelerate natural degradation of oil by manipulating the sediment.

15.2 Implementation guidance

Table 15-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. **Table 15-2** provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 15-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial shoreline clean-up operations, unless directed otherwise by DoT, are listed in **Table 15-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 15-2: Implementation guidance – shoreline clean-up

	Action	Consideration	Responsibility	Complete
Initial Actions	**Actions below are indicative only and are at the final determination of DoT as the Control Agency.**			
	Initiate Shoreline and Coastal Habitat Assessment (if not already activated).	Refer to **Section 10.8** for additional information	Environment Team Leader	❑
	Using results from Shoreline and Coastal Habitat Assessment, conduct Operational NEBA to assess shoreline-clean up suitability and recommended tactics for each shoreline location.	Shoreline and Coastal Habitat Assessment Teams are responsible for preparing field maps and forms detailing the area surveyed and make specific clean-up recommendations. The condition of affected shorelines will be constantly changing. Results of shoreline surveys should be reported as quickly as possible to the IMT to help inform real-time decision-making. Engage a Heritage Adviser if spill response activities overlap with potential areas of cultural significance.	Environmental Team Leader	❑
	If operational NEBA supports shoreline clean-up, prepare a Shoreline Clean-up Plan for inclusion in the IAP,	Shoreline Clean-up Plan may include (but not be limited to): + clean-up objectives + clean-up end points (may be derived from Shoreline and Coastal Habitat Assessment) + clean-up priorities (may be derived from Shoreline and Coastal Habitat Assessment) + assessment and location of staging areas and worksites (including health and safety constraints, zoning)	Environmental Team Leader Planning Team Leader Operations Team Leader	❑

	Action	Consideration	Responsibility	Complete
		+ utility resource assessment and support (to be conducted if activity is of significant size in comparison to the size of the coastal community) + permits required (if applicable) + chain of command for onsite personnel + list of resources (personnel, equipment, personal protective equipment) required for selected clean-up tactics at each site + details of accommodation and transport management + security management + waste management information, including logistical information on temporary storage areas, segregation, decontamination zones and disposal routes + establish no access and demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat (utilise existing roads and tracks first). Refer to IPIECA-IOGP (2015) for additional guidance on shoreline clean-up planning and implementation.		
	In consultation with the Control Agency procure and mobilise resources to a designated port location for deployment, or directly to location via road transport.		Logistics Team Leader Supply Team Leader Deputy Logistics Officer (DoT IMT)	❑

	Action	Consideration	Responsibility	Complete
	Deploy shoreline clean-up response teams to each shoreline location to begin operations under direction of the Control Agency.	Each clean-up team to be led by a Shoreline Response Team Lead, who could be an AMOSC Core Group Member or trained member of the AMSA administered National Response Team (as per the MoU agreement between Santos and AMSA). Clean-up teams and equipment will be deployed and positioned as per those observations by the Shoreline and Coastal Habitat Assessment Teams in consultation with the DoT. Team members will verify the effectiveness of clean-up, modifying guidelines as needed if conditions change.	Operations Team Leader Logistics Team Leader Deputy Logistics Officer (DoT IMT)	❑
Ongoing Actions	Shoreline Response Team Lead shall communicate daily reports to the IMT Operations Team Leader to inform of effectiveness of existing tactics and any proposed tactics and required resources.	Where possible, maintain some consistency in personnel within Shoreline Response Teams. If the same personnel are involved in shoreline and coastal habitat assessment and clean-up, they will be better placed to adapt their recommendations as the clean-up progresses and judge when the agreed endpoints have been met.	Shoreline Response Team Leader Operations Team Leader	❑
	The IMT Operations Team Leader shall work with the Planning Team Leader to incorporate recommendations into the Incident Action Plans for the following operational period, and ensure all required resources are released and activated through the Supply and Logistics Team Leaders.		Operations Team Leader Planning Team Leader	❑
	Monitor progress of clean-up efforts and report to the Control Agency.		Operations Team Leader On-Scene Commander Deputy OSC (DoT FOB)	❑

Table 15-3: Shoreline clean-up – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Manual clean-up tools (shovels, rakes, wheelbarrows, bags, etc)	AMOSC shoreline kits	Shoreline support kits first strike	Fremantle – one Geelong – one	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; equipment logistics varies according to stockpile location (**Table 10-12**)
	Santos	One shoreline clean-up container	Varanus Island	Within 12 hours for deployment from VI
	Hardware suppliers	As available	Exmouth, Karratha, Perth	
Shoreline flushing (pumps/hoses)	AMOSC	Shoreline flushing kit Shoreline impact lance kit	Fremantle – one; Geelong – one Geelong – one	Response via duty officer within 15 mins of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 10-12**
Nearshore skimmers/hoses	AMOSC AMSA	See Protection and Deflection (**Table 14-3**)		
Decontamination/staging site equipment	AMOSC	Decontamination station – three	Fremantle – one; Exmouth – one; Geelong – one	Response via duty officer within 15 mins of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 10-12**

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMSA	Decontamination station – four	Karratha – two; Fremantle – two	Access to National Plan equipment through AMOSC
	Oil spill equipment provider (e.g., Global Spill., PPS)	As available	Perth	Subject to availability
Waste storage (including temporary storage and waste skips and tanks for transport)	AMOSC temporary storage	Fast tanks – eight Vikotank (13000 L)	Geelong – four; Fremantle – two; Exmouth – two Broome – one	15 mins of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 10-12**
	AMSA temporary storage	Fast tanks	Karratha – four; Fremantle – four	Access to National Plan equipment through AMOSC
	Via North West Alliance contract	Refer **Table 17-3**	Perth, Karratha	24+ hours
Personnel (field responders) for OSR strategies	AMOSC Staff	8	Fremantle – two Geelong – six	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	12	Perth/NW Australia facilities – ten Port Bonython (South Australia) – six	12+ hours

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation
	Santos contracted Work Force Hire company (e.g., Dare)	As per availability (up to 2,000)	Australia-wide	Subject to availability (indicatively 72+ hours)

Table 15-4: Shoreline clean-up – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirms applicability of strategy and begins sourcing resources.	<4 hours
Santos Offshore Core Group mobilised to site/deployment port location.	<24 hours
Clean-up equipment mobilised to site/deployment port location.	<24 hours
Waste storage equipment mobilised to site/ deployment port location.	<24 hours
Remote island transfer vessel (if required) mobilised to deployment port location.	<24 hours
AMOSC Staff, Industry Core Group and Labour Hire mobilised to site/deployment port location.	<48 hours
Clean-up operation deployed to clean-up area under advice from Shoreline Assessment Team.	<48 hours
Minimum Resource Requirements	
NB: Resource requirements for shoreline clean-up will be situation/receptor specific. TRPs if developed for the area/receptor will outline suggested resource requirements and shoreline assessments (as part of operational monitoring strategy) will be conducted prior to clean-up to confirm techniques. TRPs are held by Santos and DoT and have been developed 80 Mile Beach, Montebello Islands, Dampier, Roebuck Bay, Ningaloo Coastline (including Muiron, Jurabi to Light House Bay Beaches, Mangrove Bay, Turquoise Bay and Yardie Creek) and Muiron Islands and are available of the Santos ER Intranet page[26]. Indicative minimum requirements for one Santos-activated shoreline clean-up team are: + manual clean-up/shoreline flushing equipment kit + waste storage (bags, temporary storage tanks, skips as appropriate) + decontamination/staging equipment kit + personal protective equipment. One clean-up team comprises: + one Team Leader (AMOSC staff, Industry Core Group or Santos Core Group) + twenty to twenty-five shoreline clean-up responders (AMOSC Core Group, Santos contracted labour hire personnel	

[26] Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA.

15.3 Shoreline clean-up resources

Shoreline clean-up equipment available for use by Santos is a combination of Santos owned, AMOSC, AMSA, DoT and OSRL equipment as well as other industry resources available through the AMOSPlan mutual aid arrangements. Shoreline consumables are available through hardware, PPE and specialist oil/chemical spill suppliers and mobile plant equipment is available through hire outlets in Perth, Karratha and other regional centres. Where vessel deployments are required, Santos will leverage from existing contracted vessel providers.

Shoreline clean-up personnel available to Santos is a combination of AMOSC Staff, AMOSC Core Group Responders (comprising AMOSC trained Santos and Industry personnel), OSRL responders, State Response Team members and National Response Team members. Personnel for manual clean-up and mobile plant operation can be accessed through Santos' labour hire arrangements.

The level of deployment of equipment and personnel for clean-up will be commensurate to the spatial extent of shoreline contact, the volume of oil arriving and the sensitivity and access constraints of the shoreline in question. Once activated as Control Agency, deployment will be under the direction of DoT and the advice of shoreline clean-up specialists from AMOSC Core Group and National/State response teams. Shoreline Assessments (**Section 10.8**) will provide information to guide the clean-up strategy and deployment of resources.

15.4 Worst case resourcing requirements

Shoreline clean-up requirements have been determined for affected Priority Protection Areas (PPAs) based on the single modelled scenario that resulted in the highest volume of shoreline loading across all shorelines. The shoreline loading and clean-up requirements should be considered conservative as they do not take into account the potential reduction in shoreline loading achieved through potential Containment and Recovery and/or SDA application.

Resourcing requirements for shoreline oil operations have been determined based on a manual clean-up rate of 1 m^3 of oily waste per person per day. A bulking factor of 10x has been applied to manual clean-up activities; i.e., it is assumed that 10% of manually collected oily waste is oil. Mechanical removal rates (earth moving equipment) are been based on a clean-up rate of 150 m^3 of oily waste per mechanical aid per day. A bulking factor of 2% has been applied to mechanical clean-up activities; i.e., it is assumed that 2% of oily waste collected via mechanical clean-up is oil.

Specific resourcing requirements for each PPA have been derived as a factor of shoreline loading volumes and arrival times (based on highest shoreline loading from a single modelling run). Daily loading data has been used to inform calculations for resourcing requirements. Daily loading represents the net volume of oil remaining on the shoreline following any daily oil arrival and daily oil removed through natural processes.

Modelling has indicated that the surface release of Caley Condensate from the Bedout South location (2,049,258 m^3 from surface LOWC) would result in the highest potential shoreline loading of oil. Caley Condensate is characteristically persistent, requiring the greatest level of effort to respond to. MDO, is comparatively lighter than Caley Condensate with physical removal not possible or recommended due to the degree of infiltration into sediments that could occur.

From the deterministic modelling undertaken (**Section 6.4.1**), the Bedout South surface LOWC resulted in the highest shoreline loading for any single receptor (Eighty Mile Beach). Personnel and equipment required to respond to this worst credible case are detailed in **Table 15-5**.

Table 15-5: Personnel and mechanical aid requirements for clean-up of oil acres PPAs based on a single modelled run providing the worst case shoreline loading (Bedout South surface loss of well control)

Bedout South surface loss of well control			Eighty Mile Beach			Bedout Island			Total		
Week following LOWC	Release Rate (STB/day)	Bulked waste volume across all receptors (tonnes)	Team Lead	Personnel	Mechanical aids	Team Lead	Personnel	Mechanical aids	Team leaders (rostered on)	Personnel (rostered on)	Mechanical aids
1	175, 990										
2	173, 322										
3	171, 912	170.6	5	100	3				5	100	3
4	170, 907	2771.7	7	150	6				7	150	6
5	170, 119	5948.5	10	200	6				10	200	6
6	169, 467	6796.4	27	550	8				27	550	8
7	168, 907	10365.2	32	650	8	2	50	N/A	40	700	8
8	168, 422	105446.3	30	600	8	5	100	N/A	35	700	8
9	167, 992	11520.1	27	550	8	5	100	N/A	32	650	8
10	167, 590	10476.2	32	650	8	2	50	N/A	34	700	8
11	167, 209	10189.0	20	400	8	2	50	N/A	22	450	8
Relief well drilled											
12		11946.0	27	550	8	2	50	N/A	29	600	8
13		11924.0	32	650	8	2	50	N/A	34	700	8
14		10707.4	22	450	8	2	50	N/A	24	500	8

Bedout South surface loss of well control			Eighty Mile Beach			Bedout Island			Total		
15		9321.5	22	450	8	2	50	N/A	24	500	8
16		6615.9	5	100	2	2	50	N/A	7	150	2
17 to 25			5	100	2	1	25	N/A	6	125	2

Red text indicates maximum personnel/equipment requirements for each protection priority area.

Eighty Mile Beach

The worst-case single run predicted peak loading of 8,836.6 would occur at Eighty Mile Beach on day 90.9, with shoreline loading beginning from day 16.7. **Figure 15-1** shows the shoreline loading timeline for Eighty Mile Beach based on the worst case run.

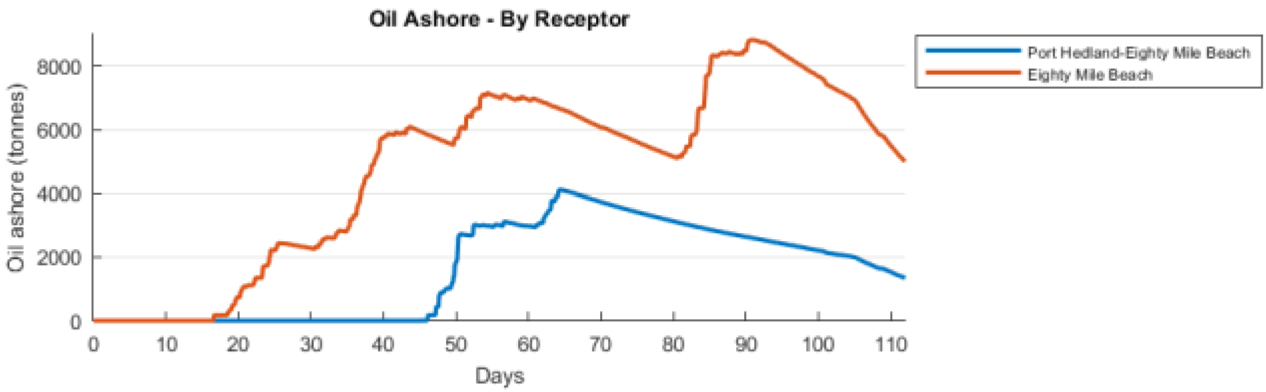

Figure 15-1: Eighty Mile Beach shoreline loading timeline based on worst-case shoreline loading run (GHD, 2020)

An indicative response schedule utilising up to 650 personnel and eight mechanical aids (earth-moving equipment) has been applied and is sufficient to theoretically remove all bulk oil from shorelines. The length of Eighty Mile Beach provides road/track access for staging areas and mechanical aids and response of up to 650 personnel could be initiated from two or more staging areas. The schedule in **Table 16-5** indicates that phase one clean-up (removal of all bulk oil) for the worst case shoreline loading could theoretically occur by the end of week 16 (approximately five weeks after relief well completion). A reduced workforce would remain for the following two months to carry out phase two of the clean-up (e.g., assisted bioremediation).

Table 15-6: Indicative response schedule for shoreline clean-up at Eighty Mile Beach based on worst-case loading

	80 Mile Beach			Crews / Personnel						
Week following LOWC	Team Leader	Personnel	Mechanical Aids	#1	#2	#3	#4	#5	#6	#7
1										
2										
3	5	100	3			100				
4	7	150	6		50	100				
5	10	200	6	50	50		100			
6	27	550	8	50		100	100	100	200	
7	32	650	8		50	100		100	200	200
8	30	600	8	50	50		100			200
9	27	550	8	50		100	100	100	200	
10	32	650	8		50	100		100	200	200
11	20	400	8	50	50		100			200
Relief Well Drilled										
12	27	550	8	50		100	100	100	200	
13	32	650	8		50	100		100	200	200
14	22	450	8		50	100	100			200
15	22	450	8	50			100	100	200	
16	5	100	2	50	50					

Bedout Island

The worst-case single run predicted peak loading of 206.3 would occur at Bedout Island on day 90.9, with shoreline loading beginning from day 51.7. **Figure 15-2** shows the shoreline loading timeline for Bedout Island based on the worst case run.

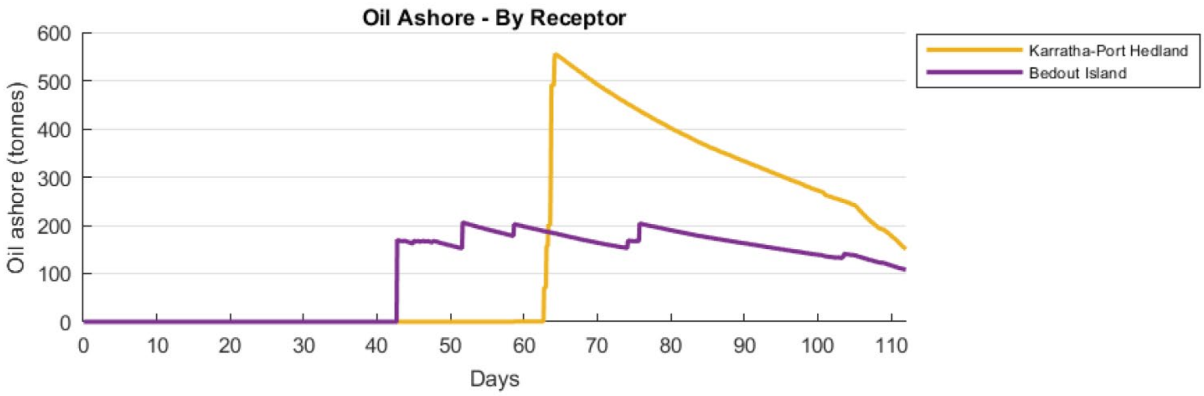

Figure 15-2: Bedout Island shoreline loading timeline based on worst case shoreline loading run (GHD, 2020)

Bedout Island is located approximately 42 km north of the WA coast, covering approximately 32 ha and has a beach coastline of approximately 2.7 km. Given the location of the island, the use of mechanical aids during the clean-up response would not be feasible. Land and/or vessel-based teams could be utilised depending on the time of year. The primary seabird breeding season occurs between May and September, during which vessel-based teams would be preferential in order to minimise interaction with breeding birds.

An indicative response schedule utilising up to 100 personnel has been applied and is sufficient to theoretically remove all bulk oil from the Bedout Island shoreline. This could be achieved using multiple land or vessel based teams deployed per the roster shown in **Table 15-7**. This schedule indicates that phase one clean-up (removal of all bulk oil) for the worst-case shoreline loading could theoretically occur by the end of week 15 (~4 weeks after relief well completion)[27]. A reduced workforce would remain for the following two months to carry out phase two of the clean-up (e.g., assisted bioremediation).

[27] Based on the Bedout Island clean-up schedule, clean-up crews would have removed all oil ashore by the end of week 10 and would only be responding to oil arriving from that point forward.

Table 15-7: Indicative response schedule for shoreline clean-up at Bedout Island based on worst-case loading

	Bedout Island			Crews / Personnel			
Week following LOWC	Team Leader	Personnel	Mechanical Aids	#1	#2	#3	#4
1							
2							
3							
4							
5							
6							
7	2	50	N/A	25	25		
8	5	100	N/A	25	25	50	
9	5	100	N/A			50	50
10	2	50	N/A	25	25		
11	2	50	N/A	25	25		
12	2	50	N/A			50	
13	2	50	N/A	25	25		
14	2	50	N/A	25	25		
15	2	50	N/A			50	
16	2	50	N/A	25	25		

15.5 Shoreline clean-up decision guides

A number of shoreline types are found within the EMBA associated with Bedout Multi-Well Drilling activities, including:

+ rocky shorelines
+ sandy beaches
+ intertidal platforms
+ shallow sub-tidal soft sediments
+ mangroves.

The shoreline types are amenable in varying degrees to clean-up methods depending upon the type of hydrocarbon spilt. To assist with planning purposes, guidance for the selection of appropriate shoreline response strategies based on shoreline sensitivities is provided within **Appendix K**.

Operational guidelines for shoreline response activities including worksite preparation, manual and mechanical oil removal and vessel access for remote shorelines are included in **Appendix L**.

The DoT Oil Spill Contingency Plans (2015) also provides guidance on shoreline clean-up techniques.

15.6 Environmental performance

Table 15-8 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 15-8: Environmental performance – shoreline clean-up

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Shoreline Clean-Up	**Response Preparedness**		
	Access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL.	Maintenance of access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity.	MoU for access to National Plan resources through AMSA.
			AMOSC Participating Member Contract.
			OSRL Associate Member Contract.
	Maintenance of MSAs with multiple vessel providers.	Santos maintains MSAs with multiple vessel providers.	MSAs with multiple vessel providers.
	Vessels for offshore island response.	Maintenance of vessel specification for resource transfer for offshore island response.	Vessel specification.
	Labour hire contract.	Maintenance of contract with labour hire provider.	Contract.
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations.	Minimum requirements mobilised in accordance with **Table 15-4** unless directed otherwise by DoT.	Incident log.
	Shoreline Clean-Up Plan.	Santos IMT to confirm protection priorities in consultation with DoT.	IAP. Incident Log.
		Prepare operational NEBA to determine if shoreline clean-up activities are likely to result in a net environmental benefit.	Records indicate operational NEBA completed prior to shoreline clean-up activities commencing.

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		Ensure operational NEBA considers waste management, to ensure environmental benefit outweighs the environmental impact of strategy implementation which may include secondary contamination.	Incident Log. IAP.
		IAP Shoreline Clean-up Sub-plan developed to provide oversight and management of shoreline clean-up operation.	Records indicate IAP Shoreline Clean-up Sub-plan prepared prior to shoreline clean-up operations commencing.
		Clean-up strategies will be implemented under the direction of DoT as the HMA.	Incident Log.
		Santos will make available AMOSC Core Group Responders for shoreline clean-up team positions to the Control Agency.	Incident Log.
		Santos will make available to the Control Agency equipment from Santos, AMOSC and OSRL stockpiles.	Incident Log.
		NEBA undertaken every operational period by the relevant Control Agency to determine if response strategy is having a net environmental benefit. NEBA included in development of following period Incident Action Plan.	IAP/Incident Log.
	Prioritise use of existing roads and tracks.	Unless directed otherwise by the designated Control Agency (i.e., DoT) access plans for shoreline operations will prioritise use of existing roads and tracks.	IAP demonstrates requirement is met.
	Soil profile assessment prior to earthworks.	Unless directed otherwise by the designated Control Agency (i.e., DoT) a soil profile assessment is conducted prior to earthworks.	Documented in IAP and Incident Log.

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	Pre-cleaning and inspection of equipment (quarantine).	Vehicles and equipment provided by Santos are verified as clean and invasive species free prior to deployment to offshore islands.	Documented in IAP and Incident Log.
	Use of Heritage Adviser if spill response activities overlap with potential areas of cultural significance.	Unless directed otherwise by the designated Control Agency (i.e., DoT) a Heritage Adviser is consulted if shoreline operations overlap with areas of cultural significance.	Documented in IAP and Incident Log.
	Select temporary base camps in consultation with DoT and DBCA.	Any establishment of forward staging areas at shoreline areas done under direction or in consultation with DoT and DBCA.	Documented in IAP and Incident Log.
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions.	OSR Team Leader assess/select vehicles appropriate to shoreline conditions	IAP demonstrates requirement is met.
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/ roosting areas and turtle nesting habitat.	Unless directed otherwise by the designated Control Agency (i.e., DoT) demarcation zones are mapped out in sensitive habitat areas.	IAP demonstrates requirement is met.
	Operational restriction of vehicle and personnel movement to limit erosion and compaction.	Unless directed otherwise by the designated Control Agency (i.e., DoT) action plans for shoreline operations include operational restrictions on vehicle and personnel movement.	IAP demonstrates requirement is met.
	Stakeholder consultation.	Consultation is undertaken with relevant stakeholders prior to deployment of resources to townships and marine/coastal areas.	Consultation records

16 Oiled Wildlife Response Plan

Note: DoT is the Control Agency and DBCA is the Jurisdictional Authority for oiled wildlife response within State waters. Santos is the Control Agency for oiled wildlife response within Commonwealth waters.

Table 16-1: Oiled wildlife response – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement tactics in accordance with the WAOWRP to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife	
Initiation criteria	Operational monitoring shows that wildlife is contacted or is predicted to be contacted by a spill	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ Oiling of wildlife has not been observed over a 48-hour period, and + Oiled wildlife has been successfully rehabilitated, and + Agreement is reached with Jurisdictional Authorities and stakeholders to terminate the incident response	

16.1 Overview

Santos will provide all necessary resources to assist DoT in an oiled wildlife response in State waters, mainly, and initially, through its access to AMOSC oiled wildlife resources. Timely provision of equipment and personnel will be provided by AMOSC to DoT as the Control Agency/ Lead IMT through a combination of owned and operated equipment, call-off contracts with suppliers, and the management of industry OWR response personnel through an Industry Oiled Wildlife Adviser (OWA). This team will work in conjunction with DBCA OWR capability under the direction of the DoT Incident Controller. Where Santos is the Control Agency for OWR in Commonwealth waters, AMOSC will also provide the above-mentioned resources and be supported by DCBA but would instead work under the direction of the Santos IC.

The key plan for oiled wildlife response (OWR) in WA is the WAOWRP. The WAOWRP has been developed by DBCA and AMOSC, on behalf of the petroleum industry, and DBCA to define the minimum standards for OWR in WA as a sub-plan to the State Hazard: SHP-MEE. The WAOWRP can also be used for guidance to OWR in Commonwealth waters adjacent to State waters, noting that OWR requirements in State waters are expected to be greater. The Pilbara Region OWRP, which sits under the WAOWRP provides operational guidance to respond to injured and oiled wildlife in the Pilbara region and covers the areas potentially contacted by a spill from Bedout Multi-Well Drilling activities.

The sections below provide guidance to the Santos IMT on OWR stages of response and implementation. In some cases, the implementation guidance (**Table 16-6**) includes detail which is additional to what is provided in the WAOWRP. The information below should be used in conjunction with the WAOWRP.

16.2 Oiled wildlife stages of response

The WAOWRP includes eight stages to an OWR, which are described in **Table 16-2**. If an OWR is initiated, implementation will follow these stages, as appropriate to the nature and scale of the incident.

Table 16-2: Oiled wildlife response stages (adapted from Western Australian Oiled Wildlife Response Plan)

Stage	Description
Stage 1: Initial wildlife assessment and notifications	Gather situational awareness on whether an OWR impact has occurred or is imminent and complete notifications to Jurisdictional Authorities and external support agencies.
Stage 2: Mobilisation of wildlife resources	Mobilise initial preventative measures and/or mobilisation of resources to deal with incident in early stages of development.
Stage 3: Wildlife reconnaissance	Wildlife Reconnaissance for the OWR should occur as part of the implementation of surveys for the fauna related Operational Monitoring Plans (OMPs) undertaken to aid planning and decision making for executing spill response or clean-up operations. Wildlife Reconnaissance will be required for the duration of the wildlife response operations.
Stage 4: IAP wildlife sub-plan development	The Wildlife Response Sub-plan should include the operational components (relevant to the scale of the OWR) of: + wildlife impact assessment + reconnaissance and monitoring + search and collection + carcass collection and necropsy storage + field stabilisation + wildlife transport + wildlife processing/admission + wildlife intake and triage + wildlife cleaning + rehabilitation/conditioning + release + post-release monitoring + OWR termination and demobilisation. (It should be noted that separate strategies and protocols may be required for different species groups).
Stage 5: Wildlife rescue and staging	This includes commencing actions such as hazing, pre-emptive capture, administering first-aid and holding and/or transportation of wildlife to oiled wildlife facilities. If oiled birds or non–avian wildlife were to be observed at sea, on-water collection should be considered for the effective capture of oiled animals before they become so debilitated that their chance of survival is severely affected (IPIECA, 2017).

Stage	Description
Stage 6: Establishment of an oiled wildlife facility	Treatment facilities would be required for the cleaning and rehabilitation of affected animals. A vessel-based 'on-water' facility would likely need to be established to enable stabilisation of oiled wildlife before transport to a suitable treatment facility.
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping, release and post-release monitoring.
Stage 8: Oiled wildlife response termination	Demobilisation of the OWR should be undertaken in accordance with parameters or endpoints established in the IAP and supplementary Wildlife Response Sub-plan. This decision will be made in consultation with the relevant jurisdictional authorities and support agencies.

16.3 Oiled wildlife response levels and resourcing

An impact assessment threshold of 10 g/m^2 for impacts on fauna from floating hydrocarbons is provided in the Bedout Multi-Well Drilling EP. This conservative threshold is broadly accepted as being the minimal thickness of surface hydrocarbons that may result in adverse impacts to seabirds through ingestion from preening of contaminated feathers (French-McCay, 2016) and is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997).

A summary of the worst-case spill modelling for each scenario is provided in **Table 16-3**. Environmental values associated with Imperieuse Reef MP, Ningaloo Coast North and Eighty Mile Beach, including a summary of fauna species associated with these receptors are shown in **Section 6.6**.

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Table 16-3: Maximum extent, shoreline loading and length of oiled shoreline

Scenario	Furthest extent of floating hydrocarbons at >10g/m²	Maximum shoreline loading at >100g/m²	Maximum length of oiled shoreline at >100g/m²
Subsea			
Bedout West – LOWC	Approximately 600 km	2,371.9 tonnes (Imperieuse Reef MP)	176.2 km (Ningaloo Coast North)
Bedout North – LOWC	Approximately 650 km	3,159.5 tonnes (Imperieuse Reef MP)	108 km (Ningaloo Coast North)
Bedout South – LOWC	Approximately 275 km	4,506 tonnes (Eighty Mile Beach)	227.4 km (Eighty Mile Beach)
Surface			
Bedout West – LOWC	Approximately 900 km	2,595.6 tonnes (Imperieuse Reef MP)	181.9 km (Ningaloo Coast North)
Bedout North – LOWC	Approximately 700 km	3,580.5 tonnes (Imperieuse Reef MP)	136.4 km (Ningaloo Coast North)
Bedout South – LOWC	Approximately 500 km	16,561.4 tonnes (Eighty Mile Beach)	483.2 km (Eighty Mile Beach)
Bedout West – Vessel collision (MDO)	Approximately 200 km	NC	NC
Bedout North – Vessel collision (MDO)	Approximately 200 km	1.6 tonnes (Imperieuse Reef MP)	2.8 km (Imperieuse Reef MP)
Bedout South – Vessel collision (MDO)	Approximately 150 km	52.8 tonnes (Bedout Island)	4.2 km (Eighty Mile Beach)

Estimates for OWR planning predict a worst-case OWR for this activity will be an OWR Level 6, as defined in the WAOWRP (2014) (**Table 16-4**). For a Level 6 response, it is expected that up to 122 personnel will be required, with a range of skill levels (**Table 16-5** – OWR 1 = basic training to OWR 4 = OWR Adviser; Information drawn from WAOWRP). Personnel at skill levels OWR 2 to 4 and those with specialised skills (e.g., vets) are expected to be sourced through AMOSC, OSRL, DBCA, Universities and contractors.

Roles could be filled by the organisations listed above and through labour hire agencies that can provide field workers that undergo an induction and basic training. Basic training (over one day) for OWR personnel can be delivered as just-in-time training through an arrangement with DBCA.

Table 16-4: Indicative oiled wildlife response level (adapted from Western Australian Oiled Wildlife Response Plan, 2014)

OWR Level	**Indicative personnel numbers**	**Indicative duration**	**Indicative number of birds** (non-threatened species)	**Indicative number of birds** (threatened species)	**Turtles** (hatchlings, juveniles, adults)	**Cetaceans**	**Pinnipeds**	**Dugongs**
Level 1	6	<3 days	1–2/day <5 total	None	None	None	None	None
Level 2	26	>4–14 days	1–5/day <20 total	None	<20 hatchlings No juv/ adults	None	None	None
Level 3	59	>4–14 days	5–10/day	1–5/day <10 total	<5 juv/ adults <50 hatchlings	None	<5	None
Level 4	77	>4–14 days	5–10/day <200 total	5–10/day	<20 juv/ adults <500 hatchlings	<5, or known habitats affected	5–50	Habitat affected only
Level 5	116	>4–14 days	10–100/ day >200 total	10–50/day	>20 juv/ adults >500 hatchlings	<5 dolphins	>50	Dugongs oiled
Level 6	122	>4–14 days	>100/day	10–50/day	>20 juv/ adults >500 hatchlings	>5 dolphins	>50	Dugongs oiled

Table 16-5: Oiled wildlife response level and personnel numbers

Skill Level	OWR Response Level and Personnel Numbers					
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
OWR 4	1	1	3	2	2	2
OWR 3	2	0	4	4	4	4
OWR 2	4	9	15	17	18	18
OWR 1	0	14	33	47	84	90
Technicians (i.e., vets)	0	1	2	4	4	4
Other specified skills	0	0	2	3	4	4
Total	7	25	59	77	116	122

16.4 Implementation guidance

Oiled wildlife response activities can be resource intensive and require additional personnel to be positioned within the IMT. The oiled wildlife response team will be managed according to the Wildlife Division outlined in the WAOWRP. The wildlife operations unit will contain all the field staff and activities, including oiled wildlife reconnaissance, who will work in close consultation with personnel undertaking relevant monitor and evaluate activities. The IAP Wildlife Response Sub-plan as outlined in **Table 16-2** will form the key management system which will provide control and oversight over the response.

Table 16-6 provides guidance to the IMT on the actions and responsibilities that should be considered when implementing OWR. These actions are provided as a guide and should be read in conjunction with the WAOWRP. In some cases, the Implementation Guidance (**Table 16-6**) will provide additional detail to the WAOWRP and has greater linkages to other aspects of the response operation and this OPEP (e.g., NEBA and aerial surveillance). Mobilisation times for the minimum resources that are required to commence initial oiled wildlife operations are listed in (**Table 16-7**).

The IC of the Control Agency is ultimately responsible for the implementation of the response and therefore, depending on the circumstances of the spill, may determine that some tasks be varied, should not be undertaken or should be reassigned.

Information on resource capability for this strategy is shown in **Appendix M**.

Table 16-6: Implementation guidance – oiled wildlife response

	Action	Consideration	Responsibility	Complete
Stage 1: Initial wildlife assessment and notifications				
Initial Actions	Personnel conducting monitor and evaluate activities shall report wildlife sightings in or near the spill trajectory (including those contacted with hydrocarbons or at risk of contact) and report them to the IMT within two hours of detection.	Record all reports of wildlife potentially impacted and impacted by spill. Record reports on: + location + access + number + species + condition of impacted animals (if available).	Surveillance personnel	❑
	If wildlife is sighted and is at risk of contact (or have been contacted), initiate oiled wildlife response by contacting AMOSC Duty Manager and DCBA State Duty Officer (who will then activate their respective Oiled Wildlife Advisers).	Obtain approval from IC prior to activating AMOSC Oiled Wildlife Adviser and/or DCBA Oiled Wildlife Adviser. DoT will be the Control Agency for OWR in State waters.	Environmental Team Leader	❑
	Notify Department of Agriculture, Water and the Environment if there is a risk of death or injury to a protected species (including MNES).	Refer to **Table 7-1** for reporting requirements. A list of MNES is provided in the Existing Environment Section of the EP (Section 3).	Environmental Team Leader	❑
	Review all wildlife reports from surveillance or opportunistic activities and contact personnel who made the reports (if possible) to confirm information collected.		Environmental Team Leader Wildlife Division Coordinator	❑

Action		Consideration	Responsibility	Complete
	Use information from initial assessments to prepare an Operational SIMA. Use this information to help determine: + initial OWR Response Level (1 to 6), as defined in the WAOWRP (**Table 16-4**) + if OWR activities are likely to result in a net environmental benefit.	Oiled wildlife response activities can cause additional stress and mortality on individuals than oil pollution alone. The Environmental Team Leader and Wildlife Division Coordinator will determine via an Operational NEBA whether capture and cleaning of oiled wildlife will result in a net environmental benefit. This may be done in consultation with the DCBA and AMOSC Oiled Wildlife Advisers and any Subject Matter Experts as relevant (if available, but an Operational NEBA should not be delayed if they are not immediately available).	Environmental Team Leader Wildlife Division Coordinator Wildlife Branch Director	❑
Stage 2: Mobilisation of wildlife resources				
Determine resources required to undertake Stage 3: Wildlife Reconnaissance and provide list to Logistics Section.		Confirm best reconnaissance platform (e.g., vessel, aerial, shoreline). Consider ability to share resources (e.g., Shoreline Clean-up Assessment Teams, Monitor and Evaluate activities).	Wildlife Division Coordinator Wildlife Reconnaissance Officer AMOSC OWA	❑
Determine number of Oiled Wildlife Responders and IMT Wildlife related positions required based on the likely number of oiled wildlife and arrange access to resources via AMOSC and DCBA.		Refer to **Table 16-5**. Consider need for veterinary care.	Wildlife Division Coordinator Logistics Team Leader AMOSC OWA DBCA OWA	❑
Commence mobilisation of equipment (including adequate PPE) and personnel to required location/s.			Wildlife Logistics Officer	❑
Contact OSRL to activate Sea Alarm if additional support is likely to be required to sustain an ongoing OWR.			Environmental Team Leader	❑

Action	Consideration	Responsibility	Complete
Stage 3: Wildlife reconnaissance			
Determine reconnaissance plan including survey locations, techniques and priority species.	Consult local experts, if available.	Wildlife Division Coordinator Wildlife Reconnaissance Officer AMOSC OWA DBCA OWA Planning Team Leader	❑
Conduct reconnaissance activities and upon completion, submit report detailing: + area/s surveyed + estimated number of animals oiled or at risk of being affected + any deaths + species affected		Wildlife Division Coordinator Wildlife Operations Officer Wildlife Reconnaissance Officer OWR field personnel Operations Team Leader	❑
Stage 4: IAP wildlife sub-plan development			
Develop Wildlife Response Sub-plan for inclusion in the IAP. IAP should include options for wildlife rescue and rehabilitation, including: + wildlife priorities for protection from hydrocarbons + any deterrence/hazing measures + anticipate number of oiled wildlife requiring rescue + reassess oiled wildlife level + actions required for the collection, recovery, transport and treatment of oiled wildlife; including resourcing of equipment and personnel anticipated.	Consider need for any permits to conduct activities.	Wildlife Division Coordinator Wildlife Operations Officer AMOSC OWA DBCA OWA Environmental Team Leader	❑

Action	Consideration	Responsibility	Complete
Stage 5: Wildlife rescue and staging			
Implement Wildlife Response Sub-plan for deterrence/hazing, pre-emptive capture, relocation.	Trained personnel required to handle wildlife.	Wildlife Division Coordinator Wildlife Operations Officer Wildlife Rescue Officer AMOSC OWA DBCA OWA OWR field personnel Operations Team Leader	❑
Establish staging site/s.	Wildlife first aid/stabilisation may be required at staging site if OWR treatment facility is more than two hours away.	Wildlife Operations Officer Wildlife Staging/Holding Officer OWR field personnel Operations Team Leader	❑
Stage 6: Establishment of an oiled wildlife facility			
Implement Wildlife Response Sub-plan for oiled wildlife facility.	Utilise OWR containers where possible. One container/kit can treat up to 150 OWR units, so will be adequate to treat oiled wildlife from the worst-case spill. If insufficient, additional OWR containers can be requested via the IAP to AMSA. Should oiled wildlife treatment be set up on vessels rather than onshore, the vessel needs to have adequate deck space to house the oiled wildlife equipment and be able to provide continuous hot water at constant pressure and temperature. The vessel must have the ability to properly contain and dispose of contaminated wastewater. Most Support Vessels are likely to be appropriate as they have	Wildlife Division Coordinator Wildlife Operations Officer Wildlife Facilities Officer AMOSC OWA DBCA OWA OWR field personnel Operations Team Leader	❑

Action	Consideration	Responsibility	Complete
	mud and other tanks for water storage and oil-water systems for treating water.		
Stage 7: Wildlife rehabilitation			
Implement Wildlife Response Sub-plan for rehabilitation.	Animals need to be stable to withstand stress of washing. Oiled animals, particularly birds, cannot thermoregulate and need to be kept indoors in a temperature-controlled room. The room needs to be well ventilated to disperse the hydrocarbon fumes.	Wildlife Division Coordinator Wildlife Veterinarian Wildlife Rehabilitation Officer AMOSC OWA DBCA OWA OWR field personnel Operations Team Leader	❑
Stage 8: Oiled wildlife response termination			
Liaise with Jurisdictional Authorities regarding OWR termination, using endpoints established in the IAP and supplementary Wildlife Response Sub-plan (Termination and Demobilisation section).		Wildlife Division Coordinator AMOSC OWA DBCA OWA Incident Commander	❑

Table 16-7: Oiled wildlife response – first strike response timeline

Task	Time from oiled wildlife contact (predicted or observed)
IMT notifies regulatory authorities and AMOSC of oiled wildlife / potential for contact	<2 hours
Mobilise Santos personnel for oiled wildlife reconnaissance **this will be already occurring through Aerial Observer mobilisation and Shoreline Assessment Team mobilisation**	<24 hours
Mobilisation of AMOSC oiled wildlife equipment and industry OWR team to forward staging area	<48 hours
Minimum Resource Requirements	
The requirements for oiled wildlife response will be situation specific and dependent upon reconnaissance reports. Indicative minimum resource requirements below align with personnel requirements for a Level 1 response as per the WAOWRP: + Six trained industry oiled wildlife response team personnel (AMOSC staff & contractors/ AMOSC Industry OWR group) + One AMOSC OWR treatment container + One AMOSC Oiled Wildlife Deterrence Kit	

16.5 Environmental performance

Table 16-8 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 16-8: Environmental performance – oiled wildlife response

Environmental Performance Outcome	Implement tactics in accordance with the WAOWRP to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Oiled Wildlife Response	**Response preparedness**		
	Maintenance of access to oiled wildlife response equipment and personnel	Maintenance of access to oiled wildlife response equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract.
			OSRL Associate Member Contract.
	Santos Oiled Wildlife Response Framework	Development of a Santos Oiled Wildlife Response Framework (to be completed by end of 2020)	Santos Oiled Wildlife Response Framework
	Labour hire contract	Maintenance of contract with labour hire provider	Contract
	Labour hire onboarding procedure (for low skilled shoreline clean-up personnel)	Development of onboarding procedure for oil spill response labour hire	Onboarding procedure
	Santos personnel trained on OWR	Additional Santos personnel trained in OWR during 2020	Training records
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 16-7** unless directed otherwise by DoT/ DBCA.	Incident log
	OWR managed in accordance with the WAOWRP	Prepare operational NEBA to help classify OWR level and determine if OWR activities are likely to result in a net environmental benefit	Records indicate operational NEBA completed prior to OWR operations commencing
		IAP Wildlife Response Sub-plan developed to provide oversight and management of OWR operation	Records indicate IAP Wildlife Response Sub-plan prepared prior to OWR operations commencing

17 Waste Management Plan

Table 17-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 17-1: Waste management – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, reusing and recycling waste where possible	
Initiation criteria	Response activities that will be generating waste have been initiated	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	+ All waste generated from the oil spill response has been stored, transported and disposed as per the regulatory requirements, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

17.1 Overview

The implementation of some spill response strategies will generate waste solid and liquid waste that will require rapid management, storage, transport and disposal. It is important that waste is collected and removed quickly to ensure waste management does not create a bottleneck in response operations.

The type and amount of waste generated during a spill response will vary depending on the spill type/characteristics, volume released, and response strategies implemented. To account for this potential variability, waste management (including handling and capacity) needs to be scalable to allow a continuous response to be maintained.

Where Santos is the Control Agency, or at the request of the designated Control Agency, Santos will engage its contracted WSP to provide sufficient waste receptacles to store collected waste and manage oily waste collection, transport and disposal associated with spill response activities. The WSP will arrange for all personnel, equipment and vehicles to carry out these activities from nominated collection points to the final disposal points. Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053) provides detailed guidance to the WSP in the event of a spill.

Where DoT is the Control Agency, Santos will provide a Facilities Support Officer to the DoT IMT Logistics Unit to support the DoT IMT in coordinating waste management services.

17.2 Implementation guidance

Table 17-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 17-3** provides a list of resources that may be used to implement this strategy The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 17-2: Implementation guidance – waste management

	Action	Consideration	Responsibility	Complete
Initial Actions	Contact WSP (Primary or Secondary Contact Person) and activate Waste Project Manager.	Refer to Incident Response Contacts Directory (SO-00-ZF-00025.020) for contact details.	Logistics Team Leader	❑
	Based on operational modelling and applicable response strategies communicate the type and quantity of empty liquid and solid waste receptacles required to support planned operations.	It is better to overestimate volumes and scale back resources then to underestimate waste volumes.	Logistics Team Leader Planning Team Leader	❑
	Using most recent monitor and evaluate data and any existing and future response activities, determine most suitable locations for waste receptacles to be positioned and for temporary storage locations to be established.	Consideration would be given to positioning receptacles and locating temporary storage sites to ensure secondary contamination of sensitive receptors is avoided or minimised. The approval of temporary storage sites would be given through Department of Water and Environmental Regulation (DWER).	Logistics Team Leader Planning Team Leader Environmental Team Leader	❑
	For each receival location indicate the anticipated: + material types + material generation rates + material generation quantities + commencement date/time + anticipated clean-up duration + receptacle types required + logistical support requirements + any approvals required from Ports, Local Governments, Landowners, State Government Agencies (Refer to Oil Pollution Waste Management Plan (QE-91-IF-10053)).	Consider facilities for waste segregation at source.	Logistics Team Leader Planning Team Leader	❑

	Action	Consideration	Responsibility	Complete
	Once the above information is obtained, ensure all necessary waste management information is included in the IAP.	Waste management should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan.	Logistics Team Leader (or delegate) Planning Team Leader Deputy Waste Management Coordinator (DoT IMT) WSP Location Responsible Person or Operations Supervisor	❑
	Mobilise waste management resources and services to agreed priority locations.		WSP Location Responsible Person or Operations Supervisor Logistics Team Leader (or delegate) Deputy Waste Management Coordinator (DoT IMT)	❑
Ongoing Actions	Provide ongoing point of contact between IMT and WSP.	If DoT is the Control Agency, the Facilities Support Officer shall be the point of contact between DoT and the WSP.	Deputy Waste Management Coordinator (DoT IMT) Logistics Team Leader	❑
	Ensure all waste handling, transport and disposal practices comply with legislative requirements.	Alert Logistics Team Leader (or delegate)/Deputy Logistics Officer (if DoT is the Control Agency) if any non-compliance is anticipated or detected. Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan.	WSP Location Responsible Person or Operations Supervisor	❑

Action		Consideration	Responsibility	Complete
	Ensure records are maintained for all waste management activities, including but not limited to: + waste movements (including types of receptacles, receival points, temporary storage points, final disposal locations) + volumes generated at each site (including total volume and generation rates) + types of waste generated at each site + approvals obtained (as required).		WSP Location Responsible Person or Operations Supervisor	❑

17.3 Waste approvals

Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan. In addition, regulatory approval may be required for the temporary storage, transport, disposal and treatment of waste, through DWER. DWER administers the *Environmental Protection Act 1986* (WA) and is the relevant Regulatory Authority for waste management approvals. If required, DoT may establish an Operational Area Support Group, as defined in the State Hazard: SHP-MEE, to request support from relevant WA Government Agencies, including DWER, during a State waters spill response. The Santos Oil Pollution Waste Management Plan (QE-91-IF-10053) provides detail on the regulatory requirements for each port/location likely to be used for waste management during any spill response operation associated with Santos' activities.

17.4 Waste service provider capability

Detailed guidance on Santos' WSP responsibilities for spill response waste management is provided in the Santos Oil Pollution Waste Management Plan (QE-91-IF-10053).

Key responsibilities of the WSP include:

+ Maintain emergency response standby preparedness arrangements, including:
  - Have access to personnel, equipment and vehicles required for a first strike and ongoing response commensurate to Santos worse case spill and waste requirements.
  - Provide primary and secondary contact details for activation of spill response waste management services.
  - Have suitably trained personnel for completing critical tasks in spill response waste management.
  - Participate in exercises undertaken by Santos.
+ Maintain ability to assist in the Control Agency's IAP and Waste Management Sub-plan process as required.
+ Mobilise resources to waste collection points identified by the Control Agency.
+ Ensure waste handling, transport and disposal practices meet legislative requirements.
+ Keep auditable records of waste streams from collection points to final disposal points.
+ Provide regular progress reporting to the Control Agency IMT and a final report relating to quantities and destinations of collected waste.
+ Provide a project manager responsible for the rollout of spill response resources to meet spill response waste management objectives.
+ Provide location-specific Operations Supervisor/s to handle on-site operational aspects (management of personnel and equipment, reporting, liaison with relevant field-based spill responders).

17.5 Waste management resources

Santos has access to capacity to deliver storage receptacles, remove, transport and dispose of all waste material from oil spill response activities to predetermined disposal points.

Table 17-3 provides waste service provider capability for waste removal and storage, which is in excess of the waste management requirements for spill response activities associated with this OPEP. Waste removal available in 48 hours is approximately 2672.5 m^3 scaling up to approximately 7, 770 m^3 per week by the first month, exceeding the accumulated volumes loading on shorelines for the period off the release (the combined capability off approximately 124,320 m^3 over the period release exceeds the maximum accumulation over 16 weeks of 11946 m^3). The storage and transportation capacity of liquid waste from containment and recovery in **Table 17-3** exceeds the volume available for containment and recovery operations **Section 11.**

Table 17-3: North West Alliance vehicle and equipment availability

Plant and Equipment	No.	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m^3)	North West Alliance mobilisation schedule to meet estimated capacity			
						No. Sourced locally	No. Sourced State-wide and Nationally		
Waste removal						**48 hours**	**1 week**	**2 weeks**	**1 month**
Skip Lift Truck	12	Lift up to 15 Tonnes	Servicing of skip bins	7	1260	4	3	3	2
Front Lift Trucks	10	28 m^3 Body	Servicing of front lift bins	7	1960	4	3	2	1
Side Loading Truck	10	18 m^3 Body	Servicing of MGBs	7	1260	1	2	4	3
Hook Lift Truck	5	70 Tonne rated	Servicing of hook lift bins	7	2450	3	2	2	N/A
Flat Bed Truck	16	15 pallet spaces	Servicing of bins	7	840	3	6	4	N/A
Vacuum container Trucks	12	8 m^3	Transporting liquid oil from containment and recovery	7	672	3	6	3	N/A
Liquid container Truck	24	15 m^3	Transporting liquid oil from containment and recovery	7	2520	12	6	6	N/A
Waste storage						**48 hours**	**1 week**	**2 weeks**	**1 month**
MGBs	500	240 litres	Mobile bins	2	240	200	300	N/A	N/A
Offshore 8 pack Lifting Cradle (MGB's)	2	16 x 240 litre MGBs	Able to remove 16 x 240 L MGBs simultaneously	continuous		0	2	N/A	N/A

Plant and Equipment	No.	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m^3)	North West Alliance mobilisation schedule to meet estimated capacity			
						No. Sourced locally	No. Sourced State-wide and Nationally		
Waste storage						**48 hours**	**1 week**	**2 weeks**	**1 month**
Lidded Bins	6	1,100 litres	Contain various waste streams	2	13	6	n/a	n/a	n/a
Front Lift Bins	50	3 m^3	Various waste streams	2	300	20	30	n/a	n/a
Front Lift Bins	25	4.5 m^3	Various waste streams	2	225	10	15	N/A	N/A
Offshore Rated Front Load Bins	100	3 m^3	Various waste streams	2	600	40	60	N/A	N/A
Offshore Rated Bins	45	7 m^3	Various waste streams	2	630	20	25	N/A	N/A
Marrell Skip Bins	60	6 to 9 m^3	Various waste streams	2	960	20	40	N/A	N/A
Hook Lift Bins	12	15 to 30 m^3	Various waste streams	25	6900	12	N/A	N/A	N/A
Forklift	4	4 tonne Forklift	All areas	continuous	N/A	4	N/A	N/A	N/A
Liquid Waste IBC's	500	1 m^3	Liquid waste used for offshore containment and recovery.	2	1000	50	450	N/A	N/A
Liquid Waste Barrels	500	205L	Liquid Waste Barrels for offshore containment and recovery.	2	205	50	450	N/A	N/A
inbuilt vessel storage	1	30m^3	Waste generated from containment and recovery	1	30	1	1	N/A	N/A

17.6 Environmental performance

Table 17-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 17-4: Environmental performance – waste management

Environmental Performance Outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, reusing and recycling waste where possible		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Waste Management	**Response preparedness**		
	Maintain access to waste management equipment, personnel, transport and disposal facilities	Maintain access to waste management equipment, personnel, transport and disposal facilities throughout activity	Contract with WSP for emergency response services
	Response Implementation		
	Implement Oil Pollution Waste Management Plan (QE-91-IF-10053)	WSP to appoint a Project Manager within 24 hours of activation	Incident Log
		Provision of liquid oil waste tanks for containment and recovery operations to deployment port, if requested, within 24 hours	Incident Log
		Provision of waste bins for oil and oily waste for shoreline clean-up operations to clean-up site or deployment port, if requested, within 24 hours	Incident Log
		WSP shall track all wastes from point of generation to final destination	Waste tracking records
		WSP to provide monthly waste management reports and more regular situation reports during the response until termination criteria are met	Waste reports

18 Scientific Monitoring Plan

Table 18-1: Scientific monitoring – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill or affected by spill response	
Initiation criteria	Refer to individual Receptor SMPs – **Appendix N**	
Applicable hydrocarbons	**Caley Condensate**	**MDO**
	✓	✓
Termination criteria	Refer to individual SMPs – **Appendix N**	

Oil spill scientific monitoring is the principle tool for detecting and quantifying environmental impact and recovery to sensitive receptors from an oil spill. Santos is required to have an oil spill SMP in place for Petroleum activities in State and Commonwealth waters.

Santos will activate and implement scientific monitoring in State and Commonwealth waters for hydrocarbon spills in line with its SMPs unless directed otherwise by the relevant Control Agency/s.

18.1 Objectives

The overarching objective of Santos' SMPs is to provide guidance to staff, consultants and contractors in developing monitoring a monitoring program for detecting impacts and recovery to environmentally sensitive receptors contacted by a spill.

Receptor-specific SMPs have different objectives as outlined in **Appendix N**.

18.2 Scope

Santos will implement its SMPs, as applicable, for Bedout Multi-Well Drilling activity oil spills across both State and Commonwealth waters. In the event that control of scientific monitoring in State waters is taken over by DoT under advice from the State Environmental Scientific Coordinator, Santos will follow the direction of DoT and provide all necessary resources (monitoring personnel, equipment and planning) to assist as a Supporting Agency.

18.3 Relationship to operational monitoring

Operational monitoring (**Section 10**) is monitoring undertaken to obtain information which will provide situational awareness and assist in the planning and execution of the oil spill response.

Scientific monitoring activities have different objectives to Operational Monitoring**,** which influences the monitoring methods likely to be used, the degree of scientific rigour required to meet the monitoring objectives, and the scope of studies. Scientific monitoring may occur in parallel to operational monitoring and is typically conducted over a wider study area, extending beyond the spill footprint. It is also typically conducted over a longer time period, extending beyond the spill response.

Scientific monitoring is designed to provide data for short-term and longer-term environmental effects assessment. This is typically required to be quantitative in nature and appropriate for statistical analyses. However, these two types of monitoring are related, and Operational Monitoring outputs typically inform the final design of the related SMP.

18.4 Scientific Monitoring Plans

Owing to the diverse nature of sensitive receptors that could be contacted by an oil spill and the different techniques and skillsets required to monitor impact and recovery to these receptors, there are a number of Oil Spill Scientific Monitoring Plans relevant to Bedout Multi-Well Drilling activities (**Table 18-2**). These are detailed further in **Appendix N**; each SMP has corresponding objectives, initiation/termination criteria, methodologies, baseline data sources and analysis and reporting requirements, noting that in a response controlled by DoT methodology, termination criteria and analysis/reporting requirements may differ.

Table 18-2: Oil spill scientific monitoring plans relevant to Bedout multi-well drilling activities

Study	Title
SMP1	Marine Water Quality
SMP2	Marine Sediment Quality
SMP3	Shorelines and Coastal Habitats – Sandy Beaches and Rocky Shores
SMP4	Shorelines and Coastal Habitats – Mangroves
SMP5	Shorelines and Coastal Habitats – Intertidal Mudflats
SMP6	Benthic Habitats
SMP7	Seabirds and Shorebirds
SMP8	Marine Mammals
SMP9	Marine Reptiles
SMP10	Seafood Quality
SMP11	Fish, Fisheries and Aquaculture
SMP12	Whale Sharks

18.5 Baseline monitoring

Baseline monitoring provides information on the condition of ecological receptors prior to, or spatially independent of (e.g., if used in control chart analyses), a spill event and is used for comparison with the post-impact scientific monitoring where required. This is particularly important for scientific monitoring where the ability to detect changes between pre-impact and post-impact conditions is necessary.

In the event of a spill to marine or coastal waters, reactive pre-impact monitoring should, where practicable, be implemented to gather additional data on the current state of the environment.

Santos periodically review the status, availability and suitability of existing baseline data sources related to key environmental sensitivities in its areas of operations. **Appendix P** provides further information on Santos baseline data reviews and outlines a baseline date assessment conducted on high priority areas for scientific monitoring in the event of a Bedout Multi-Well Drilling oil spill.

18.6 Monitoring service providers

Oil Spill Scientific Monitoring will be conducted on behalf of Santos by a contracted monitoring service providers (MSPs) and applies to the implementation of SMPs 1 to 12 (**Table 18-2**). These services are provided by Astron Environmental Services (Astron) and primary sub-contractor (BMT).

For whale sharks, scientific monitoring of whale sharks (SMP12) along the Ningaloo Coast and north Western Australian coastline will be undertaken. Santos has historically and currently supports research on the behaviour, demography and migration patterns of whale sharks at Ningaloo Reef conducted by Australian Institute of Marine Science. In the event of a spill that could impact whale sharks, Santos will leverage off this long-term research program to assess potential impacts to whale sharks at, and migrating to-and-from, Ningaloo Reef. SMP12 is regarded as complementary to SMP8 which will detect potential impacts to whale sharks from visual surveys of whale sharks wherever they may occur in relation to a spill.

As per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162), Santos' MSP provides the following scientific monitoring services to Santos:

+ 24/7 monitoring support accessed through 24 hr call out number
+ provision of a suitably trained Monitoring Coordination Team including a Monitoring Coordinator, Monitoring Operations Officer, Planning and Logistics Officer and Safety Officer
+ provision of Technical Advisers and Field Teams (staff and contractors) for first strike deployments
+ maintenance of standby monitoring equipment
+ monthly personnel capability reports
+ provision and review of Scientific Monitoring Sub-plans
+ provision and review of Standby Service Manual (EA-00-RI-10162) and associated response activation forms
+ participation in audits, workshops, drills and exercise to facilitate readiness.

Appendix P provides an overview of Santos' processes in place to provide assurance that its oil spill scientific monitoring arrangements for SMPs 1-12 are fit for purpose to meet the worst case first-strike monitoring requirements associated with the Bedout Multi-Well Drilling activities.

18.7 Activation

The SMP Activation Process is outlined in **Appendix O**. SMPs are activated as per the initiation criteria for each as outlined in **Appendix N**. The SMP Activation Form is available on the Santos Procedures Index and IMT Environment Team Leader folder.

The Santos IMT Environment Team Leader (ETL) with support from IMT Environment Team members is responsible for activating the primary MSP. The Santos Environment Team will assist the MSP Monitoring Coordination personnel and relevant Technical Advisers in defining the monitoring study design, monitoring locations and field methodologies based on Operational Monitoring information (e.g., spill modelling and aerial surveillance information), relative location of sensitive receptors to the spill and the timing of the spill with respect to seasonality of sensitive receptors.

This process will identify monitoring operational objectives and resourcing/ mobilisation requirements which the ETL will feed back to the IMT for approval. Mobilisation times for the minimum resources that are required to commence initial scientific monitoring operations are listed in **Table 18-3**.

In the event that a designated Control Agency takes command of scientific monitoring, Santos will follow the direction of the Control Agency providing planning and resourcing support through its MSPs as required.

Table 18-3: Scientific monitoring – first strike response timeline

Task	Time from activation of SMP
Santos IMT approve initial monitoring plan	<24 hours
Santos to mobilise sampling platforms to deployment location	<96 hours (72 hours from monitoring plan approval)
SMP teams and monitoring equipment mobilised to deployment locations	<96 hours (72 hours from monitoring plan approval)
Minimum Resource Requirements	
Initial resourcing requirements will be dependent upon the number of SMPs activated and the requirement for post spill baseline data to be collected. First strike personnel requirements for scientific monitoring field teams at Protection Priority areas are presented in **Appendix P**: + Suitable vessels for on-water monitoring or transfer of personnel to remotes areas/islands + Vehicle/s as required + Helicopter for aerial surveys as required + Scientific monitoring personnel for first strike teams (refer **Appendix P**) + Scientific monitoring equipment as detailed in the relevant SMP	

18.8 Environmental performance

Table 18-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 18-4: Environmental performance – scientific monitoring

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement criteria**
Scientific Monitoring	**Response preparedness**		
	Maintenance of Monitoring Service Provider contract for scientific monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity	Contract with monitoring service provider
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Conduct periodical review of existing baseline data sources across the Santos combined EMBA	Regular review of baseline data	Baseline data review report
	Water quality monitoring vessels	Maintenance of vessel specification for water quality monitoring vessels	Vessel specification
	Oil and water quality monitoring equipment	Oil and water quality monitoring located at Exmouth, Dampier and Varanus Island	Evidence of deployment to site
	Response implementation		
	Activate Scientific Monitoring Plans	Initiation criteria of SMPs will be reviewed during the preparation of the initial IAP and subsequent IAPs; and if any criteria are met, relevant SMPs will be activated	Incident Action Plan and Incident Log
		If any SMPs are activated, the subsequent activation of MSP is to follow the process outlined in Oil Spill Scientific Monitoring Standby and	Incident Log

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement criteria**
		Response Manual (EA-00-RI-10162)	
		MSP shall commence activation process within 30 mins of initial notification form being received from Santos	Monitoring Service Provider records
		Santos personnel to support MSP through the provision of operational monitoring information and relative location of sensitive receptors to the spill	Incident Log and Monitoring Service Provider records
	Mobilisation of minimum requirements for initial scientific monitoring operations	Minimum requirements mobilised in accordance with **Table 18-3**	Incident log

19 Spill Response Termination

The decision to terminate the spill response is made in consultation with the relevant Control Agency/s, Jurisdictional Authorities and other Statutory Authorities that play an advisory role (e.g., DBCA). This decision will be made with consideration of:

+ the efficacy and benefit of current response options
+ any potential for additional pollution
+ any potential for additional environmental damage caused by further clean-up efforts
+ an assessment of prevailing weather conditions that can increase risk to response teams or increase the efficacy in weathering hydrocarbon.

A NEBA will be conducted to inform the decision-making process. Termination criteria are defined within each section of contingency response activities defined within the OPEP.

Upon conclusion of the spill response activity, Santos will:

+ prepare detailed reports and collate all documents
+ report on the performance objectives of each individual spill response that was mobilised
+ undertake an inventory of consumables and prepare accounts
+ arrange for the return of equipment
+ arrange for the refurbishment of consumed equipment
+ conduct an investigation into the cause of the incident and report to relevant authorities
+ assess long-term environmental monitoring requirements.

20 Oil Pollution Emergency Plan Administration

20.1 Document review and revision

In line with regulatory requirements, this document shall be reviewed, updated and submitted to NOPSEMA every five years from date of acceptance.

The document may be reviewed and revised more frequently, if required, in accordance with the Santos Management of Change Procedure (EA-91-IQ-10001). This could include changes required in response to one or more of:

+ when major changes have occurred that affect oil spill response coordination or capabilities
+ changes to the Environment Plan that affect oil spill response coordination or capabilities (e.g., a significant increase in spill risk)
+ following routine testing of the OPEP if improvements or corrections are identified
+ after a Level 2/3 spill incident.

The extent of changes made to the OPEP and resultant requirements for regulatory resubmission will be informed by the relevant Commonwealth regulations; i.e., the OPGGS (E) Regulations.

20.2 Oil Pollution Emergency Plan custodian

The custodian of the OPEP is Santos Senior Oil Spill Response Coordinator.

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Appendix A: Hydrocarbon Characteristics and Behaviour

Marine diesel

In the marine environment diesel will behave as follows:

- Diesel will spread rapidly in the direction of the prevailing wind and waves;
- In calm conditions evaporation is the dominant process contributing to the fate of spilled diesel from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance;
- As wind increases, and breaking waves form, entrainment of diesel below the surface increases;
- The evaporation rate of diesel will increase in warmer air and sea temperatures such as those present around the Bedout Multi-Well Drilling operational area; and
- Diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

ITOPF (2011) and Australian Maritime Oil Spill Centre-AMOSC (2011) categorises diesel as a light group II hydrocarbon. In the marine environment, a 5% residual of the total quantity of diesel spilt will remain after the volatilisation and solubilisation processes associated with weathering.

For full details on the properties of marine diesel, refer to Section 7.4 of the Bedout Multi-Well Drilling EP (SO-00-BI-20003).

Table A1: Characteristics of diesel

Hydrocarbon	Initial density (kg/m^3)	Viscosity (cP) @ 20°C	Component	Volatiles (%)	Semi-volatiles (%)	Low volatility (%)	Residual (%)
			Boiling Points (°C)	<180	180–265	265–380	>380
Diesel	836.8	4.0	% of total	6	34.6	54.4	<5

Source: APASA (2013a)

Hydraulic oils

These are medium oils of light to moderate viscosity and behave similarly to marine diesel when spilt to the marine environment. They have a relatively rapid spreading rate and dissipate quickly in ocean conditions. Similar to diesel, hydraulic oil residue will have a tendency to sit on the surface during calm conditions and will entrain during variable winds between 4 to 19 knots; returning to the surface when conditions become calm. After several days up to 40% could be expected to evaporate and 15% decay (APASA, 2013a).

Lubricating fluid

Lubricating oils vary widely but in general are comprised primarily of long-carbon chain, persistent, hydrocarbons (APASA, 2013b). These are reasonably viscous and so the spreading rate of a slick of these oils would be slow. These will not readily move into the water column, therefore are likely to remain on the water's surface during calm to windy conditions. In the marine environment, approximately 90% residual of the total quantity of lubricating oil spilt is likely to remain after weathering (i.e., < 6% due to evaporation and < 8% due decay after several days). Lubricating oils also readily combine with seawater to form a water-in-oil emulsion, taking up as much as 70% by volume as water (APASA, 2013b).

Oily water

Oily water can be mixture of any hydrocarbon used or stored on the vessel mixed with stormwater, ocean water, or process water. The concentrations of oil in the water are usually quite low; thereby the volumes of hydrocarbons released in a spill event are quite low and tend to dissipate quickly.

Caley Condensate

A summary of Caley Condensate properties is provided in **Table A2**.

Table A2: Summary of Caley Condensate properties

Hydrocarbon	Specific Gravity	Viscosity (cSt) @ 20° C	Component	Volatiles (%)	Semi-volatiles (%)	Low volatility (%)	Residual (%)
			Boiling Points (°C)	<175	175-236.5	236.5-381.5	>381.5
Caley Condensate	0.7737	1.878	% of total	46.6	13.7	24.6	15.1

Source: Intertek (2020)

Further hydrocarbon characteristics for Caley Condensate include:

- Asphaltene content (% mass) = <0.5 resulting in low tendency for the hydrocarbons to take up water to form water in oil emulsions
- Wax content (% mass) = 9.2%
- Pour Point (°C) = <-15
- Condensate to Gas ratio = 570.4/STB/MMscf

Dispersant Efficacy

LAVRANS

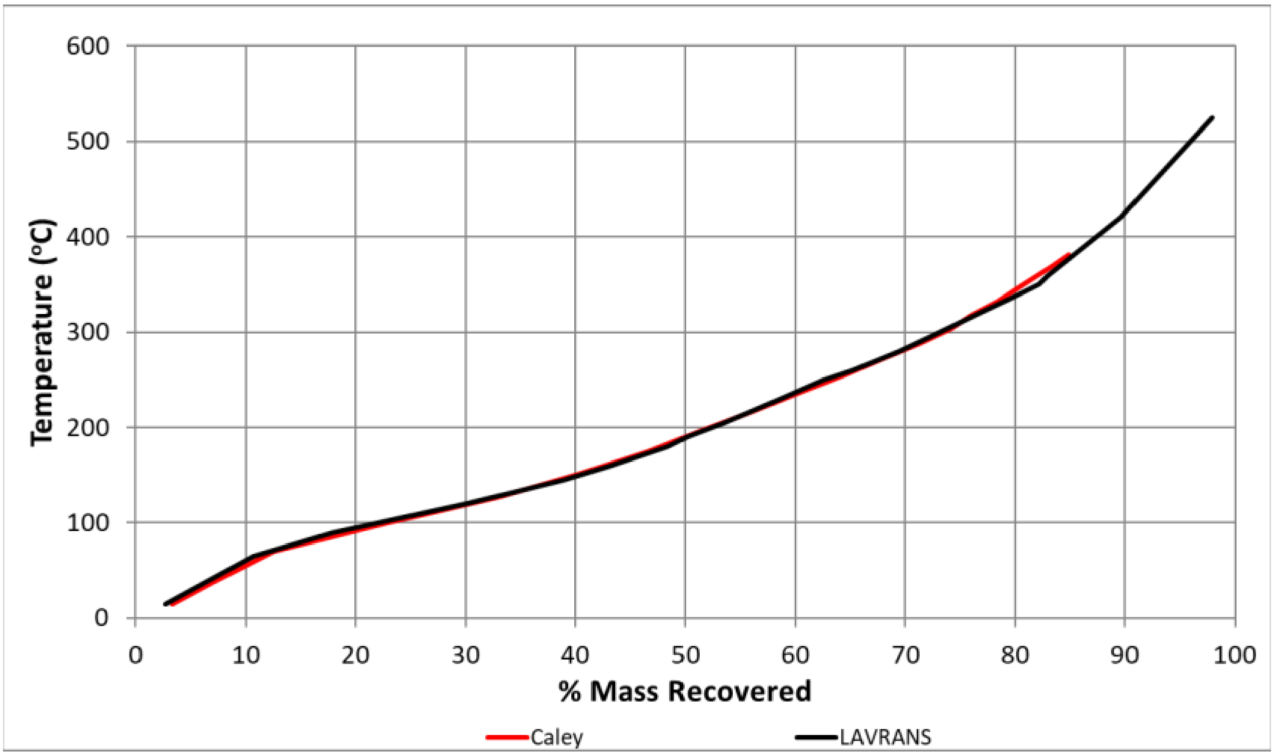
LAVRANS was used as an analogue for Caley Condensate during spill modelling. A summary of LAVRANS properties is provided in **Table A3**.

Table A3: Summary of LAVRANS properties

Parameter	LAVRANS
API	47.8
Specific Gravity	0.789
Wax Content (%)	6
Pour Point (°C)	-6
Asphaltene (%)	0.01
Viscosity (cSt)	2 (@20°C)

A comparison of the distillation curves of LAVRANS and Caley is presented in presented in **Figure A1**. The distillation curve is derived from laboratory tests to determine the percentage of hydrocarbon evaporated when heated to various temperatures. Lighter oil components evaporate under lower temperatures, whereas heavier components have a greater tendency to remain in liquid state, requiring higher temperatures to evaporate. This is analogous to oil weathering in the marine environment, whereby lighter components have a higher tendency to evaporate, dissolve or decay, and heavier components tend to persist as liquid hydrocarbon for extended durations. The distillation curve provides a reasonable prediction of the relative proportions of hydrocarbon components that will have rapid rates of weathering and the relative proportions that will persist. The comparison of the distillation curves for LANVRANS and Caley Condensate match very well, suggesting the hydrocarbons would have similar weathering behaviour.

Figure A1: Comparison of LAVRANS and Caley Condensate distillation curves (GHD, 2021)



Appendix B: Oil Spill Response ALARP Framework & Assessment

ALARP Assessment Framework

1. Rationale

As part regulatory approval requirements for petroleum activities, the Environment Plan (EP) and/or Oil Pollution Emergency Plan (OPEP) must demonstrate that through the implementation of all reasonable control measures, environmental risks have been reduced to a level that is As Low As Reasonably Practicable (ALARP).

With respect to hydrocarbon spill risk and response planning, this includes an assessment to demonstrate that the oil spill response control measures are reducing risk to a level that is ALARP.

This ALARP Assessment Framework provides a process to facilitate the identification of all existing and potential spill response control measures, the selection or rejection of which are supported by reasoned arguments.

2. Guidance Documents

Guidance documents used in the preparation of this framework include:

+ Oil Spill Risk Assessment and Response Planning Procedure QE-91-II-20003;
+ NOPSEMA Guidance Note ALARP N-04300-GN0166 Revision 6 June 2015;
+ NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020;
+ NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721 Revision 6 – November 2019;
+ NOPSEMA Guidance Note Risk Assessment GN0165 Revision 5 May 2017; and
+ NOPSEMA Oil Pollution Risk Management GN1488 Rev 2 February 2018

3. Overview

The ALARP Assessment Framework uses activity specific information to systematically assess existing and potential control measures and ensure that all practicable control measures are identified and documented.

When selecting controls to reduce risk it is good practice to apply a preferential order; elimination, substitution, prevention, reduction and mitigation. In the context of this ALARP Assessment Framework for oil spill response, all control measures are response strategies to reduce the impacts of an unplanned event that has already occurred. All source control response measures may be classed as ‘reduction’ in the hierarchy of controls with all other response measures classed as ‘mitigation’.

The ALARP Assessment Framework is shown in **Figure B1**.

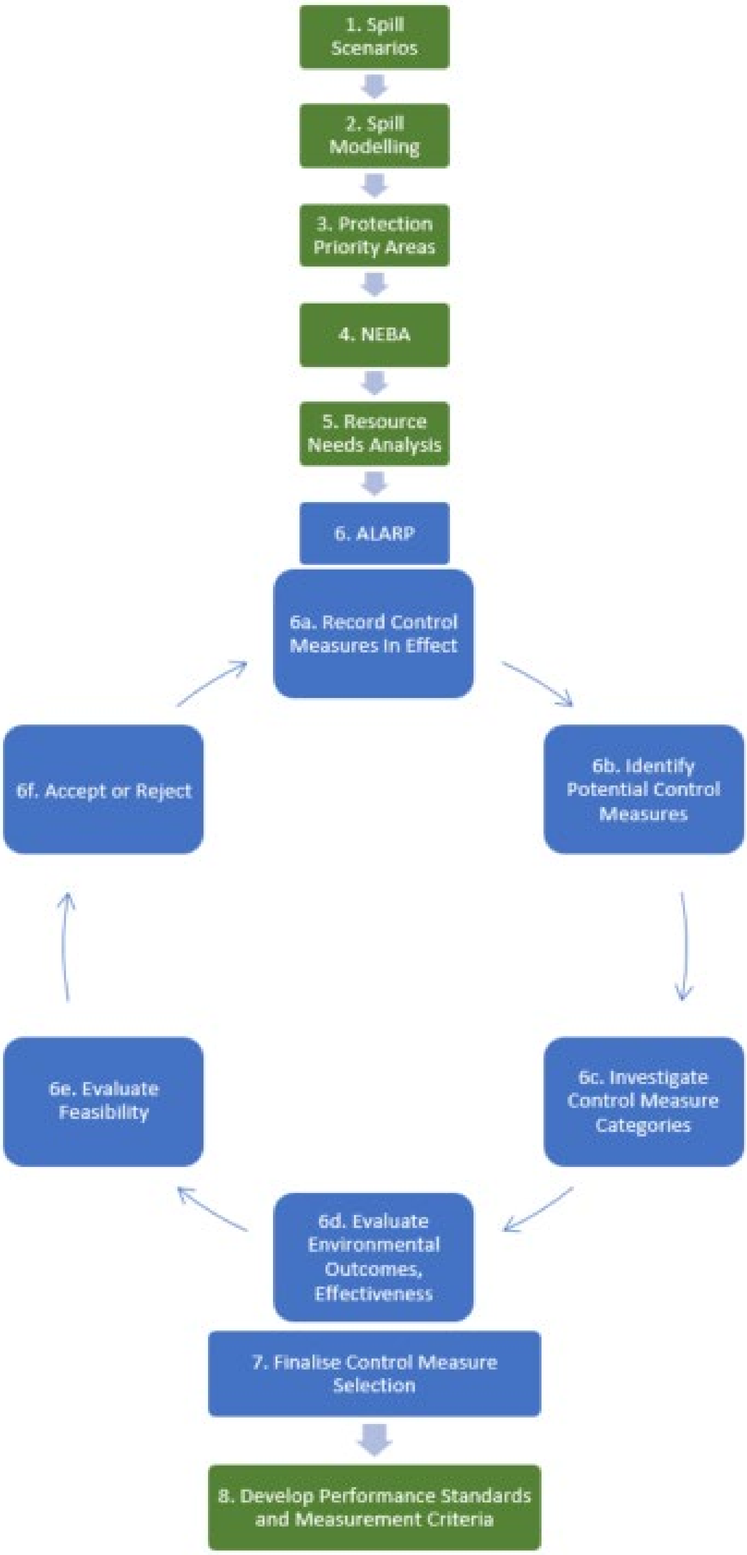


Figure B1: ALARP Assessment Framework

In **Figure B1**, Steps 1 to 5 (in GREEN) denote input information into the ALARP Assessment Framework. This information comprises:

1. Spill Scenarios: this step will involve assessing all possible spill scenarios from the activity and identifying the worst-case credible scenarios as a basis for pollution response planning.
2. Spill Modelling: a quantitative spill modelling assessment is conducted for the worst-case credible scenarios identified in Step 1.

3. Protection Priority Areas: The environment that may be affected (EMBA) is the largest area within which impacts from hydrocarbon spills associated with the activity could extend. The EMBA is predicted using spill modelling results from Step 2. Protection Priority Areas are locations of high ecological value within the EMBA that would be targeted in response. Selection of Protection Priority Areas is detailed in the Oil Spill Risk Assessment and Response Planning Procedure QE-91-II-20003
4. NEBA: Net Environmental Benefit Analysis (NEBA) is used to select the most effective response strategies to protect the Protection Priority Areas identified in Step 3.
5. Resource Needs Analysis: For the response strategies identified through NEBA, the worst-case resource, timing, and location requirements are determined, using quantitative spill modelling information where applicable. An Implementation Guidance is then developed to detail what arrangements and actions are required to be initiated by the Incident Management Team (IMT) to meet the incident requirements up to a worst-case incident.

Through the development of the Implementation Guidance, it may be possible to identify resource, timing and location requirements that could be improved. These areas of improvement should be noted in the ALARP so that additional, alternative or improved control measures can be considered in this context.

A detailed ALARP Assessment Framework for the evaluation of control measures is shown in Figure 1, Step 6 (in BLUE). Criteria and definitions used to evaluate control measures are shorn in Table 1.

- 6a) Record Control Measures In Effect: the spill response control measures currently in place for Santos Offshore are listed here. The environmental outcomes and effectiveness of the in-effect control measures are noted, using the Resource Needs Analysis to assess whether there are any areas of improvement. Environmental outcomes include potential harmful effects of control measures.
- 6b) Identify Potential Additional Control Measures: potential control measures are identified, with a focus on any control measures that address areas of improvement identified in Step 6a.
- 6c) Investigate Control Measure Categories: in-effect and potential control measures from Steps 6a and 6b are classified as either additional, alternative or improved, and as either people, system, equipment or procedures. This step serves as a prompt to ensure that potential control measures from all categories are explored.
- 6d) Evaluate Environmental Outcomes, Effectiveness: the environmental outcomes and effectiveness are assessed for all control measures identified and described through Steps 6a, b and c.
- 6e) Evaluate Feasibility: time, cost and effort required for implementation are assessed for all control measures identified and described through Steps 6a, b and c.
- 6f) Accept or Reject: the potential control measure will be accepted or rejected on the basis of environmental outcomes and effectiveness described in Step 6d and whether cost is grossly disproportionate, as described in Step 6e.

When evaluating potential control measures, implementation plans of in-effect control measures are carefully considered to ensure that any accepted control measures will equal or improve Santos capacity to meet resource needs. Potential control measures are also considered within the context of current Santos response arrangements to determine if synergies or resource conflicts might occur.

As control measures are evaluated for selection or rejection, they can be compared with industry good practise to ensure that all practicable control measures were implemented. Where unique circumstances exist and further analysis is required, a different evaluation technique may be used, such as technical analysis, detailed cost benefit analysis or combination of approaches.

New information on risks, impacts and response strategies obtained through analysis of operations, exercises and scheduled documentation reviews can be incorporated into the ALARP Assessment Framework cycle in a process of continual improvement.

In Figure B1, Steps 7 and 8 show the conclusion of the ALARP Assessment Framework:

7. Finalised Control Measure Selection: outputs from the ALARP Assessment shown in Step 6 comprise finalised control measures (in BLUE).
8. Develop Performance Standards and Measurement Criteria: for each control measure finalised in Step 7, performance standards and measurement criteria are then developed and documented in the OPEP (in GREEN).

Performance standards for all accepted control measures should be written to enable the operator to measure, monitor and test effectiveness. Only the key aspects of any given control will require performance standards and these may include the various measures of effectiveness; functionality, availability, reliability, survivability, dependency and compatibility. Parameters set in the performance standard should be ‘SMART’; specific, measurable, appropriate, realistic and timely.

Corrective action based on deviations or trends in performance should be taken by amending either the performance standard or the control measure, as appropriate.

4. Criteria and Definitions

Standardised criteria and definitions are used to bring consistency to the ALARP assessment across diverse activities and response strategies. Criteria and definitions are shown in **Table B1**.

Table B1: Criteria and Definitions of ALARP Assessment Framework

Column	Description
Strategy	Response Strategy
Control Measure	Aspect of Response Strategy being evaluated Description of the control measure that is In Effect or description of the potential control measure
In Effect, Alternative, Additional, Improved	In Effect control measures are already in place. Alternative control measures are evaluated as replacements for the control already in effect. Additional control measures are evaluated in terms of their ability to reduce an impact or risk when added to the existing suite of control measures. Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures. Adapted from NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721 Revision 6 – November 2019
Control Measure Category	A range of different types of controls generally provide effective protection as they provide independence and multiple layers of protection. The OPGGS(S) Regulations refer to technical and 'other' controls where technical control measures involve hardware like shutdown valves and alarms. 'Other' control measures include administrative and procedural control measures such as inductions, a drug and alcohol policy or an inspection regime. Industry practice has further developed this concept of a range of different types of controls based on a POiSTED framework to assess organisational capability: People – personnel System – organisation, information/communications, support facilities, training/ competency Equipment – equipment Procedures – doctrine Santos aims to implement a range of different types of controls where possible.
Environmental Outcomes	Assessment of environmental benefits, particularly those over and above those environmental benefits documented in the Control Measure that is in effect. Environmental impacts of the Control Measure are also considered here.

<table>
<tr><td>Effectiveness</td><td>The effectiveness of a Control Measure in reducing the risk to ALARP is evaluated using the following six criteria.
<u>Functionality</u>
The functional performance of a control measure is what it is required to do. How does the control perform in order to achieve the required risk reduction?
<u>Availability</u>
Probability that the control measure will be available when required and has not failed or is undergoing a maintenance or repair.
<u>Reliability</u>
The reliability of a control measure is the probability that at any point in time it will operate correctly for a further specified length of time. Reliability is all to do with the probability that the system will function correctly and is usually measured by the mean time between failure.
<u>Survivability</u>
Whether or not a control measure is able to survive a potentially damaging event such as fire or explosion is relevant for all control measures that are required to function after an incident has occurred.
To achieve their purpose, oil spill response control measures should have high survivability. However, some control measures, such as those involving equipment deployment from an FPSO would have low survivability in an incident that involves an FPSO explosion or fire.
<u>Dependency</u>
The dependency of the control measure is its degree of reliance on other systems in order for it to be able to perform its intended function. If several control measures can be disabled by one failure mechanism (common mode failure), or the failure of one control measure is likely to cause the failure of others, then the control measures are not independent and it may not be appropriate to count such measures as separate.
<u>Several control measures are reliant on equipment, people and vessels, hence have high dependence.</u>
<u>Compatibility</u>
Whether or not a control measure is compatible takes into account how alternative control measures may interact with other controls and the rest of the facility, if introduced. Consideration should be given to whether new control measures are compatible with the facility and any other control measures already in use.
Adapted from NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020</td></tr>
<tr><td>Feasibility</td><td>Feasibility describes the time, cost and/or effort required to implement the Control Measure.</td></tr>
<tr><td>Accept/ Reject</td><td>Outcome of assessment and key reasons for the decision</td></tr>
</table>

Bedout Multi-Well Drilling Oil Spill Response ALARP Assessment

ALARP Assessment Summary - Source Control (refer worksheet for further detail)
The Control Measures in place for relief well drilling represent industry best practice and are considered to reduce the timeframe for drilling a relief well to as low as reasonably practicable in the context of the risk of an uncontrolled well leak from an exploration well. Potential Control Measures were identified and assessed by the Santos Drilling & Completions Department representatives. The drilling of a relief well is considered to be an effective control and relief well planning conducted in the area has demonstrated that a MODU will be on site for relief well drilling by day 34 from the start of a well release. Relief well drilling can be completed within 77 days using MODUs, equipment and specialist personnel that Santos has arrangements to gain access to. Five potential additional Control Measures were identified and assessed. Two additional Control Measures were accepted as reasonably practicable. Accepted response strategies were: + Direct surface intervention via well control experts + Pre purchase of relief well drilling supplies Three Control Measures were rejected as grossly disproportionate. Rejected response strategies were: + Contract source control personnel through a provider in addition to existing arrangements + Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC + MODU on standby at activity location Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key performance requirements for relief well drilling are the maintenance tracking, access and relief well planning arrangements (during times of maintaining preparedness) and the timely mobilisation of resources (during a response). These key areas of effectiveness are reflected in the Performance Standards.
ALARP Assessment Summary - Monitor and Evaluate (refer worksheet for further detail)
Various, independent inputs from multiple service providers are used to build a detailed Common Operating Picture in the incident. Areas of improvement for monitor and evaluate activities were the availability of aerial observers and SCAT trained personnel in initial 24 hours of incident and availability of vessels for water quality monitoring. One potential Control Measure sought to make trained aerial observers available from Day 1 of a response, rather than Day 2, however an assessment of the Control Measure found that the cost was grossly disproportionate to the benefit. No potential Control Measures were identified to improve availability of SCAT trained personnel in the initial 24 hours of incident. A potential control measure to improve the availability of vessels for water quality monitoring by implementing more detailed vessel tracking parameters was evaluated and accepted. Six other potential Control Measures were also identified and assessed. Four were rejected as cost was grossly disproportionate to the reduction in risk, whilst two Control Measures around the provision of strategically located water quality monitoring kits and improved record keeping of service providers that could assist with fauna aerial observations were accepted as reasonably practicable. Eight additional potential Control Measures were identified and assessed. Three additional Control Measures were accepted as reasonably practicable. The accepted measures were: + Determine required vessel specifications and improve accuracy of Vessel Tracking System

- Purchase of First Strike Oil/Water quality monitoring kits to be positioned at Exmouth, VI and Dampier.
- Maintain a list of providers that could assist with fauna aerial observations; e.g., whale shark spotting planes

Five additional Control Measures were rejected as grossly disproportionate. Rejected response measures were:

- Purchase of oil spill modelling system and internal personnel trained to use system
- Purchase additional satellite tracking buoys
- Ensure trained aerial observers based at strategic locations such as Exmouth (North Ningaloo Coast, Muiron Islands)
- Trained monitoring specialists on site
- Ensure trained marine mammal/fauna observers based at strategic locations such as Port Hedland, Karratha and Broome

Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, focus on maintaining access to equipment and personnel through contractual arrangements with vessel providers, aircraft providers, aerial observers, UAV providers, tracking buoys, oil spill trajectory modelling providers, satellite imagery providers water quality monitoring providers and spill responders. Additional key areas for effectiveness during preparedness are following relevant procedures such as the Protected Marine Fauna Interaction and Sighting Procedure, and limiting environmental impacts from response activity through personnel and vehicle management. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence monitor and evaluate operations. These key areas of effectiveness have been represented in Performance Standards for monitor and evaluate operations.

ALARP Assessment Summary - Containment and Recovery (refer worksheet for further detail)

Santos, AMOSC and AMSA equipment is available in the northwest region and within WA (including stockpiles at Karratha, Dampier and Exmouth) which includes offshore rated boom and skimmers suitable for application in response to a potential Caley spill. Containment and recovery equipment availability is not considered a limiting factor to containment and recovery operations; the quantity of equipment available to Santos through contractual arrangements and the positioning of equipment in first strike locations is considered adequate for the scale of worst case containment and recovery operations identified in the OPEP. The timely mobilisation of suitable vessels and personnel required for containment and recovery operations are considered to be the key constraints for this strategy given the ready access of suitable equipment and potentially limited window of effectiveness of the strategy for short duration oil spills (e.g. The timely mobilisation of suitable vessels and personnel required for containment and recovery operations are considered to be the key constraints for this strategy given the ready access of suitable equipment and potentially limited window of effectiveness of the strategy for short duration oil spills (e.g., rapid vessel tank releases or rapid flowline releases). A review of Control Measures associated with personnel and vessels identified that improvement could be made with respect to the identification of suitable containment and recovery vessels (through development of a vessel specification) but no improvements could be made to the availability of personnel or vessels (above current arrangements) without the cost/effort being disproportional to the risk.

Five additional potential Control Measures were identified and assessed.

One additional Control Measure was accepted as reasonably practicable. The accepted control measure was:

+ Define containment and recovery vessel specifications and input this information to improve vessel tracking. Specifications may include crane, open transom, deck space for boom container, deck space for waste storage, separate additional vessel for towing boom.

Four additional Control Measures were rejected as grossly disproportionate. Rejected control measures were:

+ Purchase additional booms and ancillary equipment to be owned by Santos
+ Access to additional vessels by contracting vessels to remain on standby for containment and recovery
+ Train additional Santos personnel for spill response teams
+ Contract for staff from an alternative oil spill personnel provider

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to suitable vessels, equipment and personnel through contractual arrangements and the tracking of suitable vessels. During response, a key area for increasing effectiveness is the rapid mobilisation of first strike resources so that operations can be undertaken when oil concentration is at its highest. Given effectiveness of this strategy increases with oil concentration and decreases under high wind/sea state conditions, the consideration of these factors within an operational NEBA (SIMA) is considered a key control for maintaining effectiveness as well as the use of aerial surveillance to inform areas of operation of highest oil concentration. Waste storage may be a limiting factor for ongoing containment and recovery operations, so a key area for increasing effectiveness will be the application for approval for decanting wastewater from liquid oil waste storage tanks onboard vessels. These key areas of effectiveness have been represented in Performance Standards for containment and recovery operations.

ALARP Assessment Summary - Mechanical Dispersion (refer worksheet for further detail)

Mechanical dispersion is a secondary strategy that could be undertaken by vessels undertaking primary response strategies without the requirement for additional equipment, and no areas of improvement were identified. The use of mechanical dispersion in a response would be assessed as part of an operational NEBA.

No potential additional Control Measures were identified and assessed.

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures during a response are around the development of an operational NEBA to confirm suitability and environmental benefit, and the mobilisation of vessels. These key areas of effectiveness are reflected in the Performance Standards.

ALARP Assessment Summary - Subsea Dispersants (refer worksheet for further detail)

Subsea dispersant application is a secondary strategy that would be complementary to surface dispersant application but is likely to have limited effectiveness under a LOWC event. SSDI is only suitable for subsea LOWC scenarios. For this activity, the most likely type of loss of well control would be a surface discharge. Modelling indicates SSDI provides only a negligible benefit and in some instances resulted in a minor increase in shoreline loading. Accordingly, using the Subsea First Response Toolkit for debris clearance or SSDI is considered a secondary response strategy for this activity, due to:

+ no ROV-controllable devices installed subsea (surface wellhead and BOP used)
+ the high exit velocity of subsea plumes which results in small, entrained droplets that are not materially affected by the subsea application of chemical dispersants that indicates minimal environmental benefit from SSDI.

For the reasons stated above, surface dispersant application is considered a primary strategy with SSDI considered a secondary strategy that might be employed if surface dispersant application and containment and recovery were not effective in meeting their performance outcome.

Deterministic modelling scenarios to which chemical dispersants were applied predicted varying levels of effectiveness in reducing shoreline loading for each LOWC scenario. This is likely due to the volatile nature of Caley Condensate meaning that more mass of fresh oil is lost, however once the oil is weathered dispersant may be more effective.

Control measures are in place for a rapid mobilisation of the SFRT, personnel and dispersants to Exmouth, however the key limiting factor for deployment is suitable SFRT capable vessels which may take considerably longer to mobilise (7-10 days). A Control Measure involving the positioning of SFRT vessels on standby at a regional port in order to reduce deployment time was assessed but was found to be disproportionate in terms of costs to the reduction in risk gained. Dispersant volumes available within WA, Australia and internationally (including if necessary, under manufacturing arrangements) and the mobilisation of these stocks exceed worse case requirements, hence dispersant is not a limiting factor to the operation.

Five additional potential Control Measures were identified and assessed.
One additional Control Measures were accepted as reasonably practicable:

+ Develop and maintain dispersant supply and logistics plan to ensure worst case LOWC SSDI requirements can be met

Four additional Control Measures were rejected as grossly disproportionate. Rejected control measures were:

+ Purchase of Santos SFRT to be located at Exmouth of Dampier
+ Relocate AMOSC SFRT to Dampier
+ Enable improved vessel access by contracting a suitable, dedicated vessel on standby
+ Access to additional dispersant stockpiles owned by Santos

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around the maintenance of contracts for the SFRT equipment, dispersants and deployment personnel and the tracking of suitable SFRT vessels. In the event of a response, the key areas for ensuring effectiveness are the mobilisation of requirements to commence subsea dispersant operations, the subsea monitoring of dispersant efficacy by ROV and the consideration of this information together with other operational monitoring information within an operational NEBA for the activity. These key areas of effectiveness are reflected in the performance standards.

ALARP Assessment Summary - Surface Dispersants (refer worksheet for further detail)

Vessel based dispersant spray systems are available from WA, AMOSC and AMSA in the region (including stockpiles at Exmouth and Dampier) and within WA. These spray systems are not considered a limiting factor to surface dispersant operations; the quantity of equipment available to WA through contractual arrangements and the positioning of equipment in first strike locations is considered adequate for the scale of worst case surface dispersant operations identified in the OPEP. The timely mobilisation of suitable vessels and personnel required for surface dispersant operations are considered to be the key constraints for this strategy. A review of control measures associated with personnel and vessels identified that improvement could be made with respect to the identification of suitable surface dispersant vessels (through development of a vessel specification) but no improvements could be made to the availability of personnel without the cost/effort being disproportional to the risk. Aerial based dispersant application is available to WA through national and international resources via contractual arrangements. Mobilisation times for these resources are considered to be in line with industry best practice. No potential Control Measures were identified that could improve mobilisation times for aerial dispersant application. Dispersant volumes available within WA, Australia and internationally (including if necessary, under manufacturing arrangements) and the mobilisation of these stocks exceed worse case requirements, hence dispersant is not a limiting factor to the operation. Nine additional potential Control Measures were identified and assessed. Two additional Control Measure was accepted as reasonably practicable. The accepted control measure was: + Define spray vessel specifications and input this information to improve vessel tracking + Develop and maintain dispersant supply and logistics plan to ensure worst case LOWC SDA requirements can be met Seven Control Measures were rejected as grossly disproportionate. Rejected response strategies were: + Access to additional spray systems stored in Port Hedland, Broome, Karratha, Exmouth or Dampier + Access to additional spray systems with dispersant stored on vessels + Access to additional vessel (with trained personnel, equipment and dispersant onboard) by contracting a dedicated vessel to remain on standby for chemical dispersion + Faster access to response personnel via Santos employment of local personnel + Santos to contract personnel from Exmouth freight and logistics to deploy and operate vessel spray systems + Access to aircraft via additional service provider + Access to additional dispersant stockpiles owned by Santos Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures during times of preparedness, are around the maintenance of contracts for the vessel based and aerial dispersant application resources, dispersants and deployment personnel and the tracking of suitable vessels. In the event of a response, the key areas for ensuring effectiveness are the mobilisation of requirements to commence surface dispersant operations and evaluating dispersant efficacy using test sprays and operational monitoring. Information on dispersant efficacy then feeds into the development of the operational NEBA. These key areas of effectiveness are reflected in the performance standards.
ALARP Assessment Summary - Protect and Deflect (refer worksheet for further detail)
Large quantities of various types of nearshore booms and skimmers from Exmouth, Dampier and Fremantle ensures that equipment is in place to implement this response strategy within 24 hrs in a wide range of metocean conditions. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services, followed by AMOSC staff and AMOSC Core Group from Perth. These

regional and state resources ensure that equipment and personnel are not a limiting factor in this response strategy. An area of improvement is availability of shallow draft vessel. A review of Control Measures associated with vessels identified that improvement could be made by adding a provision for shallow draft boom tow vessels in existing Master Service Agreements with vessel providers.

Five additional potential Control Measures were identified and assessed.

One additional Control Measures was accepted as reasonably practicable. The accepted response strategy was:

- Provision for shallow draft boom to vessels added to Master Service Agreement

Four additional Control Measures were rejected as grossly disproportionate. Rejected control measures were:

- Santos to purchase additional shoreline and nearshore booms and ancillary equipment
- Access to additional shallow draft boom tow vessels owned by Santos
- Ensure trained personnel based at strategic locations such as Port Hedland, Broome, Karratha or Exmouth
- Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations

Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence protection and deflection operations and the preparation of an operational NEBA for each operational period that takes into account protection priorities and the ongoing effectiveness of the response strategy. These key areas of effectiveness have been represented in Performance Standards for protection and deflection operations.

ALARP Assessment Summary - Shoreline Clean-up (refer worksheet for further detail)

Regional and Fremantle stockpiles and locally available supplies provide a range of shoreline clean-up equipment can be accessed to suit most beach types / required clean-up operations. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services, followed by AMOSC staff and AMOSC Core Group from Perth. Equipment and trained personnel are not expected to be limiting factors for this response strategy. The availability of labour hire personnel for initial stages of a response was identified as an area of improvement. Control Measures that were evaluated to improve the availability of labour hire was either not feasible or the cost was grossly disproportionate to the reduction in risk. The availability of shallow draft vessels in initial stages of a response was also identified as an area or improvement. A review of control measures associated with vessels identified that improvements could be made by adding a provision for shallow draft boom tow vessels in existing Master Service Agreements with vessel providers. Waste management may be a limiting factor for ongoing shoreline clean-up operations and further information is shown in the ALARP assessment for Waste.

Nine additional potential Control Measures were identified and assessed.

One additional Control Measure were accepted as reasonably practicable. They accepted control measure was:

- Develop vessel specification for shallow draft transfer vessels for remote island clean-up
- Provision for shallow draft vessels added to Master Service Agreement

Eight Control Measures were rejected as grossly disproportionate. Rejected control measures were:

- Mechanical mobile plant equipment for clean-up pre purchased and positioned at strategic locations such as Port Hedland, Broome, Karratha or Exmouth
- Pre-purchase and storage of additional equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at strategic locations such as Port Hedland, Broome, Karratha or Exmouth
- Access to additional shallow draft vessels owned by Santos to transport personnel to key sensitive areas on offshore islands such as Bedout Island, Ashmore Reef, Imperieuse Reef MP, Clerke Reef MP and Muiron Islands
- Access to additional team leaders that are locally based at strategic locations (Port Hedland, Broome, Karratha or Exmouth) or can be mobilised within short time frames
- Faster access to clean-up personnel via Perth based labour hire contractor
- Faster access to clean-up personnel via locally based labour hire companies or emergency response organisations
- Faster access to clean-up personnel via Santos employment of local personnel – Port Hedland, Broome, Karratha or Exmouth
- Review of shoreline sensitivity mapping. Review of TRPs and development of additional TRPs for all PPAs

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to suitable equipment and personnel through contractual arrangements. During response, a key area of effectiveness is the rapid mobilisation of equipment and personnel and preparation of a Shoreline Clean-up Subplan and NEBA to ensure that impacts from response activities are minimised and operations are conducted in accordance with protection priorities as confirmed by the Control Agency.

ALARP Assessment Summary - Oiled Wildlife (refer worksheet for further detail)

Oiled wildlife equipment including first strike kits and containers can be mobilised from regional locations and Perth. Further equipment is available through national or international resources to implement a timely and sustained response adequate for the scale of worst-case oiled wildlife operations identified in the OPEP. The availability of trained personnel in the initial stages of an incident is a limiting factor for this response strategy. Control Measures around the provision of trained personnel were reviewed to identify that trained Santos personnel could be based not just in the Perth Office but also at VI and DC facilities. Potential Control Measures around additional responders through pre-hiring or contracts with additional service providers were investigated but were found to be not beneficial and/or the cost was grossly disproportionate to risk reduction. An additional area of improvement is clarity for how Santos will integrate with Control Agencies OWR. It has been identified that additional planning captured in a Santos Oiled Wildlife Response Framework is a practicable control measure to ensure that resources are deployed in a coordinated approach.
Four additional potential Control Measures were identified and assessed.

Two Control Measures were accepted as reasonably practicable. The accepted control measures were:

- Development of a Santos Oiled Wildlife Response Framework which will set the corporate guidance for OWR preparedness and response and define how Santos will integrate with Control Agencies to provide a coordinated response
- Additional Santos OWR trained personnel positioned at VI and Perth

Two Control Measures were rejected as grossly disproportionate. Rejected control measures were:

- Pre-hire and/or prepositioning of staging areas and responders
- Direct contracts with service providers

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, the mobilisation of requirements for initial oiled wildlife response operations and the management of the oiled wildlife response in accordance with the WA Oiled Wildlife Response Plan are both key elements for achieving this strategy and they are represented as a Performance Standards.

ALARP Assessment Summary – Waste (refer worksheet for further detail)

The Santos contract with the waste service provider has provisions for waste management operations of the scale estimated to be required in worst case scenarios detailed in the OPEP. Further detail is captured in the Waste Management Plan - Oil Spill Response Support (QE-91-IF-10053). The waste service provider can mobilise waste receptacles to Port Hedland, Broome and Exmouth from Karratha within 12 hrs. Given the waste service provider arrangements and preplanning already undertaken, waste storage facilities, road transport and logistics are not expected to be limiting factors in the response. For these components, potential Control Measures were identified and evaluated but were found to either make no improvement in capability or cost was grossly disproportionate. An area of improvement is the availability of vessels required for waste transport at sea. One potential Control Measure to address this area of improvement was identified and assessed but cost was grossly disproportionate to risk. No other potential control measures were identified.

Three potential additional Control Measures were identified and assessed.

No Control Measure was accepted as reasonably practicable
Three Control Measures were rejected as grossly disproportionate. Rejected control measures were:

+ Maintain contracts with multiple service providers
+ Procure temporary waste storage for Santos stockpile
+ Contract additional vessels on standby for waste transport

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to waste management equipment and services through contractual arrangements. During response, a key area for increasing effectiveness is the timely mobilisation of requirements for initial response operations and defining critical management and reporting services to be provided by the waste service provider. These key areas of effectiveness are captured in the Performance Standards.

ALARP Assessment Summary - Scientific Monitoring (refer worksheet for further detail)

Oil spill scientific monitoring will be conducted on behalf of Santos by a contracted monitoring service provider as detailed in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) and the relevant Scientific Monitoring Programs. An area of improvement is the availability of vessels in the initial stages of response. To address this area of improvement, a potential Control Measure around more detailed vessel tracking was assessed and accepted. Additionally, three potential Control Measures were identified and assessed. One Control Measure, the purchase and standby of scientific monitoring resources was found to be grossly disproportionate in cost in comparison to the reduction in risk. Two potential Control Measures relating to improved record keeping for scientific monitoring consumable requirements and suppliers and the provision of water quality sampling kits to be located at strategic regional locations were both found to be reasonable and practicable, both were adopted.
Four additional potential Control Measures were identified and assessed.

Three additional Control Measure were accepted as reasonably practicable. The accepted control measures were:

+ Maintain equipment list and list of suppliers for implementation of Scientific Monitoring Plans

- Oil/water quality sample kits for scientific monitoring personnel to be positioned at Varanus Is., Exmouth and Dampier
- Determine required vessel specifications required for Scientific Monitoring implementation and improve accuracy of Vessel Tracking System

One Control Measure was rejected as grossly disproportionate. The rejected control measure was:

- Scientific monitoring personnel, plant and equipment on standby at the operational location

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements, regular reviews of monitoring service provider capability and reviews of existing baseline data. During response, a key area for effectiveness is the mobilisation of requirements to commence scientific monitoring and ensuring relevant approved manuals and plans are followed. These key areas of effectiveness are reflected in the Performance Standards.

Appendix C: Pollution Report

Department of **Transport**

BEFORE completing this form please contact the MEER duty officer on (08) 9480 9924 (24hrs). Immediate reporting will enable a rapid response.

Marine Pollution Report (POLREP)

Return completed form to:
Maritime Environmental Emergency Response
Department of Transport
Email: marine.pollution@transport.wa.gov.au and rccaus@amsa.gov.au
Phone (08) 9480 9924
Fax: 1300 905 866

INCIDENT DETAILS

Date of Incident:_________________Time of Incident *(24 hr format)*: _______________

Location name/description:

Incident Coordinates Latitude of spill ______________________________ **Longitude of spill** ____________________________________

Format of coordinates used *(select one)* ☐ *Degrees & decimal degrees* ☐ *Degrees, minutes & decimal minutes* ☐ *Degrees, minutes & seconds*

Description of Incident:

POLLUTION SOURCE

☐ Vessel ☐ Land *(Specify)* __________________________ ☐ Other *(Specify)* ______________________________ ☐ Unknown

Vessel type *(if known)* ☐ Tanker ☐ Container ☐ Bulk ☐ Cargo

☐ Fishing ☐ Defence ☐ Recreational ☐ Other *(Specify)*_____________________________

Vessel name: ___________________________________ Flag State / Callsign: _____________________ Australian vessel? ☐ Yes ☐ No

POLLUTANT

☐ **Oil** *(type)* ☐ Bilge ☐ Diesel ☐ HFO bunker ☐ Crude ☐ Unknown ☐ Other *(Specify)*____________________

☐ **Chemical** Name: ____MARPOL cat / UN Nos: ___________________

☐ **Garbage** Details/description: ____

☐ **Packaged** Details/description: ____

☐ **Sewage** Details/description: ____

☐ **Other** Details/description: ____

EXTENT

Size of spill ***(length & width in metres):*** ____

Amount of pollutant, if known ***(litres):*** ____

Has the discharge stopped? ☐ Yes ☐ No ☐ Unknown

Weather conditions at site:

☐ **Photos taken** Details: ____held by: _______________________

☐ **Video taken** Details: ____held by: _______________________

☐ **Samples taken** Description:____held by: _______________________

☐ **Items retrieved** Description:____held by: _______________________

ADDITIONAL INFORMATION

Response action undertaken? ☐ Yes ☐ No If yes, provide details below, please include any environmental impact.

Equipment used? ☐ AMSA ☐ State / NT ☐ Industry

Is assistance for an investigation required from DoT ☐ Yes ☐ No

ORIGINAL REPORT SOURCE

Name:__________ Position: __________ Phone: __________

Combat agency:__________ Statutory agency: __________

SENDER DETAILS

Name:__________ Agency: __________ Date:__________

Phone: __________ Fax: __________ Email:__________

PRIVACY STATEMENT

The Department of Transport is collecting the information on this form to enable it to carry out its role as Jurisdictional Authority as per WestPlan - Marine Oil Pollution. The Department of Transport and/or AMSA may give some or all of this information to other government bodies, non-government organisations who have responsibilities under the National Plan, and law enforcement agencies.

Once you have completed the form please check that all relevant fields have been filled with accurate data.
To post the form please click on the "POST" button opposite.

POST Reset Form

mep_polrep_0815

Appendix D: Situation Report

Marine Pollution Situation Report (SITREP)

Send completed form to:
Maritime Environmental Emergency Response
Department of Transport
PO Box 402 Fremantle , 6159
Email: marine.pollution@transport.wa.gov.au
and rccaus@amsa.gov.au
Fax: 1300 905 866

MARINE POLLUTION SITUATION REPORT (SITREP)

This is advice from the Control Agency of the current status of the incident and the response.

This form is transmitted to all relevant agencies including:

- Jurisdictional Authority
- Support Agencies

Incident Name: ____________________ **Ref. No.** ____________________

Priority ☐ Urgent ☐ Immediate ☐ Standard

Final SITREP? ☐ Yes ☐ No Next SITREP on: ____________________

Date: ____________________ **Time:** ____________________

POLREP Reference: ____________________

Incident location Latitude ____________________ Longitude ____________________

Brief description of incident and impact: ____________________

Overall weather conditions: ____________________

Summary of response actions to date: ____________________

Current Strategies:

Summary of resources available/deployed:

Expected developments:

Other Information:

SITREP Prepared By	Name:	
	Agency:	
	Role:	
	Contact	Telephone
		Fax
		Mobile
	No of Pages Attached:	

To post the form please click on the "POST" button below

POST

RESET

MEP_Sitrep_1114

Appendix E: Vessel Surveillance Observer Log

Santos

Vessel Surveillance Observer Log – Oil Spill

Survey Details			
Date	Start time:	End Time:	Observers:
Incident:			Area of Survey:
Vessel:			Master:

Weather Conditions	
Wind speed (knots):	Wind direction:
Time high water and height (LAT):	Current direction:
Time low water and height (LAT):	Current speed (nM):
Tide during observations:	Sea state:
Stage of tide during observations (incoming/falling):	Other weather observations:

Slick Details						
Slick grid parameters by lat/long:		Slick grid parameters (vessel speed)		Slick grid dimensions: N/A		
Length Axis:	Width Axis:	Length Axis: N/A		Width Axis	Length	nm
Start Latitude	Start Latitude	Time (seconds)		Time (seconds)	Width	nm
Start Longitude	Start Longitude				Length	nm
End Latitude	End Latitude	Speed (knots)		Speed (knots)	Width	nm
End Longitude	End Longitude				Grid area	km^2

Code	Colour	%age cover observed	Total grid area		Area per oil code		Factor	Oil volume	
1	Silver			km^2		km^2	40-300 L/ km^2		L
2	Iridescent (rainbow)			km^2		km^2	300-5,000 L/ km^2		L
3	Discontinuous true oil colour (Brown to black)			km^2		km^2	5,000-50,000L/ km^2		L
4	Continuous true oil colour (Brown to black)			km^2		km^2	50,000 – 200,000 L/ km^2		L
5	Brown / orange			km^2		km^2	>200,000 L/ km^2		L

Timeline of observations:

Time	Description

Appendix F: Aerial Surveillance Observer Log

Santos

Aerial Surveillance Observer Log – Oil Spill

Survey Details			
Date:	Start time:	End Time:	Observer/s:
Incident:			Area of Survey:
Aircraft type:	Call sign:	Average Altitude:	Remote sensing used:

Weather Conditions	
Wind speed (knots)	Wind direction
Cloud base (feet)	Visibility
Time high water	Current direction
Time low water	Current speed (nM)

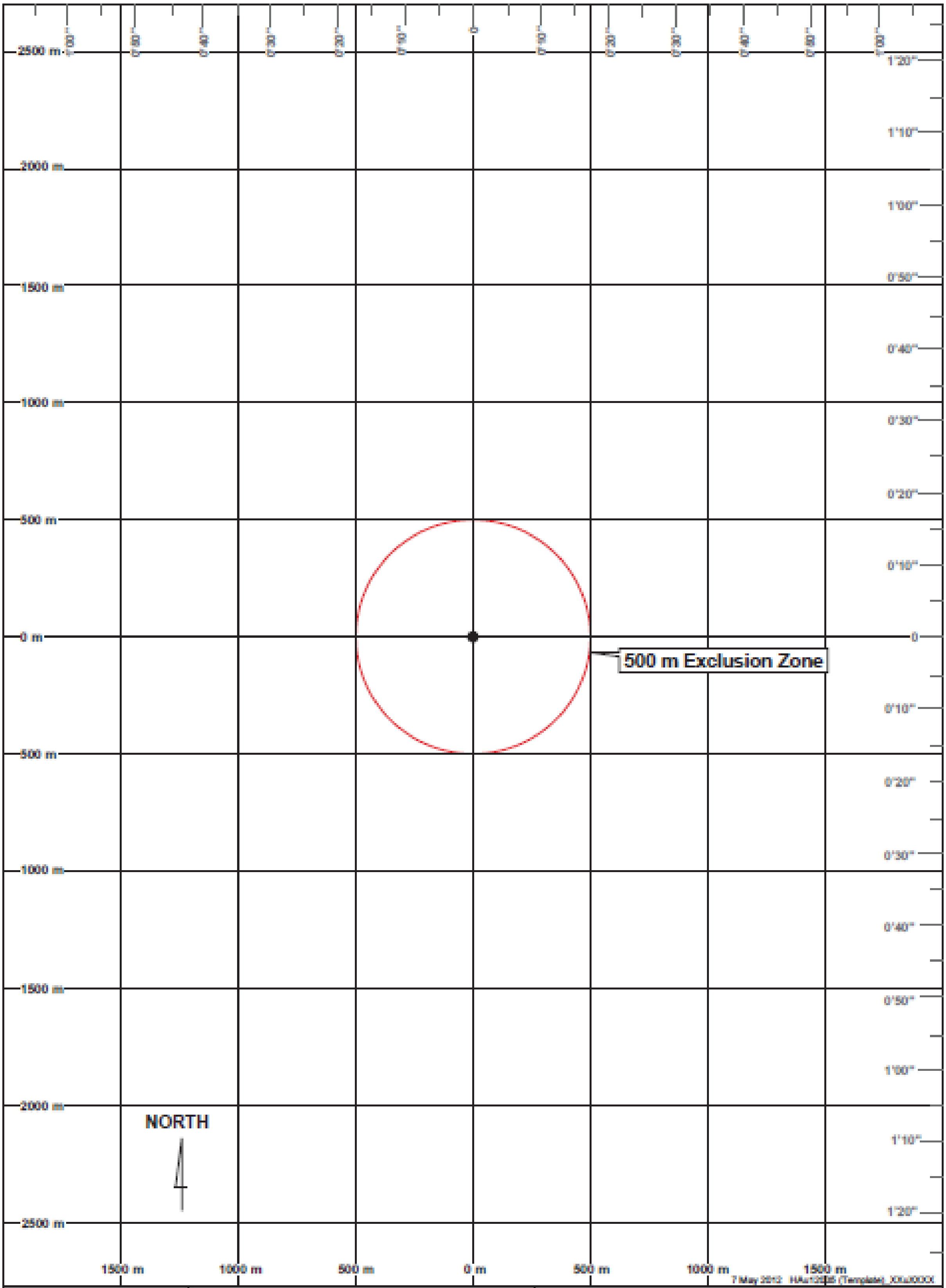
Santos

Slick Details						
Slick grid parameters (lat/long)		Slick grid parameters (air speed)		Slick grid dimensions		
Length Axis	Width Axis	Length Axis		Width Axis	Length	nm
Start Latitude	Start Latitude	Time (seconds)		Time (seconds)	Width	nm
Start Longitude	Start Longitude				Length	nm
End Latitude	End Latitude	Air Speed (knots)		Air Speed (knots)	Width	nm
End Longitude	End Longitude				Grid area	km^2

Code	**Colour**	**% cover observed**	**Total grid area**		**Area per oil code**		**Factor**	**Oil volume**	
1	Silver			km^2		km^2	40-300 L/ km^2		L
2	Iridescent (rainbow)			km^2		km^2	300-5,000 L/ km^2		L
3	Discontinuous true oil colour (Brown to black)			km^2		km^2	5,000-50,000L/ km^2		L
4	Continuous true oil colour (Brown to black)			km^2		km^2	50,000 – 200,000 L/ km^2		L
5	Brown / orange			km^2		km^2	>200,000 L/ km^2		L

Appendix G: Aerial Surveillance Surface Slick Monitoring Template

AERIAL SURVEILLANCE SURFACE SLICK MONITORING TEMPLATE



	NAME:	VESSEL / AIRCRAFT:
	DATE / HOUR:	OTHER REFERENCE:

Appendix H: Aerial Surveillance Marine Fauna Sighting Record

Santos

OIL SPILL SURVIELLANCE - MARINE FAUNA SIGHTING RECORD SHEET

Date:		**Time:**	
Latitude:		**Longitude:**	

MARINE FAUNA ID GUIDE

◯ Humpback whale

◯ Blue whale

◯ Minke whale

◯ Sperm whale

◯ Killer whale

◯ Bryde's whale

◯ Whale species unknown

◯ Bottlenose dolphin

◯ Spinner dolphin

◯ Dolphin species unknown

◯ Whale shark

◯ Dugong

◯ Hawksbill turtle

◯ Loggerhead turtle

◯ Green turtle

◯ Flatback turtle

◯ Leatherback turtle

◯ Turtle species unknown

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FAUNA DETAILS					
Category	**Type/species?** **Adult/juvenile?** **ID confidence?**	**Number**	**Date/Time**	**Photo/ video taken?** **Reference No.**	**Behaviour / Comments.** **Proximity to oil? Oiled?** **Milling? Feeding? Transiting?**
Cetaceans (Whales/ Dolphins)					
Turtles					
Birds					
Dugongs					
Sharks					
Other					

Other details for each observation location

WEATHER DETAILS

Sea State ◯ Mirror calm ◯ Small waves ◯ Slight ripples

◯ Large waves some whitecaps ◯ Large waves, many whitecaps

Visibility ◯ Excellent ◯ Good ◯ Moderate ◯ Poor ◯ Very Poor

OBSERVER DETAILS

Observer Name	Observer signature	**Observer** ◯ Inexperienced ◯ Experienced

Appendix I: Aerial Surveillance Shoreline Observation Log

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Aerial Surveillance Reconnaissance Log – Oil Spill

Survey Details							
Incident:		Date:	Start time:	End Time:	Observer/s:		
Area of Survey							
Start GPS LATITUDE: LONGITUDE:				End GPS LATITUDE: LONGITUDE:			
Aircraft type		Call sign		Average Altitude		Remote sensing used (if any)	
Weather Conditions							
Sun/Cloud/Rain/Windy			Visibility			Tide Height L/M/H	
Time high water			Time low water			Other	
Shoreline Type - Select only ONE primary (P) and ANY secondary (S) types present							
	Rocky Cliffs		Boulder and cobble beaches		Sheltered tidal flats		
	Exposed artificial structures		Riprap		Mixed sand and gravel beaches		
	Inter-tidal platforms		Exposed tidal flats		Fine-Medium sand grained beaches		
	Mangroves		Sheltered rocky shores		Other		
	Wetlands		Sheltered artificial structures				
Operational Features (tick appropriate box)							
	Direct backshore access		Alongshore access		Suitable backshore staging		
Other							

Appendix J: Shoreline Clean-up Equipment

Equipment List for an Initial deployment of a 6 person Manual Clean Up Team

On Shore Clean-up Tools		Quantity
	Disposal Bag Labelled, 140 cm x50cm x 100um	1000
	Disposal Bag large fit 205ltr drum, 100cm x 150cm x 100um	50
	Polyethylene Safety Shovel 247mm z 978mm	2
	Steel Shovel	4
	Steel Rake	2
	Landscapers Rake	2
	Barrier Tape – “Caution Spill Area”	10
	Pool scoop with extendable handle – flat solid	2
	Poly Mop Handle	2
	Safety Retractable Blade Knife	2
	Poly Rope 20m	6
	Star Pickets	24
	Star Picket driver	1
	Hand Cleaner	1
	Cable ties – general use	1000
	Wheel Barrow	2
	Galvanised Bucket	4
	Pruning secateurs	2
	Hedge Shears	1
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Respirator dust/mist/fume and valve	40
	Disposable box light nitrile gloves (100bx)	2
	Alpha Tec gloves (assort size)	24
	Ear Plugs (200bx)	1
	Safety Glasses	18
	Safety Goggles non vented	6
	Gum Boots (assort size)	18
	Rigger Gloves (assort size)	18
	Day/Night Vest	6
Storage Equipment		
	Collapsible Bund 1.6m x 1.2m	2
	Collapsible bund 4m x 2.4m	1
	Misc sizes of ground sheets/tarps	6
Absorbents		
	Absorbent Roll ‘oil and fuel only’ 40m x 9m	6
	Absorbent Pad “oil and fuel only” 45cm x 45cm	400
	Poly Mops (snags)	150
	Poly Absorbent Wipes	10
Additional Items		
	Folding Deck Chair	6
	Folding Table	1
	Shelter open side	1
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6
	Boxes, Bin and Lid Storage/transport assorted	
Optional Items		

	Inflatable Tent 9 square metres	1

Equipment list for a decontamination unit for Beach Clean Up Team

Shore Clean-up Tools		Quantity
	Inflatable Decon Tent	1
	Inflatable Tent 9 square metres – Modesty or Control tent	1
	Misc sizes of ground sheets/tarps	4
	Collapsible Bund 1.6m x 1.2m (two stages)	2
	2 stools in each bund	
	Collapsible Bund 4m x 2.4m (for used PPE and clothing into DB's)	1
	Long Handled Scrub brush	2
	Scrub Brush	2
	Simple Green 20 ltr	2
	Poly Absorbent Wipes	10
	Wet Wipe Canister	6
	Disposal Bag for Clothing, 140cm x 50cm x 100um	100
	Bath towel	6
	Liquid soap in push dispenser (citrus based)	1
	Track mat – Absorbent for Corridor/walkway	1
	Star pickets	16
	Star picket driver	1
	Barrier tape to create corridors	4
	Safety Goggles non vented (used during decon)	6
Optional Items		
	Folding Deck Chair	6
	Folding Table	1
	Shelter open side	1
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6
	Boxes, Bin and Lid Storage/transport assorted	

Equipment list for deployment of a 6-person team for flushing or recovery

		Quantity
Flushing Equipment		**Quantity**
	Diesel self prime semi trash pump, 25-35 psi, 4.8hp	1
	Perforated 2” lay flat hose, 20 mtr sections	2
	Section Hose 2”, 20m sections	5
	Hose End Strainer	1
Recovery Equipment		
	Tidal Boom (shoreline boom) 25m lengths	2 (50m)
	Tidal Boom Accessories pack	1
	Versatech Zoom Curtin Boom 300mm chamber, 450mm skirt 25m section	2 (50m)
	Towing Bridle	2
	Danforth Sand Anchor Kit, 30m lines, 15m trip lines	3
	Diesel Powered pump with hose	1
	Manta Ray skimmer	1
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Respirator dust/mist/fume and valve	40
	Disposable box light nitrile gloves (100bx)	2
	Ear Plugs (200bx)	1
	Safety Glasses	18
	Gum Boots (assort size)	18
	Hyflex Oil Restraint Gloves (assort size)	18
	Day/Night Vest	6
Storage Equipment		
	Collapsible Bund 1.6m x1.2m	1
	Misc sizes of ground sheets/tarps	6
	Collapsible Tank 5000 litres	2
Absorbents		
	Absorbent Boom ‘oil and fuel only’ 3 or 6m x 180mm	200mtrs
	Absorbent Roll ‘oil and fuel only’ 40m x 9m	10
	Absorbent Pad “oil and fuel only” 45cm x 45cm	1000
	Poly Absorbent Wipes	10
Additional Items		
	Folding Deck Chair	6
	Folding Table	1
	Shelter open side	1
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6
	Boxes, Bin and Lid Storage/transport assorted	
	Inflatable Tent 9 square metres	1

Equipment list for a 6 person team for near shore clean up

Absorbents		
	Absorbent Roll 'oil and fuel only' 40m x 9m	20
	Absorbent Pad "oil and fuel only" 45cm x 45cm	2000
	Absorbent Boom "oil and fuel only" 3or6m z 180mm	200mtrs
	Poly Mops (snags)	150
	Poly Absorbent Wipes	20
Recovery Equipment		
	Tidal Boom (shoreline boom) 25m lengths	4 (100m)
	Tidal Boom Accessories pack	2
	Versatech Zoom Curtin Boom 300mm chamber, 450mm skirt 25m section	8 (200m)
	Towing Bridle	2
	Danforth Sand Anchor Kit 15kg 30m lines, 15m trip lines	10
	Weir Skimmer 30T hr	1
	Trash Screen for above	1
	Diesel Powered pump with hose	1
	Manta Ray skimmer	1
Shore Clean-up Tools		**Quantity**
	Disposal Bag large fit 205ltr drum, 100cm x 150cm x 100um	200
	Pool scoop with extendable handle – flat solid	2
	Poly Mop Handle	2
	Poly Rope 20m	10
	Star Pickets	24
	Star Picket driver	1
	Intrinsic Safe Torch	6
	Hand Cleaner	1
	Cable ties (to add extra join to absorbent booms)	150
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Disposable box light nitrile gloves (100bx)	2
	Alpha Tec gloves (assort size)	24
	Ear Plugs (200bx)	1
	Safety Glasses – with head strap	18
	Gum Boots (worn extra large or as advised by skipper)	18
	Steel cap waders	2
	Personal Flotation Device	6
	Rigger Gloves (assort size)	18
Storage Equipment		
	Collapsible Bund 1.6m x 1.2m	2
	Collapsible bund 4m x 2.4m	1
	Collapsible Tank 5000 litres	2
	Alum box, Bin & lid Storage/transport cases	10
	Misc sizes of ground sheets/tarps	6
Optional Items		
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6

Appendix K: Shoreline Response Strategy Guidance

Shoreline Response Strategy Guidelines

Guidance on response methods for sensitive coastal habitats is provided in **Table 1**.

Guidance on applicable shoreline clean-up techniques based on shoreline substrate and degree of oiling are presented in **Figure 1** to **Figure 4**.

Table 1 Strategy Guidance for shoreline response at coastal sensitivities

Sensitive Receptors	Strategy Guidance	
Mangroves	- All efforts should be mounted to prevent any oil from moving towards this area by using booms to divert the oil away from this area. - However, if oil is expected to move into this area, multiple rows of booms, or earthen booms can be deployed at the entrance of creeks or along the mangrove fringe to prevent/minimise oiling. - Sorbents can be used to wipe heavy oil coating from roots in areas of firm substrate. Close supervision of clean-up is required. - Where thick oil accumulations are not being naturally removed, low-pressure flushing may be attempted at the outer fringe – sorbent pads and sorbent sweeps can be used to recover the sheen. - No attempt should be made to clean interior mangroves, except where access to the oil is possible from terrestrial areas. - Oily debris should be removed; it is extremely important to prevent disturbance of the substrate by foot traffic; thus most activities should be conducted from boats. - Live vegetation should not be cut or otherwise removed.	-
Seabirds, shorebirds and migratory waders	- All efforts should focus on deflecting oil away from this area or dispersing the oil offshore or using booms offshore to divert the oil away from this area. - If oil is expected to move into the coastal colonies and roosting areas, multiple booms can be deployed along the reserve to prevent/minimise oiling.	-

Sensitive Receptors	Strategy Guidance	
Turtle nesting beaches during or near nesting season	- All efforts should be mounted to prevent any oil from moving towards this area by using booms to divert the oil away from this area. - However, if oil is expected to move into this area, booms can be deployed along the reserve to prevent/minimise oiling.	-
Fringing coral reef communities (Note: submerged coral reef communities are less susceptible to oiling)	- Little can be done to protect coral reef beds along exposed sections of shoreline. - Floating oil would potentially coat living reef communities, which are usually slightly elevated and are consequently exposed at low tide. - Natural recovery with a close monitoring program is the preferred clean-up technique. Clean-up of the reef itself by natural processes is expected to be rapid. - As much as practicable, oil should be removed from adjacent intertidal areas to prevent chronic exposure of the corals to oil leaching from these sites. - Use of sorbents should be limited to those that can be contained and recovered.	-
Macroalgal and seagrass beds	- All efforts should focus on deflecting oil away from this area, dispersing the oil offshore, or using booms to divert the oil away from this area. - Extreme care should be taken not to disturb the sediments during clean-up operations in the vicinity of macroalgal and seagrass beds, which could result in total loss of the macroalgal and seagrass beds. - Removal of oiled parts of the macroalgal and seagrass beds should only be considered when it can be demonstrated that special species are at significant risk of injury from contact or grazing on the macroalgal and seagrass beds. - Otherwise, the best strategy for oiled seaweed is to allow natural recovery.	-

Sensitive Receptors	Strategy Guidance	
Rocky coast	- Where practicable, booms can be deployed parallel to the rocky coasts to prevent/minimise oiling. - Flushing rocky shoreline is considered the most effective method of cleaning. Care must be taken to assess the fate and transport of the flushed oil and sorbent snares can be used to recover if deemed necessary to reduce impacts to ALARP. - For small areas of contamination, rocky structure can be manually wiped with sorbent pads or scraped to remove oil.	-

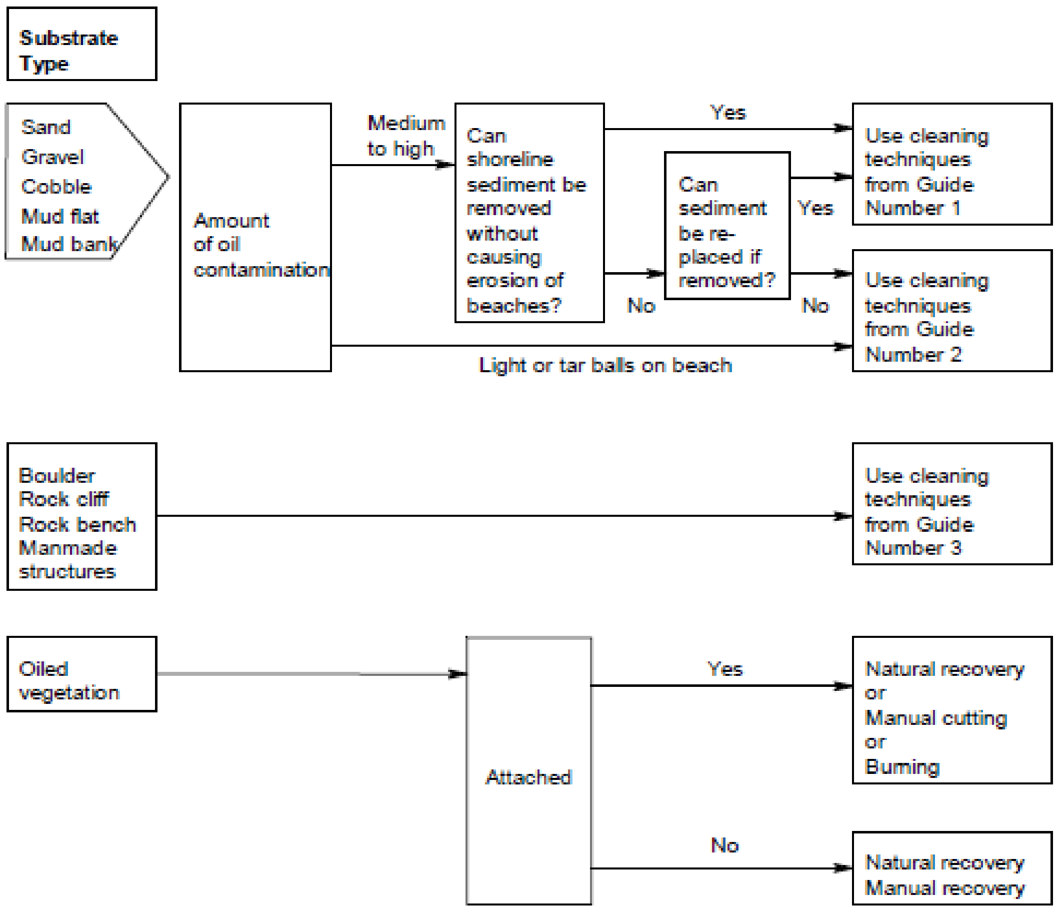

Figure 1: Shoreline Clean-up Master Decision Guide

Shoreline Cleanup Decision Guide Number 1

TRAFFICABILITY		SUBSTRATE TYPE	DEPTH OF OIL PENETRATION	CLEANUP TECHNIQUES IN ORDER OF PREFERENCE	ACCESS
1. Can rubber-tyred equipment operate on beach?	Yes	Sand, Gravel, Mud	Less than 3cm	Motor Grader and Elevated Scraper Combination. Elevated Scraper. Motor-Grader and Front-End Loader (Rubber-Tyred) Combination.	**3.** Is there access to beach for heavy equipment or can access be constructed?
			Greater than 3cm	Elevated Scraper. Front-End Loader (Rubber-Tyred). Bulldozer and Front-End Loader (Rubber-Tyred) Combination.	
		Cobble	Less than 30cm	Front-End Loader (Rubber-Tyred).	
			Greater than 30cm	Bulldozer and Front-End Loader (Rubber-Tyred) Combination. Front-End Loader (Rubber-Tyred).	
		Mud Bank	Not applicable	Backhoe. Front-End Loader (Rubber-Tyred).	

No

2. Can tracked equipment operate on beach?	Yes	Sand, Gravel, Mud, Cobble	Less than 30cm	Front-End Loader (Tracked). Bulldozer and Front-End Loader (Tracked) Combination.
			Greater than 30cm	Bulldozer and Front-End Loader (Tracked) Combination. Front-End Loader (Tracked).

Select most preferable technique

No

Use dragline or hydraulic grader or leave to natural recovery.

No

Go to next figure, Decision Guide Number 2, Question 4.

Figure 2: Shoreline Clean-Up Decision Guide 1

Shoreline Cleanup Decision Guide Number 2

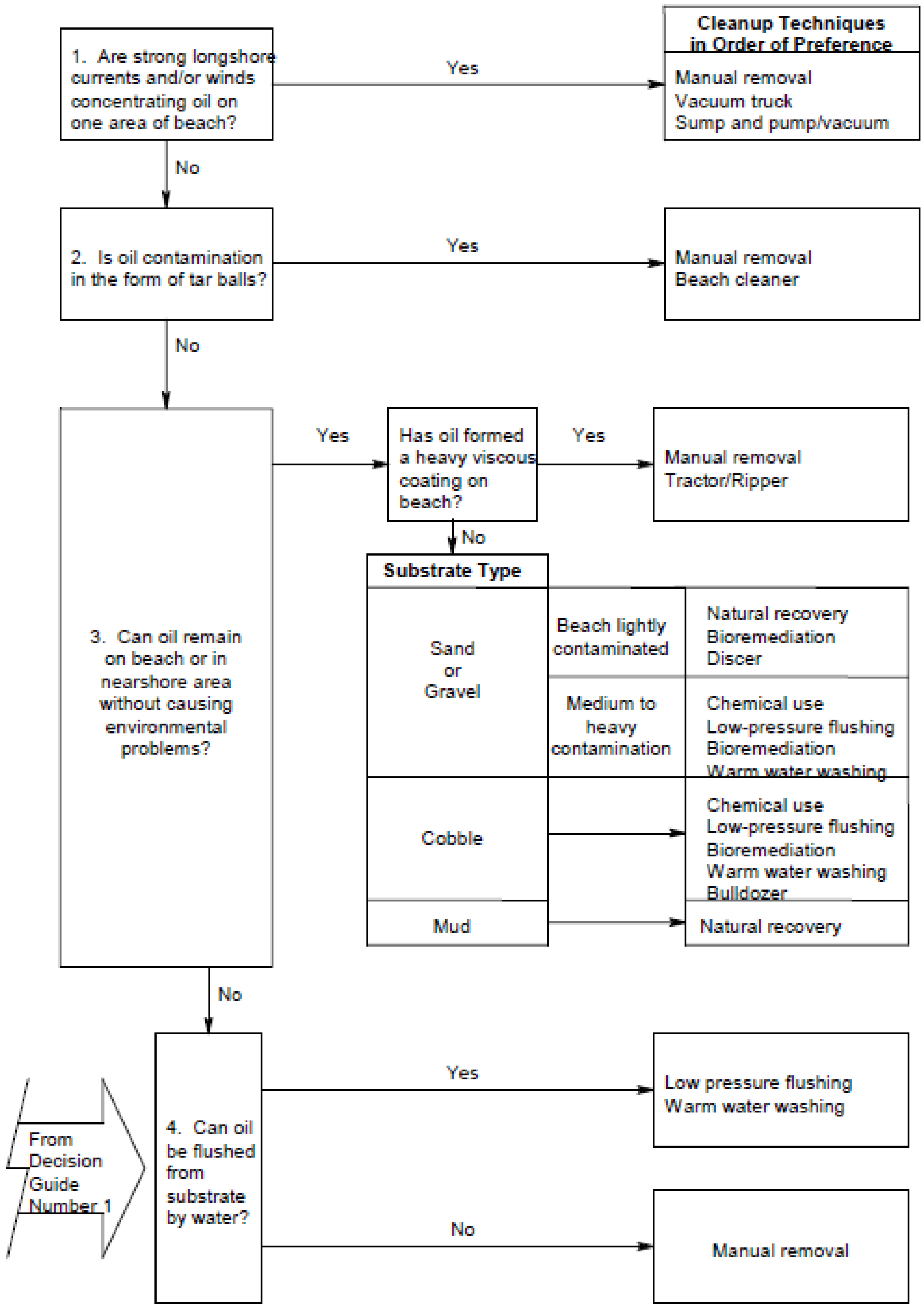

Figure 3: Shoreline Clean-Up Decision Guide 2

Shoreline Cleanup Decision Guide Number 3

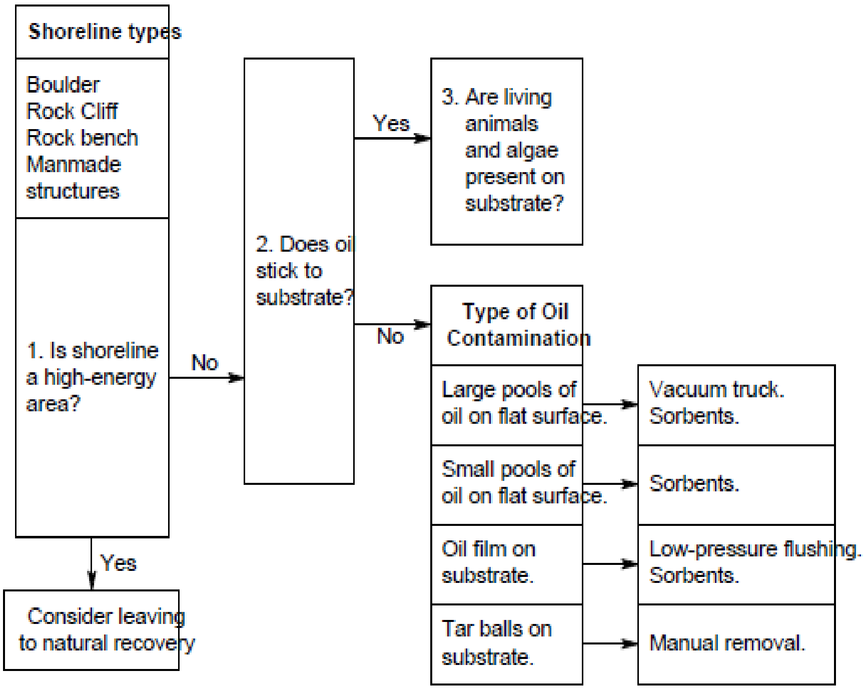

Figure 4: Shoreline Clean-Up decision Guide 3

Appendix L: Operational Guidelines for Shoreline Response

Operational Guidelines for Shoreline Clean-up activities

1.1.1 Worksite preparation guidelines

The following provides guidelines for the preparation of staging areas supporting shoreline clean-up operations.

Organisation and worksite set-up

The worksite does not only include the polluted areas that require cleaning. Several other specific areas must be identified and cordoned off and routes for pedestrians and vehicles should be signposted.

These specific areas are:

- The polluted area;
- The waste storage area, with different types of containers suitable for the different kinds of waste;
- The decontamination area: whatever the size of the spill, a decontamination phase for operational personnel, equipment and tools must be carried out in order to provide some comfort to personnel after each work session, avoiding oiling clean areas, and group together personal clean-up equipment and protective gear, to facilitate the management of the site (cleaning, storage, re-use);
- A rest area, with at least changing rooms, toilets, a first aid kit and cold and hot beverages. Cold or even hot meals can also be organised on the spot provided that a canteen tent or temporary building is available; and
- A storage area for tools and machinery (or equipment warehouse).

Access to the worksite should be restricted and traffic of vehicles should be strictly regulated to avoid accidents.

Preparation

- Prevent the general public from accessing the worksite;
- Delineate accesses for vehicles and machinery (check load-bearing capacity) and routes;
- Channel vehicle and pedestrian traffic;
- Protect the ground (geotextile, roll out mat system…) during operations in sensitive areas (dunes...);
- Prepare and signpost the different areas of activity (on the beach), living areas (locker room, meals, showers, toilets...) and stockpiling areas presenting a risk (fuel, equipment, waste pit....);
- Define a site for fluid storage away from the locker room:
    - Provide an extinguisher for each cabin
    - Set up a recovery system for fuel leaks
- Provide at least minimum lighting for installations and the surrounding area during the winter.

Basic Equipment	Extra Equipment
✓ Plastic liners, geotextiles	✓ Bins, barrels, skips, tanks
✓ Barrier tape and stakes	✓ Hot and cold beverages Welfare)
✓ Signposting equipment	✓ Cooking oil, soap (Welfare)
	✓ Earthmoving equipment

PRIMARY STORAGE OF WASTE

A primary storage site is:

- ✓ An emergency staging area of the immediate deposit of the waste collected before its transfer to either an intermediate long term storage site or if possible directly to a treatment facility; and
- ✓ A key stage in the waste management process for sorting, labelling and quantifying the types and volumes of waste collected and when possible, reducing volumes to be transported by pre-treatment.

The storage site must be closed as soon as clean-up operations are completed.

The return of the site to its original condition implies:

- ✓ A contamination diagnosis made by an organisation specialised in ground pollution, decontamination operations if needed and the approval of the authorities; and
- ✓ In some cases, botanical evaluations to define a plant cover restoration operation.

✓ Segregate the different types of waste
✓ Protect containers from rain water and to contain odours
✓ Protect containers from prolonged exposure to sunlight if necessary
✓ Ensure security to prevent unauthorised dumping

Primary waste storage sites should meet certain criteria:

- ✓ Close proximity to the site of clean-up;
- ✓ Good access to roads for heavy lorries; and
- ✓ A flat area with enough space away from environmentally-sensitive areas (vegetation, groundwater) and out of reach of the sea tides and waves.

- ✓ Depending on the volume of waste, site characteristics and availability of containers, prepare:
  - o Staging areas
  - o Pits if necessary
  - o Platform within earth berms
  - o Platform for bagged solids and liquids in tank.
- ✓ Protect areas using watertight plastic liners
- ✓ Lay fine gravel or sand at the base of the storage area to protect the membranes
- ✓ Prepare rain water or effluent management
- ✓ Ensure correct labelling of the containers to avoid mixing the different types of waste (liquid, solid, non-biodegradable – oiled plastics, contaminated cleanup equipment, biodegradable – oiled seaweed, faunal)
- ✓ Control access to the cleanup sites and protect access routes using lining and/or geotextiles

BASE CAMP/REST AREA

The rest area (base camp) should at least consist of:

- ✓ Changing rooms;
- ✓ Toilets; and
- ✓ A rest area.

At base camp, operators must be provided with:

- ✓ A first aid kit; and
- ✓ Hot and cold beverages, meals.

Selection of the rest area must meet certain criteria:

- ✓ Close proximity to the clean-up site;
- ✓ Easy access; and
- ✓ A flat area with enough space away from environmentally sensitive areas.

Equipment

- ✓ Shelter/rest area (tent, temporary building;
- ✓ Portable toilets (at least one for men and one for women);
- ✓ Locker rooms;
- ✓ First aid kit;
- ✓ Fire extinguisher; and
- ✓ Communication equipment.

STORAGE AREA FOR EQUIPMENT AND MACHINERY

This area consists of and equipped repair and maintenance site.

In order to avoid incidents and clean-up equipment failures, equipment should only be used by trained personnel and all equipment should regularly be checked for conformity with standard operating procedures and safety.

✓ Check and adjust daily levels of gasoline, diesel, oil, water and other fluids ✓ Regularly maintain the machines (pumps, pressure washers...) ✓ Equipment must be checked, counted by the person in charge of logistics and stored daily at the end of the work day ✓ Some pieces of equipment must be washed or at least rinsed daily, with proper recovery of cleaning effluent, other kinds of equipment should be washed weekly or at the end of operations ✓ Set up a systematic maintenance-cleaning-repair operation at the end of each week ✓ Small tools and equipment and even detachable parts of all equipment remaining outside should be securely stored away (eg stainless steel bucket of small sand screeners) ✓ In case of interruption of operations, large pieces of equipment should be moved to a supervised site ✓ Regularly check equipment for conformity and safety

The storage area for equipment and machinery must meet certain criteria:

✓ Close proximity to the site of clean-up;

✓ Easy access; and

✓ A flat area with enough space away from environmentally-sensitive areas.

Equipment

✓ Cabins;

✓ Hut;

✓ Maintenance equipment and tools; and

✓ Cleaning equipment.

1.1.2 Manual clean-up guidelines

Oil, polluted sediment and debris are removed by hand or with the help of manual tools and then stored for disposal.

Conditions of use

- ✓ Pollution : all types ; most often scattered pollution; on large spills, if implementation of other techniques is impossible;
- ✓ Pollutant : all types;
- ✓ Substrate : all types; sufficient load bearing capacity for pedestrians and light equipment; and
- ✓ Site: all types sufficiently accessible and which tolerate intensive traffic.

Equipment

Basic Equipment:

- ✓ Scrapers (paint scrapers, long handle scrapers...), rakes, brushes, forks; and
- ✓ Landing nets, shovels, trowels.

Extra Equipment:

- ✓ Waste containers, big bags, bins, plastic bags; and
- ✓ Front-end loader (for disposal).

PPE: At least protective clothing: overalls, boots, gloves, etc. depending on the nature of the pollutant, expose and responder activity.

- ✓ Divide the response personnel among three functions:
    - o Collection/scraping/gathering
    - o Placing in bags/waste containers
    - o Disposal
- ✓ Rotate the teams among the three functions;
- ✓ The waste can be disposed of manually or with the use of mechanical means if possible;
- ✓ Don't overfill bins, plastic bags; and
- ✓ Don't remove excessive quantities of sediments.

Impact

- ✓ Impact insignificant to heavy, depending on the type of substrate. Risk of destroying the structure of the substrate in marshes. Erosion;
- ✓ Potentially destructive effects on vegetation (dunes, marshland);
- ✓ Deconstruction and destabilisation of the foot of the dune (upper end of beach); erosion, destruction of the dune and the associated vegetation, decrease in biodiversity and fertility by reduction of the low water mark; and
- ✓ Can tend to fragment the oil in certain conditions.

Performance

This is a highly selective technique, but requires a lot of time and personnel. If not done correctly, there is a risk of removal of large quantities of clean sediment.

1.1.3 Mechanical clean-up guidelines

This technique consists of collecting the oil in order to facilitate its removal from the beach. Collection is carried out using a tractor, ATV or earthmoving vehicle or earthmoving equipment.

Conditions of use

- ✓ Pollution : heavy pollution, continuous slick;
- ✓ Pollutant : slightly to very viscous oil;
- ✓ Substrate : vast, flat foreshore with wet fine-grain sand (very damp to saturated) and a good load-bearing capacity, without ripple marks; and
- ✓ Site: accessible and sufficient load bearing capacity for earthmoving equipment, sufficiently large to allow vehicles to manoeuvre.

Equipment

Basic equipment:

- ✓ Backhoe loader;
- ✓ Grader/bulldozer;
- ✓ Tractor or loader with front blade; and
- ✓ Front-end loader or lorry (for removal).

PPE: At least suitable for heavy machinery operation

Impact

- ✓ Normally only removes the oil, but some sediment may also be taken with it (if the operator is poorly supervised or inexperienced), especially if used on light pollution or an unsuitable site;
- ✓ High risk of disturbance due to traffic and mixing of oil with sediment; and
- ✓ May lead to reduction of beach stability and beach erosion/loss of beach area.

Minimum workforce required: 2 people per vehicle (1 drive + 1 assistant)

Waste: oil mixed with a varying quantity of sediment; but can rapidly become unselective if scraping is carried out on moderate pollution (should be avoided)

- ✓ Consists of bringing the oil together in order to facilitate its removal from the beach. Scraping is carried out using a tractor or earthmoving equipment fitted with a front end blade in an oblique position. According to the viscosity of the oil, two options are available:
  - o (case 1) fluid oil: radial or converging scraping towards a collection point on the foreshore; removal by pumping
  - o (case 2) more viscous oil /solids: concentration to form windrows, by successive slightly curing passes parallel to the water line; subsequent removal of windrows
- ✓ Should only be carried out on heavy pollution; do not use on moderate to light pollution
- ✓ Inform and supervise operators; use experienced operators
- ✓ Work methodically
- ✓ Set up traffic lanes on the beach in order to reduce oil and sediment mixing

- ✓ Don’t remove excessive amounts of non-contaminated materials
- ✓ Don’t fill the bucket of loader more than 2/3 capacity
- ✓ Don’t drive on polluted materials

1.1.5 Shoreline vessel access guidelines

There are numerous landing craft vessels available in the North West Shelf area. These vessels are capable of grounding out; therefore the vessels can access a contacted area on high tide, ground out, unload equipment and personnel, reload with waste oil then depart on the next high tide. Landing craft vessels are supplied through Quadrant Energy existing vessel suppliers.

Mechanical equipment and PPE are to be mobilised to the nominated marine operational base for onward movement to the affected locations.

For shoreline clean-up of remote islands the following guidelines will be considered so as to minimise the secondary impacts of high numbers of spill response personnel on shorelines:

Vessels are to be mobilised to the designated deployment Port to mobilise shoreline clean-up teams by water. The shoreline clean-up will be undertaken through on-water deployment to the defined shorelines in 4 stages:

(1) Drop off of 6-person clean-up containers (refer below) to shoreline contact locations defined by IMT through observation data;

(2) Deployment of marine and environmental specialists to demarcate the clean-up zones with barrier posts and tape to prevent secondary impacts to flora and fauna by the clean-up teams;

(3) Deployment of small clean-up teams with a trained/competent shoreline responder as a Team Leader to conduct clean-up methods (flushing, bag and retrieve, etc.) with all waste being bagged and stored in temporary bunding made of HDPE above the high-high tide mark; and

(4) Deployment of the waste pickup barges to retrieve collected wastes from the temporary bunding and to complete the shoreline clean-up and final polishing.

Appendix M: Oiled Wildlife Response Personnel and Equipment

In the event of a spill impacting wildlife, Santos WA will commence arrangements to mobilise personnel and equipment to fill responder positions as identified in the WAOWRP. An overview of sources of personnel is provided in Table 1 and an overview of 'first-strike' equipment for initial deployment is provided in Table 2**.**

In the event of large-scale OWR, further specialised OWR equipment and personnel will be provided by in-country and international organisations, as necessary, accessed through AMOSC (primary) and OSRL (secondary). Equipment and personnel required for the development and operation of staging areas/ treatment facilities can be provided locally (for example veterinary personnel and supplies). The Pilbara Region OWR Plan provide detail of local organisations and suppliers for personnel and equipment.

In addition to OWR providers mobilised through AMOSC and OSRL/Sea Alarm, Santos WA maintains access to the workforce marketplace during an emergency response. Level 1 oiled wildlife responders, of which the WAOWRP indicates 90+ could be required for a Level 6+ event, could be provided through Santos WA's workforce hire arrangements. On the job training requirements for Level 1 responders could be provided by DBCA, AMOSC or Sea Alarm personnel. Skilled but ubiquitous roles required for manning and maintaining facilities and staging areas, such as trades, technicians and vets, could also be filled through workforce hire arrangements. The Pilbara Region OWR Plan provide contact details for local trade personnel, vets and wildlife specialists that could be employed for manning/maintenance of forward response wildlife response facilities.

Table 1: Sources of Oiled Wildlife Response Personnel

AMOSC / INDUSTRY RESPONDERS	Activated through	Capability
AMOSC Technical Advisor – Oiled Wildlife – assistant in IMT (as industry OWA if required)	AMOSC Duty Officer	1*
AMOSC OWR Industry Team– Level 2-4 responders (DBCA training)		18*
WA Petroleum industry personnel – Trained by individual petroleum industry companies – activated via mutual aid		~50*
AUSTRALIAN OWR EXPERTISE	Activated through	Capability
Blue Planet Marine (ACT and WA) – Oiled Wildlife Responders	AMOSC Duty Officer	10-20*
Phillip Island National Parks (VIC) – Oiled Wildlife Responders		~70 staff ~45 volunteers*
NatPlan Mutual Aid		50-100*
Wildlife care and rehabilitation	Personnel potentially available to petroleum industry (currently there is no formal arrangement)	

Perth Zoo – Duty Veterinarian	advice, expertise and management Links to wildlife rehabilitation networks	
OWA	DBCA State Duty Officer –	1 per shift
Personnel		
DBCA staff with wildlife and emergency management skill set who currently operate in fire preparedness and response		
INTERNATIONAL OWR EXPERTISE	Activated through	Capability
DwyerTECH NZ - Facilities Management Personnel Call-off contract)	AMOSC Duty Officer	2*
Wild base, Massey University (NZ) - Oiled Wildlife Responders		4-6*
International Bird Rescue (USA)- Oiled Wildlife Responders		4*
Sea Alarm (Belgium) – Expert assistance with organisational set-up and global OWR resourcing	OSRL Duty Officer	2/3** (Sea Alarm) + additional OWR responders accessed through global network

* As per AMOSC Capacity Statement 25 Jun 2020

** As per Sea Alarm/OSRL Service Level Agreement Statement

Table 2: First Strike Deployment-Ready OWR Equipment

AMOSC OWR Equipment*	Activated through	Location
1 x AMOSC owned OWR container 1 x AMOSC owned box kit 1 x Fauna Hazing and Exclusion kit	AMOSC Duty Officer	Fremantle
1 x AMOSC owned OWR container 1 x AMOSC owned box kit 1 x Fauna Hazing and Exclusion kit		Geelong
1 x AMOSC owned box kit		Exmouth
1 x AMOSC owned box kit		Broome
National Plan (NatPlan) OWR Equipment*	**Activated through**	**ion**
1 x NatPlan OWR container 1 x NatPlan/DBCA Box/trailer kit	AMSA RCC	Dampier
1 x NatPlan OWR container		Darwin
1 x NatPlan OWR container		Townsville
1 x NatPlan OWR container		Devonport
WA DBCA OWR Equipment*	**Activated through**	**Location**
1 x DoT OWR container	DoT Duty Officer	Fremantle
DBCA OWR trailer kit		Karratha
DBCA OWR trailer kit		Kensington
NSW Maritime OWR Equipment*	**Activated through**	**Location**
1 x NSW Maritime OWR container	AMSA RCC	Sydney
OSRL OWR Equipment**	**Activated through**	**Location**
1 x Search and rescue response package 1 x Intake and triage response package 2 x Cleaning and rehabilitation response package	OSRL Duty Officer	UK
1 x Search and rescue response package 1 x Cleaning and rehabilitation response package		Singapore
1 x Search and rescue response package 1 x Cleaning and rehabilitation response package		Bahrain

1 x Wildlife Rehabilitation Unit 1 x Cleaning and rehabilitation response package		Fort Lauderdale, USA

* As per AMOSC Capacity Statement 25 June 2020

** As per OSRL SLA Equipment Report 4 May 2020.

Appendix N: Scientific Monitoring Plans

1 Scientific Monitoring Principles

1.1 Monitoring Design

In the event of an oil spill the monitoring design will depend upon the nature of the spill, the availability of baseline data in relation to the spill extent and expert opinion. In order to ensure the application of robust designs and sampling approaches which have the highest likelihood of detecting an environmental impact while allowing suitable flexibility, this plan provides a set of Guiding Principles for monitoring design and sampling (**Table 3**). A structured decision making framework for allocating monitoring effort in both time and space is described in **Figure 1**.

Table 1: Guiding Principles for Oil Spill Monitoring Design and Methodologies.

Principle	Explanation	Key guiding references
Match baseline	Designs and methodologies should follow those used in appropriate baseline studies wherever possible.	N/A
Comprehensive sampling	Sampling methods should seek to sample the full range of taxa within each assemblage. This may require the use of several complimentary techniques (the exception is if indicator taxa are employed; see below).	N/A
Reliable indicator taxa	If indicator taxa are targeted then the choice of indicator should be defensible, and a link to the response of the broader assemblage demonstrated. Indicators of ecosystem function should also be considered.	Hilty and Merenlender (2000)
Appropriate sample area or volume	Size of sampling unit should be determined based on the level of clustering of individuals and whether the goal is to quantify this clustering, or establish low inter-sample variability (probably more the latter for oil spill studies).	Kenkel et al. (1989)
Reduce within sample variation over time	Wherever possible repeated measures are carried out on the same sample space in order to reduce within treatment variation.	N/A
Compositing of samples	Appropriate compositing to increase statistical power should be considered.	Carey and Keough (2002)
Account for environmental gradients and partition variations	Sources of variation are considered and compartmentalised to best reduce within treatment variation, and thereby maximise power to detect an impact. This is managed through several means:	English et al. (1997), Snedecor and Cochran (1989)

Principle	Explanation	Key guiding references
	Environmental covariates are considered in sampling design recorded and incorporated statistically. A hierarchical or stratified sampling design is used to address variation at multiple scales Design is standardized, by sampling equivalent strata (e.g., level of exposure, depth etc.).	
Assess statistical power	Where null-hypothesis tests are planned, statistical power of the design is assessed prior to execution.	Gerrodette (1987) Legg and Nagy (2006) Toft and Shea (1982)
Appropriate sampling extent	Sample the range of hydrocarbon concentration (and at least the upper end).	Skalski (1995)
Independence amongst samples	Site selection should aim for independence amongst samples and potential spatial or temporal autocorrelation should be considered.	Hurlbert (1984)
Reduce observation error	Observer bias and amongst observer variation should be considered.	Thompson and Mapstone (1997)
Appropriate spatial replication	Sites are replicated. A limitation is that there is only one spill, but control sites should be replicated and spatially Interspersed. Ideally, the design should be able to detect an impact at several possible scales.	Underwood (Underwood 1991, 1992, 1994)
Appropriate temporal replication	Sampling should account for natural temporal variation.	Underwood (Underwood 1991, 1992, 1994)

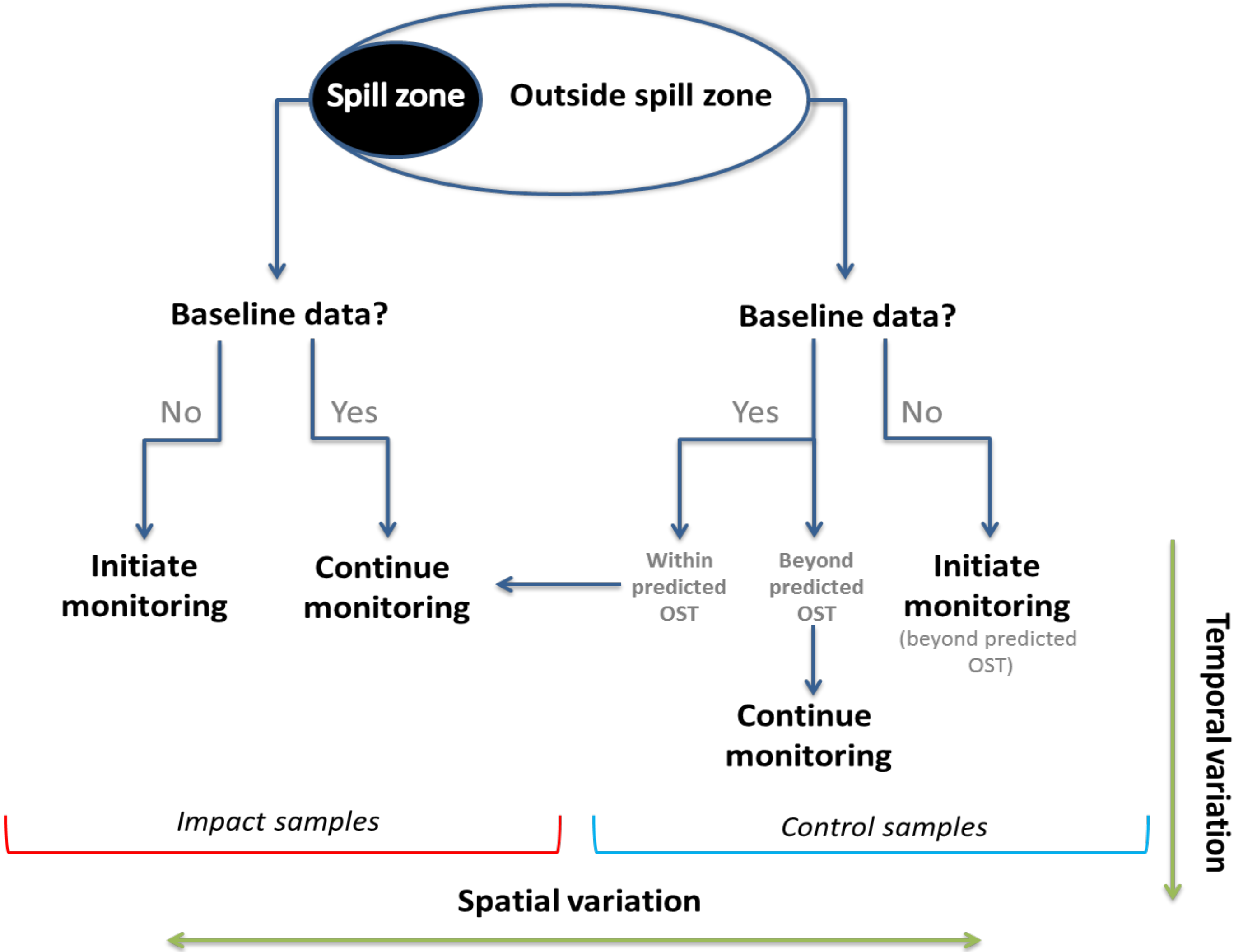

Figure 1: Structured Decision Making Process Based on Gregory et al. (2012) in Reference to Monitoring Programs, the Availability of Baseline Data, and Oil Spill Trajectory. An ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

1.2 Data Analysis

Appendix B details the most important approaches to statistical analysis and related sampling design. These approaches are summarised in Table 4 (below). An important consideration is how this information is best summarised and communicated to guide further decision making and management. **Appendix B** also describes the reporting of environmental outcomes through the use of report card systems and includes a summary of their structure and design.

Table 2: Summary of Data Analysis Techniques.

Analysis type		Description	Strength	Limitations	Addressing limitations
Gradient analysis		Impact is quantified in terms of distance from spill.	Can be established post-spill.	Doesn't account for inherent spatial patterns present prior to spill.	Include spatial covariates in model. Incorporate a temporal component.
Control chart	Univariate	Single variable is monitored and plotted over time, and breaching of control limits tested.	Control sites are not required. Takes account of natural variation in system.	Control limits do not necessarily have biological meaning. Doesn't control for broader spatial scale temporal variation.	Include control charts for control sites which incorporate broad scale temporal variation.
	Multivariate	Multiple variables are combined, monitored and plotted over time, and breaching of control limits tested.	Ability to combine suite of data (e.g. community composition) into one variable. Sites plots not required.	Individual responses are masked. Control limits do not necessarily have biological meaning. Significant control limits challenging to define. Direction of change is undefined.	Compliment with graphical approaches to identify direction of change and individual species responses.
	Reference	Control limits are based on knowledge of biological system (e.g. minimum viable population size, toxicity).	Control limits have recognised biological meaning or consequence.	Control limits may be considered arbitrary.	Use established standards for control limits.

Analysis type	Description	Strength	Limitations	Addressing limitations
BACI	Quantifies state before and after potential impact, and also at impacted and control sites. Impact is tested by statistical interaction of terms.	Controls for natural variation, by incorporating control sites.	Limited power to detect significant impact. Requires appropriate matching of control (non-impacted) sites. Requires pre-impact data.	Increase power by increasing temporal component. Choose indicators with low natural variability.

2 Scientific Monitoring Plans by Receptor

Table 1 provides a glossary of an SMP as prepared in this report.

Table 3: Glossary of Scientific Monitoring Plans.

SMP Receptor	
Rationale	Importance of receptor, possible impact and importance of monitoring program.
Aim	Description of program aim(s)
Baseline	Refer to **Table 2**, detailed in Baseline Data Review (Astron Environmental Services 2019) (QE-00-BI-20001)
Contact	Contact is defined as occurring where any aerial, visual or florescence observation reports submitted to the Incident Command Team (ICT) show presence or likely presence of oil; or spill fate modelling predicts oil at sensitive receptors of > 1g/m^2 for surface oil, and >10 ppb for entrained and dissolved oil. This then activates the relevant SMP, which determines if any impact has occurred based upon applicable thresholds.
Initiation criteria	Initiation criteria, based on data from OMPs.
Termination criteria	Termination criteria based on analysis of Scientific Monitoring data translated to the Incident Management Team (IMT) through the planning function.
Receptor impact	Measured states and pressures according to the State-Pressure-Response model.
Methodological approach	Descriptions of sampling methods in order to carry out scientific monitoring, including reference to methods described in an appendix.
Scope of works	Timeline for scope of works (SoW) development.
Statistically significant	The basis of the significance is determined by the methodological approach as outlined in the relevant SMP.
Resources	List of required resources which may not necessarily be listed within a description of a particular method as described in **Appendix C**.
Implementation	Mobilisation requirements for service provider(s).
Analysis and reporting	Summary of analysis, data management and reporting.

2.1 SMP1 Marine Water Quality

SMP1 – Marine Water Quality	
Rationale	The release of hydrocarbons at sea will pollute marine waters via floating, entrained or dissolved aromatic hydrocarbons. The water quality SMP may also be used in conjunction with OMP1 (Surveillance and Monitoring), to inform the sampling design of other SMPs where objectives are to evaluate impact and recovery of sensitive receptors, in relation to hydrocarbon contamination.
Aim	To monitor changes in water quality following an oil spill and associated response activities for the purpose of detecting a potential impact and recovery and for informing other scientific monitoring studies.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). In addition, the Industry-Government Environmental Metadatabase (IGEM) (publicly available via the *Index of Marine Surveys for Assessments* (IMSA) website maintained by WA DWER) will be reviewed for applicable marine water quality baseline data. In the absence of baseline data for hydrocarbons, data from appropriate reference sites will be used in place of the baseline values.
Initiation criteria	Upon notification of a Level 2 or 3 incident -(a level 2 or 3 incident includes those which may have an adverse effect on the environment. This may be informed by operational water quality monitoring)
Termination criteria	Concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are not significantly higher than baseline data or similar non-impacted sites data. In the absence of baseline or similar non-impact sites data, concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are below the relevant hydrocarbon contaminant trigger level within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower and values are not significantly different to reference sites. Forensic fingerprinting of the released hydrocarbon and water quality sample analysis by way of gas chromatography/mass spectrometry (GC/MS) may be used to determine the source of contaminants where this is not otherwise clear from operational monitoring.
Receptor impact	Impacts to specific receptors from hydrocarbons within marine waters are described in individual SMPs.
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied;

Santos

SMP1 – Marine Water Quality	
	2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied; 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. See **Appendix B** and **Figure 1** for detailed description of these approaches. The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling. Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design. Water profiles A water quality probe will be used to measure conductivity (to derive salinity), temperature and depth (CTD), dissolved oxygen (% and mg/L), turbidity, total dissolved solids and fluorometry along a depth profile. Sampling methods will be aligned with the recommended standard operating procedures for the use of sensors for oil spill monitoring found in Appendix F of the Oil Spill Monitoring Handbook (Hook et al. 2016). Water quality Water quality samples will be taken along a similar depth profile as the CTD measures using a Niskin bottle, Van Dorn water sampler, rosette sampler or equivalent instrument. The laboratory(ies) will inform and supply the appropriate sample containers, storage requirements, holding times, detection limits/limit of reporting for required analytes and the analysis required for each sample. Water samples shall be analysed for key contaminants of concern including polycyclic aromatic hydrocarbons (PAHs), monocyclic aromatic hydrocarbons (including benzene, toluene, ethylbenzene, xylene), and nutrients, metals and chlorophyll-a. At each site, replicate water samples (at least three samples) will be collected to allow appropriate statistical analyses to be made including samples for quality assurance and quality control (QA/QC) purposes (i.e. split sample, triplicate sample, field blanks, transport blanks). Water sample collection and handling will align with Standard operating procedures found in the Oil Spill Monitoring Handbook (Hook et al., 2016), specifically the following sections: + Appendix A & B hydrocarbon analysis; + Appendix C Volatile Organic Compounds Analysis; and + Appendix D Surface Oil Analysis. Environmental DNA (eDNA) will also be collected to detect for the presence of marine species in the water column. Water samples will be collected in Nalgene bottles and sent to an appropriate laboratory for analysis. Sample processing will

SMP1 – Marine Water Quality	
	depend on holding times required (<8 hours ideal) and may involve filtering and freezing of each sample (Grochowsi and Stat 2017).
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ Marine scientist with experience in water quality sampling + Geographic Information Systems (GIS) personnel + National Association of Testing Authorities (NATA) accredited laboratories for water sample analysis + Vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Sampling equipment + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the SoW following approval by Santos (this time allows for costing, preparation of equipment and disposables and travel time to site).
Analysis and reporting	Chemical analysis will be carried out by NATA-accredited laboratories. A government endorsed laboratory for forensic fingerprinting (GS/MS) will be used. Data will be entered to spatially explicit database. Data will be analysed appropriately in order to determine if there was a statistical difference in water quality before and after a hydrocarbon impact. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.2 SMP2 Sediment Quality

SMP2 – Sediment Quality	
Rationale	Hydrocarbons released during a spill scenario may contact, settle and/or accumulate in marine sediments. Toxic substances found in accumulated hydrocarbons may lead to impacts to ecosystem processes associated with this primary producer habitat. Sediments and marine infauna will be sampled concurrently in order to establish potential correlations amongst the two parameters.
Aim	To monitor the fate and persistence of hydrocarbons in marine sediments following an oil spill and associated response activities.

SMP2 – Sediment Quality	
	To monitor marine benthic infauna assemblages as an indicator of sediment quality, in relation to an oil spill and associated response activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). In addition, the IGEM will be reviewed for applicable marine baseline sediment quality and infauna data. In the absence of baseline sediment quality data, hydrocarbon contaminant trigger values for marine sediments as listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) will be used as a proxy for baseline levels. Where other regulatory site-specific trigger levels exist, the lower of these levels and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) levels will be used as proxy baseline levels.
Initiation criteria	Operational Monitoring or SMP1 indicates that contacted sediment or sediment predicted to be contacted by a hydrocarbon spill as defined in Table 1. +
Termination criteria	Concentrations of hydrocarbons in marine benthic and shoreline sediments, attributable to the released hydrocarbon, are not significantly higher than baseline or similar non-impact sites. In the absence of baseline or similar non-impact sites data, concentrations are below marine sediment quality interim guideline levels within the ANZG (2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower. For infauna assemblages, abundance and species diversity/richness/composition are not significantly different from baseline (where baseline data exists) or are not statistically significantly different from comparable non-impacted benthic infauna assemblages. Forensic fingerprinting of the released hydrocarbon and sediment quality samples by way of GC/MS may be used to determine the source of contaminants where this is not otherwise clear from operational monitoring.
Receptor impact	Impact to sediment quality is measured through change in hydrocarbon content and concentration. Change to sediment quality is also reflected by changes to infaunal assemblages. Potential impact to infaunal assemblages are measured through change(s) in: + Taxonomic diversity + Assemblage composition + Abundance of indicator species Other pressures to these states are: + Discharge of other toxicants + Physical disturbance including dredging + Sedimentation

SMP2 – Sediment Quality	
	+ Introduction of marine pests + Shading from marine infrastructure + Climate change
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied; 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. See **Appendix B** and **Figure 1** for detailed description of these approaches. The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling. Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design Sediment quality Operational Monitoring (including spill trajectory modelling) and the results of SMP1 Marine Water Quality monitoring will be used to inform the location of potentially impacted sediment sites. Sediment monitoring sites in nearshore and shoreline locations will also consider and align where practicable, with sites selected for habitat monitoring (i.e. SMP3, 4, 5 and 6). Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design. At each site, replicate sediment samples will be taken including those for QA/QC purposes. Sediment grab (i.e. Van Veen or Box corer) or coring equipment will be selected based on water depth (offshore, inshore or shoreline) and sample size requirements. Sediment sample collection and handling will align with Standard operating procedures found in the Oil Spill Monitoring Handbook (Hook et al. 2016), specifically the following sections according to sampling equipment utilised: + Appendix G hydrocarbon analysis (Grab samplers) + Appendix H hydrocarbon analysis (Ship borne corer) + Appendix H Manual push corer, and + Appendix O Sediment infauna.

SMP2 – Sediment Quality	
	The laboratory(ies) will inform and supply the appropriate sample containers, storage requirements, holding times, detection limits/limit of reporting for required analytes and the analysis required for each sediment sample. Sediment samples shall be analysed for key contaminants of concern including metals, hydrocarbons, nutrients, particle size distribution, and nutrients. Infauna samples A subset of the sediment sample shall be sieved in the field (if time permits) with collected infauna preserved (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of infauna to lowest taxonomic resolution possible. eDNA will also be collected to detect for the presence of marine infauna species in sediments. Sediment will be removed from the surface of a subset of the sediment sample and sent to an appropriate laboratory for analysis.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ Marine scientist with field experience in deep sea sediment sampling + Scientist with skills in infauna identification + GIS personnel + NATA accredited laboratory for sample contaminant analysis + Laboratory for infauna sorting and taxonomic identification + Vessel with appropriate davit/winch to deploy grab/corer equipment and tender in operation + Refuelling facilities + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be capable of mobilising within 72 hours of the SoW having been approved by Santos. Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Sediment samples analysed by NATA-accredited laboratories for presence and concentrations of hydrocarbons associated with the spill including full suite PAHs and total organic carbon. A government endorsed laboratory for forensic fingerprinting (GC/MS) will be used. Infauna samples sorted and identified by qualified marine invertebrate specialist to acceptable taxonomic groups. Data will be entered to spatially explicit database and analysed statistically in order to detect significant differences among sites. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer

SMP2 – Sediment Quality	
	review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.3 SMP3 Sandy Beaches and Rocky Shores

SMP3 – Sandy Beaches and Rocky Shores	
Rationale	Contact of entrained oil and stranded floating oil of shoreline habitats may occur on sandy beaches and rocky shores. Rocky and sandy shores provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds. Large tides tend to create a large degree of horizontal zonation amongst taxa. Rocky and sandy shores are included within the one receptor as they are often spatially mixed and both represent high energy regions.
Aim	To monitor changes in biota of sandy and rocky shoreline habitats in relation to an oil spill and associated activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). In addition, the IGEM shall be reviewed for applicable rocky shoreline and sandy beach biota baseline data. Minimal baseline data currently exists for rocky shorelines and sandy beaches.
Initiation criteria	Operational monitoring, SMP1 or SMP2 indicates that rocky and/or sandy shorelines are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Shoreline assemblage structure, and hydrocarbon concentration levels in representative invertebrate species, are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated AND Shoreline clean-up at the site has been completed.
Receptor impact	Impact to shoreline invertebrates from pressures including hydrocarbons is measured through change in: + Species diversity + Assemblage composition + Abundance of indicator taxa. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Litter/waste + Introduction of marine pests + Over-collection

SMP3 – Sandy Beaches and Rocky Shores	
	+ Nutrification + Climate change.
Methodological approach	Monitoring will be designed as follows: 1. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved, a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied. Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority where no baseline data exists. If this opportunity is not available, a gradient approach to monitoring will be applied. Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. Rocky shoreline intertidal assemblages (fauna and flora) will be monitored using a quadrat/transect approach, with the positioning of quadrats/transects accounting for any natural variation in assemblage structure along a seaward-landward gradient. Assemblage structure to be recorded through in-situ counts of fauna and flora or still images taken for further analysis. Sandy shoreline infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists, the methodology will be adapted to available data so that results are comparable. Samples to be sieved with collected infauna preserved (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists. Biomonitoring of hydrocarbon concentrations in shoreline invertebrates will occur through collection of replicated tissue samples from representative, and preferably widely available species, across impact and non-impacted locations. The laboratory(ies) will supply and inform the appropriate method for collection, storage and holding times of tissue samples for required laboratory analysis and to avoid cross-contamination among samples. Where limitations in the distribution and abundance of representative invertebrate species preclude collection of sufficient samples for analysis, in-situ biomonitoring using a locally available species (e.g. the use of caged oysters) shall be considered for assessing spatial and temporal changes in bioaccumulation of hydrocarbon concentrations in invertebrates across impact and reference sites.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in shoreline macroinvertebrates sampling + Supporting Scientist

SMP3 – Sandy Beaches and Rocky Shores	
	+ GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Laboratory facilities for sorting and taxonomic identification of specimens
Implementation	With the aim of collecting post-spill pre-impact data, service provider able to mobilise within 72 hours of the SoW having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Specimens not identified in situ (in the field) will be processed and identified in the laboratory by appropriately qualified scientists. Biota tissue samples (if collected) analysed for hydrocarbon contaminants by NATA-accredited laboratories. Data will be entered to spatially explicit database and analysed in order to test for significant difference between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.4 SMP4 Mangrove Communities

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
Rationale	In the event of Tier 2 or 3 spill, mangroves may be contacted by floating or entrained oil. Mangrove health may be adversely affected due to increased concentration of hydrocarbons in sediments and coating due to surface oil, which in turn can lead to leaf-loss, mortality and a reduction in areal extent of mangrove habitat. This plan's focus is mangrove vegetation. Associated monitoring of sediment quality and mudflat fauna is described in SMP2 and SMP5, respectively.
Aim	To monitor changes to mangrove extent and health in relation to an oil spill and associated activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). Santos holds long term data from field mangrove health surveys at Varanus Island/ Bridled Island (Lowendal Group). Baseline extent and of mangroves is monitored by remote sensing in several regions, and further historical and post-impact data for mangrove health and extent

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
	can be obtained as remotely sensed imagery (e.g., Sentinel, Landsat and Worldview).
Initiation criteria	Operational Monitoring, SMP1 or SMP2 indicates that mangroves are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Mangrove extent and health are not significantly different from their baseline state (where baseline data exists) or are not statistically significant different from comparable non-impacted mangroves; AND Sediment quality monitoring (SMP2) at the site has been terminated; AND Shoreline response at the site has been completed.
Receptor impact	Impact to mangroves from pressures including hydrocarbons is measured through change in: + Tree health + Aerial extent. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Litter + Introduction of marine pests + Dust + Sedimentation from human activities + Climate change.
Methodological approach	Remote sensing data will be accessed for the purpose of detecting change in aerial cover and change in canopy health through and index of plant health (e.g., NDVI or MSAVI) (Astron Environmental Services 2013). Where long term on-ground baseline monitoring has occurred, further post impact on-ground monitoring should be carried out to complement any analysis of remote sensing. Analysis of long-term on-ground monitoring data will be as follows: 1. Where long-term baseline data sites (only) are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See **Appendix B** for detailed description of these approaches and **Figure 1**). On-ground monitoring of mangroves will aim to detect change in mangrove health, including canopy cover and plant/leaf health indices.

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
	Field methodology will follow the routine monitoring techniques currently employed for Santos at Varanus Island (Quadrant Energy Australia Limited 2018), adapting where required to align with pre-existing baseline field data, where available. Sampling of sediments as per SMP2 will occur at mangrove health assessment sites to allow any changes in mangrove health to be related to sediment hydrocarbon levels. In-field mangrove health sampling frequency will be dictated by the number and location of sampling sites and the sampling design applied.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in mangrove condition assessment + Supporting Scientist + GIS and remote-sensing personnel + Available vessel in operation + Satellite and/or aerial imagery
Implementation	On-ground monitoring will only occur where long-term baseline data has been collected, and hence no post-spill pre-impact data collection will be required. On-ground post-spill data will be collected at an appropriate time as guided by the analysis of remote sensing imagery, and potential on-ground assessment.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to test statistically significant change to parameters associated with hydrocarbon spill. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.5 SMP5 Intertidal Mudflats

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
Rationale	Intertidal mudflat communities are primary producer habitats which support invertebrate fauna, which in turn provides a valuable food source for shorebirds. High diversity of infauna (particularly molluscs) occur within these habitats and may be affected by penetrating oil. At high tide, these habitats become foraging grounds for vertebrates such as rays and sharks. While there is some localised disturbance, most of the communities in the area of interest are generally in an undisturbed condition. These habitats are at high risk of impact as the sheltered environments promote high faunal diversity combined with low-energy wave action.
Aim	To monitor changes in intertidal mudflat communities associated with an oil spill and associated activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001).

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	In addition, the IGEM shall be reviewed for applicable intertidal mudflat infauna baseline data.
Initiation criteria	Operational Monitoring, SMP1 or SMP2 indicates that mudflat habitats are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Mudflat infaunal assemblages are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated; AND Clean-up of the shoreline site has been completed.
Receptor impact	Impact to mudflat epifauna and infauna from pressures, including hydrocarbons, is measured through change in: + Species diversity + Assemblage composition + Abundance of indicator taxa. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Overfishing (bait collecting) + Introduction of marine pests + Climate change.
Methodological approach	Monitoring will be designed as follows: 1. Where long-term baseline data sites (e.g., Roebuck Bay) are contacted, a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied (See **Appendix B** for detailed description of these approaches and **Figure 1**). Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority if baseline data are not available. If this opportunity is not available, a gradient approach to monitoring will be applied. Mudflat infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists methodology to adapt to available data such that results are comparable. Sites selected for mudflat infauna sampling to be concurrently sampled for sediment quality as per SMP2.

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. Samples to be sieved with collected infauna preserved (buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in epifauna and infauna assessment and sampling + Supporting Scientist + GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	With the purpose of collecting post spill pre-impact data, service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilization time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.6 SMP6 Benthic Habitats

SMP6 – Benthic Habitats	
Rationale	Benthic habitats are those habitats associated with the seafloor. Major benthic habitats at risk are: + Coral reefs (likely high susceptibility to spill) + Macroalgae and seagrass (likely moderate susceptibility to spill) + Non-coral benthic filter feeders (likely moderate susceptibility to spill) + Sub-tidal pavement (likely moderate susceptibility to spill)

SMP6 – Benthic Habitats	
	+ Soft-substrate (likely lower susceptibility to spill). Macroalgal and seagrass communities are important primary producers which also provide habitat, refuge areas and food for fish, turtles, dugongs and invertebrates. Seagrass and macroalgae also increase structural diversity and stabilise soft substrates. Western Australia contains the largest and most diverse assemblages of seagrasses in the world, which are found throughout the EMBA, including notably the vast meadows contained within the Shark Bay World Heritage Area. Non-coral benthic filter feeders, which include sponges, molluscs, sea whips and gorgonians, are considered indicators of disturbance due to their immobility and long life cycles. Corals are important primary producers that provide food, substrate and shelter for a diversity of marine life, including invertebrates and fish. They also protect coastlines from wave erosion and provide important substrate for algae. Undisturbed intertidal and subtidal coral reefs occur in several locations throughout the EMBA and are generally considered to be in good condition.
Aim	To monitor changes in the cover and composition of benthic habitats in relation to an oil spill and associated activities. To monitor change in hard coral health and reproduction in relation to an oil spill and associated activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). In addition, the IGEM will be reviewed for applicable benthic habitat and coral health and reproduction baseline data. Remote sensing data, satellite and aerial imagery previously acquired (for example Hyperspectral imagery along the Ningaloo lagoon) (Kobryn et al. 2013) may also be applicable for shallow clear-water benthic habitats to detect changes in benthic habitat cover and composition. Pollution-induced change to benthic habitat cover and composition may take some time to be detected. Therefore, post-spill, pre-impact benthic survey data will be collected when required to have a baseline state following initial oil contact.
Initiation criteria	Benthic habitat cover and composition Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill. Coral health and reproduction Operational Monitoring, SMP1 or SMP2 indicates that coral habitat is contacted or is predicted to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Benthic habitat cover and composition Cover and composition of benthic habitats are not statistically significantly different from that of their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages. Coral health and reproduction Hydrocarbon concentration in corals, reproductive state and settlement indices are not statistically different from the baseline state (where baseline data exists) or from comparable non-impacted assemblages.

<table>
<tr><th colspan="2">SMP6 – Benthic Habitats</th></tr>
<tr><td>Receptor impact</td><td>Impact to benthic habitats from pressures including hydrocarbons is measured through change in:
+ Species diversity
+ Assemblage composition
+ Percent cover.
Other pressures to these states are:
+ Physical disturbance
+ Discharge of toxicants
+ Introduction of marine pests
+ Shading
+ Climate change.</td></tr>
<tr><td>Methodological approach</td><td>Monitoring design will be as follows:
1. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied.
2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.
3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1).
<u>Benthic Habitat Cover and Composition</u>
Field survey methodology will be based upon acquiring repeat digital imagery (video or still images) of benthic habitats along random transects (preferable), using a stratified sampling approach at each site to target different habitat types and depths where clear gradients in these conditions exist. Site selection and image acquisition methodology will aim to align applicable baseline studies where these exist, such that imagery is comparable.
The number of sites and frequency of sampling will depend upon the sampling design philosophy.
Divers, towed video or remotely operated vehicles (ROVs) will be employed to collect imagery considering safety aspects and the depth of water at survey locations.
Where divers are employed, fish species will also be recorded where practicable (for example following methodologies employed by Babcock et al. (2008) to contribute to SMP11.
<u>Coral Health and Reproduction</u>
Using divers, selected coral colonies will have tissue samples removed for the purpose of laboratory analysis of the concentration of accumulated hydrocarbons and for determining reproductive state, noting sampling for reproductive state will be dependent upon the timing of coral spawning. Reproductive state will be</td></tr>
</table>

SMP6 – Benthic Habitats	
	determined from measures of gamete size, stage and fecundity determined from in-field examination and laboratory analysis of histological samples. In addition to the standard suite of ecotoxicology testing done on the released hydrocarbon as part of the Operational Monitoring Program, ecotoxicology testing of the released hydrocarbon on the larval competency of representative coral species will be conducted. Settlement plates will be deployed to monitor settlement of coral recruits following spawning periods to ascertain the level of coral recruitment at impacted and non-impacted sites.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Marine Scientist with experience in benthic habitat assessment + Supporting Scientist + Divers or ROV operators + GIS personnel + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Diving equipment or ROVs + Video recording facilities + Satellite imagery
Implementation	Service provider is to be able to mobilise within 72 hours of the SoW being approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Digital imagery will be analysed using a point-count technique (using software such as AVTAS, Coral Point Count with Excel extensions (CPCe) or TransectMeasure (SeaGIS)) to estimate the percentage cover of biotic and abiotic categories (in line with the CATAMI classification scheme) comprising the benthic habitat. Biotic categories to include the following as applicable: corals; macroalgae and seagrass; and non-coral benthic filter feeders. Live, dead and bleached coral cover shall be recorded. The imagery collected will allow for the determination of percent cover, abundance, measurement of size (if scaling lasers are included in the image) and a visual assessment of health (Kohler and Gill 2006). NATA accredited laboratory analysis to determine the concentration of hydrocarbons within coral tissue.

SMP6 – Benthic Habitats	
	Reproductive output to be determined by complementary means, including in-field and laboratory analysis of gametes, including microscopic examination of histological samples preserved in the field. Coral larval competency tests to be conducted by ecotoxological laboratory in addition to standard suite of ecotoxological tests using released hydrocarbon. Data will be entered to spatially explicit database and analysed in order to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card provided as part of report. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.7 SMP7 Seabirds and Shorebirds

SMP7 – Seabirds and Shorebirds	
Rationale	The region supports around 25 species of migratory shorebirds, 20 species of resident shorebirds, and approximately 30 species of seabirds. Shorebird foraging is most highly concentrated on tidal mudflats, while seabirds tend to nest on offshore islands. Impacts to seabirds and shorebirds due to the presence of surface, entrained and dissolved hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical (e.g. matting of feathers, inability to fly). These effects may ultimately lead to death or failed breeding. For the purposes of this document, seabirds and shorebirds are defined as: + shorebirds – those birds that inhabit and feed in the intertidal zone and adjacent areas and are resident or migratory, using the area principally during the austral summer + seabirds – those birds associated with the sea and deriving most of their food from it, and typically breeding colonially, including the marine raptors osprey and white-bellied sea eagle.
Aim	Quantify seabirds and shorebirds, in the spill and response areas. Quantify lethal and/or sub-lethal impacts of hydrocarbon spill exposure on seabirds and shorebirds. Monitor changes in seabird populations (reproductive success) in relation to the hydrocarbon spill and clean-up activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). The Oil Spill Response Atlas (Department of Transport (DoT)),National Conservation Values Atlas (Department of Agriculture, Water and the Environment (DAWE) -(http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf)

SMP7 – Seabirds and Shorebirds	
	and Pilbara Region Oiled Wildlife Response Plan (Department of Parks and Wildlife and Australian Marine Oil Spill Centre 2014) should also be consulted. Long-term seabird monitoring has been conducted on Lowendal, Airlie and Serrurier Islands by Santos as part of seabird and shearwater monitoring programs.
Initiation criteria	Operational monitoring indicates that known foraging, roosting or nesting areas for seabirds and/or shorebirds has been contacted, or are predicted to be contacted, by a hydrocarbon spill; OR Operational monitoring indicates that seabirds and shorebirds have been contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in Table 1.
ermination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are not present in seabird and shorebird tissues; AND measured variables are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured variables at non-impacted sites; AND Monitoring is terminated in consultation with the relevant environmental authority (DBCA and/or DAWE).
Receptor impact	Impact to seabirds and shorebirds from pressures including hydrocarbons is measured through change in: + Species diversity + Bird abundance + Health/condition + Breeding success (resident species only). Other pressures to these states are: + Physical disturbance of foraging and nesting habitat + Accidental chemical spillage + Entanglement in litter + Displacement by less favourable species (e.g. Silver Gull) + Predation + Climate change.
Methodological approach	Monitoring design will be as follows: 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. Given the ease of survey establishment, post-spill pre-impact monitoring will be attempted wherever practicable in order to established pre-impact state.

SMP7 – Seabirds and Shorebirds	
	3. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See **Appendix B** for detailed description of these approaches and **Figure 1**). Monitoring for seabirds and shorebirds will measure abundance and diversity in key foraging/roosting areas with the timing of surveys to coincide with seasonal peaks in abundance. The seabird and shorebird roost count monitoring will follow current accepted survey methodology conducted in the area, such as Bamford and Moro (2011) at Barrow Island, and survey guidelines standardised by the Department of the Environment and Energy (2017). Monitoring of seabirds to focus on nesting (burrow) density, breeding participation and breeding success, taking measurements of the number of adults, eggs and chicks with the timing of surveys to allow assessments immediately after egg laying and immediately prior to chick fledging. Bird mortality to be recorded during monitoring of seabirds and shorebirds with tissue samples taken from dead birds for hydrocarbon analysis in the laboratory. Necroscopies will follow the process of Gagnon and Rawson (2010).
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Experienced seabird biologist + Experienced shorebird biologist + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Draft annual report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

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2.8 SMP8 Marine Mammals

SMP8 – Marine Mammals	
Rationale	Thirty-eight species of marine mammals are known to occur within the region. These include cetaceans (whales and dolphin) and sirenians (dugong). Effects to marine megafauna due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.
Aim	To monitor short and long-term environmental effects on marine mammals that may have resulted from the hydrocarbon spill and associated response.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). The Oil Spill Response Atlas (DoT), National Conservation Values Atlas (DAWE - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and Pilbara Region Oiled Wildlife Response Plan (Department of Parks and Wildlife and Australian Marine Oil Spill Centre 2014) should also be consulted.
Initiation criteria	Operational monitoring indicates that marine mammals are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Restoration or resumption of key biological processes (e.g. abundance, distribution, breeding) necessary to ensure post-impact recovery is demonstrated. Specific criteria to be developed by Marine Scientist(s) with expertise in marine mammals in the north-west of Western Australia; AND No further instances of dead marine mammals with detectable levels of hydrocarbons attributable to the hydrocarbon spill; AND Monitoring is terminated in consultation with the relevant environmental authority (DBCA and/or DAWE).
Receptor impact	Impact to marine mammals from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Physical disturbance + Entanglement in fishing gear and litter + Accidental chemical spillage + Climate change + Over-exploitation.
Methodological approach	Aerial and marine surveys will be implemented to identify individuals in proximity of the spill and to quantify damage: + Aerial surveys will follow the protocols of Hedley et al. (2011), **Appendix C8**

SMP8 – Marine Mammals	
	+ Marine surveys will follow the protocols of Watson et al. (2009), **Appendix C8** Tissue sampling of dead or injured animals will follow the protocols of: + Department of Environment and Heritage (DEH) (2006) (Cetaceans) + Eros et al. (2000) (Dugongs).
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	**Aerial survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities **Vessel-based survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Sample container and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database. Data and conclusions will be summarised in an environmental report card. Statistical power related to these receptors is likely to be low, due to observational data and small sample sizes. Therefore, the assessment of quantified impacts will be corroborated with marine scientist(s) with expertise in relevant fauna in the north west of Western Australia. Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.9 SMP9 Marine Reptiles

SMP9 – Marine Reptiles	
Rationale	Six species of marine turtle, 22 species of sea snake and one species of estuarine crocodile are considered to occur within the region. Impacts to marine reptiles due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural, physiological (e.g. disruption to digestion) or physical effects. This plan is primarily focussed on marine turtles, while assessing other reptiles where encountered.
Aim	To observe and quantify the presence of marine reptiles in the spill and response areas, and broader regional areas. To assess and quantify lethal impacts or sub-lethal impacts of this exposure or interactions. To monitor changes in turtle populations in relation to an oil spill and associated activities.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). The Oil Spill Response Atlas (DoT), National Conservation Values Atlas (DAWE - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and Pilbara Region Oiled Wildlife Response Plan (Department of Parks and Wildlife and Australian Marine Oil Spill Centre 2014) should also be consulted.
Initiation criteria	Operational monitoring indicates that marine reptiles or nesting sites are contacted or likely to be contacted by a hydrocarbon spill; OR Operational monitoring indicates that marine reptiles are contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in Table 1.
Termination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are no longer present in marine reptile tissues collected from live or dead individuals; AND In the event that an impact attributable to the hydrocarbon spill is detected on marine reptiles, the measured parameters are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured parameters at non impacted sites; AND Monitoring is terminated in consultation with the relevant environmental authority (DBCA and/or DAWE).
Receptor impact	Impact to marine turtles from pressures including hydrocarbons is measured through change in: + Abundance + Health/condition + Nesting success. Impact to other marine reptiles from pressures including hydrocarbons is measured through change in observed injury and condition. Other pressures to these states are: + Lighting and flares causing disorientation (turtles)

SMP9 – Marine Reptiles	
	+ Vessel strike + Physical disturbance of nesting sites + Predation + Entanglement in fishing gear and litter + Accidental chemical spillage + Habitat loss or change due to dredging + Climate change + Over-exploitation.
Methodological approach	**Abundance** In-water impacts – aerial surveys. Shoreline impacts – ground surveys (either rapid track census survey or tagging program). **Health/condition** In-water impacts – vessel surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis). Shoreline impacts – ground surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis). Dead reptiles will be collected for autopsy following Gagnon (2009). **Reproductive success** Shoreline impacts – ground surveys (detailed tagging and/or nesting success studies). Design of ground surveys for turtles will be applied as follows: 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved, and timing allows, a post spill pre-impact approach will be attempted 4. If a post-spill pre-impact approach is not practicable, a gradient approach to quantifying impacts will be applied
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	**Aerial survey** + Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities

SMP9 – Marine Reptiles	
	Vessel-based Survey + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database. Turtle data will be analysed in order to test for significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Owing to their observational nature and potentially low sample size, observed impacts to other reptile fauna will be corroborated with marine scientist(s) with expertise in relevant fauna in the north-west of Western Australia. Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.10 SMP10 Seafood Quality

SMP10 – Seafood Quality	
Rationale	Exposure of commercial and recreationally targeted demersal and pelagic fish species to entrained and dissolved aromatic hydrocarbons can cause flesh tainting and increase the levels of toxicants above human consumption guidelines. Aromatic hydrocarbons are carcinogenic to humans. This scope includes finfish, sharks and invertebrates (principally crustacea).
Aim	To identify potential human health risks due to the presence of hydrocarbon concentrations in the flesh of targeted seafood species for consumption.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001). Human health benchmarks relating to the exposure of PAHs shall be used to determine health effects as per Yender et al. (2002). Flesh samples from non-impacted sites to be used as baseline for olfactory analysis for flesh taint.

SMP10 – Seafood Quality	
Initiation criteria	Operational monitoring and results from SMP1 predicts or observes contact of oil to target species for consumption as defined in Table 1.
Termination criteria	The following termination criteria will be adopted in consultation with WA DPIRD-Fisheries, DAWE – Fisheries, AFMA and Department of Health. Hydrocarbon concentrations in seafood tissues are not above levels considered a human health risk; AND Flesh taint is not detected from olfactory testing of seafood samples; AND Target species are no longer exposed to hydrocarbons in the water column.
Receptor impact	Impact to seafood quality from hydrocarbons is measured through change in: + Toxicity indicators + Olfactory taint. Other pressures to these states are: + Accidental chemical spillage + Disease.
Methodological approach	Target fish species determined from water quality monitoring results and relevant and available commercial and recreational-fished species. Sampling of target species will follow a gradient design (Gagnon and Rawson 2012) ranging from impacted to non-impacted (or non-suspect) catches using commercial and recreational fishing techniques undertaken by commercial and recreational fishers. Sampling method (netting, trawling, baited fish traps, spear fishing, line fishing) will be determined by habitat, target species and spill location. If more than one target species is affected, replicate samples of each species shall be collected, with a minimum of five replicate samples. Olfactory testing will follow Rawson et al. (Rawson et al. 2011) in **Appendix C10**, following the duo-trio method (Standards Australia 2005).
Scope of works	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Marine vessel + Sample containers and preservative + NATA accredited laboratory for sample analysis + Decontamination/washing facilities
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.

SMP10 – Seafood Quality	
Analysis and reporting	Laboratories will be NATA-accredited for food standards analyses. Data will be stored in spatially explicit database and analysed in order to test for significant differences between impacted and non-impacted seafood. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.11 SMP11 Fish, Fisheries and Aquaculture

SMP11 – Fish, Fisheries and Aquaculture	
Rationale	Impacts to fisheries species due to presence of entrained hydrocarbons may include lethal and sub-lethal physiological effects (e.g. reduced growth) and physical effects. The region comprises the Indo-West Pacific area which consists of a high diversity of fish species and assemblages and provides important spawning and nursery grounds for several fisheries species. Fish are concentrated in a number of biodiversity hotspots. The environment is also conducive to aquaculture including pearl production. Fisheries species that spawn or inhabit near shore areas face a greater risk to an oil spill than finfish found in deeper waters.
Aim	To monitor changes in structure and distribution of fish assemblages in relation to an oil spill and associated activities. To monitor the effect of hydrocarbon exposure and physiological condition on fisheries and aquaculture species.
Baseline	Further details in Baseline Data Review (SO-00-BI-20001. In addition, the IGEM shall to be reviewed for applicable baseline data.
Initiation criteria	Operational monitoring indicates fish, fisheries or aquaculture are contacted or likely to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Fish assemblages are not statistically significantly different than those of baseline or similar non-impacted assemblages; AND Hydrocarbon concentrations, physiological condition indices, and biomarker levels in affected fish and aquaculture species are not statistically significantly different from those of non-impacted samples; AND Termination of monitoring is done in consultation with the Department of Primary Industries and Regional Development (DPIRD).
Receptor impact	Impact to fish, fisheries and aquaculture from pressures including hydrocarbon concentrations is measured through change in: + Species diversity + Abundance of indicator taxa + Assemblage structure + Health.

SMP11 – Fish, Fisheries and Aquaculture	
	Other pressures to these states are: + Accidental chemical spillage + Overfishing + Introduction of marine pests + Habitat disturbance + Climate change.
Methodological approach	Fish assemblages will be assessed using the stereo-baited remote underwater videos (BRUVs) following Shortis et al. (2009), **Appendix C11**. Fish assemblages will be randomly sampled within discrete habitats at cross-shelf impact areas and non-impact areas. Sampling design for fish assemblages will be as follows: 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. If baseline data is not available, a gradient approach to quantifying impacts will be applied (See **Appendix B** for detailed description of these approaches and **Figure 1**). Where relevant, data available from DPIRD, including catch/effort data, will be assessed to determine potential changes from baseline levels in fishing grounds potentially affected by an oil spill compared to after the event. For fish and aquaculture species potentially exposed to an oil spill, species will be sampled across the contamination gradient as per Gagnon and Rawson (2012). Hydrocarbon concentrations (particularly PAH) within tissues of fish and aquaculture species will be determined. Exposure to hydrocarbons on fish health will also be determine through analysis of physiological indices and biochemical markers following Gagnon and Rawson (2012). If fish kills are observed, whole specimens will be obtained and preserved (frozen) for necropsy to determine the cause of death.
Scope of works	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Marine scientist trained in fish identification and necropsy + Marine scientist with BRUV experience + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby

SMP11 – Fish, Fisheries and Aquaculture	
	+ Resources to analyse BRUV data.
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	BRUV imagery will be processed using EventMeasure (SeaGIS) software. NATA-accredited laboratories will be employed for health analyses. Data will be entered to spatially explicit database and analysed to test for statistically significant differences between non-impacted and impacted fish assemblages. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.12 SMP12 Whale Sharks

SMP12 – Whale Sharks	
Rationale	The whale shark (*Rhincodon typus*) is known to occur within the region. Effects to the whale shark due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.
Aim	To quantify impacts of an oil spill on whale sharks within Biologically Important Areas (BIAs) along the Ningaloo Coast and north Western Australian coastline.
Baseline	Baseline monitoring information of whale sharks includes: 1. Aerial survey. Monthly surveys funded by Woodside Energy were completed from 2000 to 2002. The Department of Environment and Conservation (DEC; now DBCA) undertook monthly surveys of Ningaloo Reef during the whale shark season from 2006 to 2010. The results of work funded by Woodside were published by Sleeman et al. (2010). Because whale sharks are not constrained to visit the surface in the same way as marine mammals, both surveys recorded relatively few whale sharks. Analysis of the DBCA survey data by Professor Helene Marsh of James Cook University concluded its surveys did not account for problems of availability and perception errors and that due to the relatively low numbers of sharks available to be counted in the Ningaloo region, aerial survey was probably not an appropriate means to census these sharks (DBCA pers. comm.). Note that while aerial survey techniques have shortfalls for determining abundance patterns, they are still

SMP12 – Whale Sharks	
	useful for identifying aggregation sites of whale sharks in the Exmouth sub-basin. 2. 2) Photo-identification databases. Two databases of whale sharks sighted at Ningaloo Reef are available although there is likely to be considerable overlap in their content. The first of these is held by AIMS and uses open-source software to compare and match images of sharks. Access to this database is not restricted. The second is held by Ecocean and requires user-access agreements to deposit, match and retrieve images or access metadata. The software used by Ecocean to compare images is proprietary. In the case of the AIMS database, images are available from 1992 to the present day with most of them provided by ecotourism operators at the end of each whale shark season. As part of licence agreements with DBCA, videographers working with each tourist operator must surrender footage of each shark encountered by the operator. DBCA staff then download id-images from these videos. Metadata and id-images are provided to both Ecocean and AIMS databases. These databases can be used in mark-recapture modelling frameworks to examine trends in the composition and abundance of whale sharks at Ningaloo, but outputs must be considered in the light of the caveats mentioned earlier (i.e. representativeness, sampling protocol etc.). 3. Operator and researcher trip logs. Each time a whale shark is encountered by a tourist and research vessel, or by a spotter plane, a record is kept of the location, size and sex (where possible) of the animal and the date and time. These records now exist from 1994 to the present day. These data suffer from the same caveats applicable to photo-id databases (e.g. representativeness of sampling of the entire population within the Exmouth region). Furthermore, planes do not search for animals in any formally structured manner, but rather fly up and down the reef at varying distances from the reef crest until a whale shark is sighted. If animals are sighted early in the day and all operators have completed tourist swims with sharks, then searches are terminated and the plane returns to base. Conversely, if whale sharks are difficult to find the area of search is widened and the plane will search for longer. Thus, the area and duration of searches can be highly variable. There have been changes in the format of reporting (written logs to GPS records) of encounters both by the boats and the planes through time. Finally, at times when there are few whale sharks, encounters with the same shark may be shared among tourist vessels, so that there is the possibility of double (or even triple) counting of the same shark in the database. Despite these problems, analysis of tourist industry databases have returned valuable insights into physical drivers of whale shark abundance at Ningaloo Reef (e.g. Sleeman et al. (2010)). Other relevant baseline datasets include: 4. 4) Sightings by the oil and gas industry. Occasional sightings of whale sharks either from the decks of oil rigs or by remotely operated vehicles (ROVs) around oil platforms and deepwater facilities have been compiled by AIMS for the past six years. No formal sampling program exists and these sightings occur largely by chance, although they do indicate the presence of these animals around oil and gas facilities offshore and in deep water on the shelf. 5. 5) Tagging data. Satellite telemetry has been used to describe the movement patterns of whale sharks along the Ningaloo coast and extending into the Timor Sea and south-east Indian Ocean. This data cannot be used to estimate patterns of abundance, but does provide important insights into the feeding, residency and migratory behaviours of sharks under ‘normal’ oceanographic conditions within the Exmouth sub-basin. Much of this data has been gathered by tag deployments led or assisted by AIMS. Researchers from other institutions have also deployed tags on whale sharks at Ningaloo at tracked

SMP12 – Whale Sharks	
	movement, including a recent study by Ecocean/University of QLD (Reynolds et al. 2017). 6. Food chain studies. Surveys of euphausiids (a major food item of whale sharks at Ningaloo; (Jarman and Wilson 2004)) and other mesoplankton in the region of Ningaloo Reef have been published (Wilson et al. 2001, 2003). Preliminary work on the food chains leading to the prey of whale sharks is underway but has not been published as yet (Meekan et al., unpublished data). This ongoing research may identify the physical and biological factors correlated with whale shark abundance at Ningaloo and thus result in a better understanding of variability in the ecosystem. Such information is essential if the effects of an oil spill or development are to be discerned against a background of natural changes in distribution and abundance of whale sharks.
Initiation criteria	Operational monitoring indicates that whale shark aggregations are contacted or likely to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Measured parameters of whale shark abundance and distribution are not significantly different to baseline levels; AND The water quality at feeding/aggregation sites has been measured as not significantly different to baseline levels.
Receptor impact	Impact to whale sharks from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Intentional and unintentional mortality from fishing outside Australian waters + Boat strike + Habitat disruption from mineral exploration, production and transportation + Marine debris + Climate change.
Methodological approach	During spill activities may require the following surveys and sampling: + Aerial surveys + Satellite tagging + Toxicology + Food chain studies + Photo-identification + Vessel and plane logs + Acoustic tagging. The methodologies adopted will follow the approaches of those baseline studies identified allowing consistency of data from baseline to impact and recovery phases.
Scope of works	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.

SMP12 – Whale Sharks	
Resources	+ Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

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Appendix O: SMP Activation Process

Oil Spill Scientific Monitoring Activation and Response Process

Step	Responsibility	Action	Timeframe#	Resources	Date/Time Complete
Phase 1 – Activation					
1	Santos IMT (Environmental Team Leader (ETL))	Astron Monitoring Coordinator notified of incident.	On approval from Santos Incident Commander	Astron oil spill response phone number and answering service	
2	Astron Monitoring Coordinator (MC)	Call back client for further details, request *Activation Form* if not received.	Within 30 minutes of receiving initial notification	Activation Form	
3	Astron MC	Call Planning & Logistics Officer to advise of incident.	Immediately following Step 2	n/a	
4	Santos IMT (ETL)	Complete *Activation Form* and submit to Astron via email.	Within one hour following initial notification (Step 2)	Activation Form	
5	Astron Planning & Logistics Officer (PLO)	Notify MCT, Technical Advisors and key subcontractors via SMS Global.	Within 30 minutes of Step 3	SMS Global Guidance	
6	Astron PLO	Notify all staff of incident via SMS Global.	Within one hour of receiving Activation Form	SMS Global Guidance	
Phase 2 – Response Planning					
7	Astron MC	Maintain verbal communication with Santos IMT (ETL).	At least twice daily (0800 and 1700)	n/a	

Step	Responsibility	Action	Timeframe#	Resources	Date/Time Complete
8	Astron MC Astron Operations Officer Astron PLO	Maintain Functional Log.	Daily	Functional Log	
9	Astron PLO	Set up Command Room.	Within 4 hours of activation (Step 5)	Command Room Resource Checklist	
10	Astron MC, PLO and BMT Oceanica Operations Officer	Attend Santos incident briefing and relay information to MCT.	As advised by the Santos IMT (ETL)	n/a	
11	Astron Operations Officer	MCT and Technical Advisors to meet at Royal St office, review personnel and equipment resource status.	Within 6 hours of activation (Step 5)	Capability report Training matrix Resource chart	
12	Astron PLO	Confirm availability of additional personnel and equipment resources.	Within 16 hours of activation (Step 5)	External Supplier Details Requisition Request Form	
13	Santos IMT (ETL)	Provide spill trajectory modelling and sensitive receptor information to Astron.	When available	APASA modelling Department of Transport database Santos GIS Mapping	
14	Astron MC in consultation with Santos ETL	Define the scale of response - identify which SMPs are activated. Identify if operational water quality monitoring is required.	Within 2 hours of receiving spill and receptor information (Step 13).	Scientific Monitoring Plan* Relevant OPEP Spill trajectory modelling Operational monitoring results	

Step	Responsibility	Action	Timeframe#	Resources	Date/Time Complete
15	Astron Technical Advisors in consultation with Santos ETL	**Determine monitoring locations for activated SMPs:** • Identify monitoring locations in order of priority for activated SMPs based on: o nature of hydrocarbon spill o spill trajectory modelling and time to shoreline impacts o sensitive receptors impacted or potentially at risk of being impacted o state of current baseline data o current environmental conditions o current results of operational monitoring. • Determine if post-spill pre-impact data is required to be collected from any locations. See SMP Work Method Statements for decision making process when considering availability of baseline data.	Within 6 hrs of relevant SMP activation (Step 14).	Relevant SMPs Information from Astron: • baseline information for relevant receptors. Information from Santos IMT: • sensitive receptor information from relevant EP, Santos GIS mapping and online resources (DoT oil spill response atlas, DoE conservation values atlas) • oil spill trajectory modelling • response strategies and priority protection areas • results from OMPs currently activated • baseline information for relevant receptors as reference in the relevant SMP.	
16	Astron Technical Advisors in consultation with Santos ETL	Submit Department of Parks and Wildlife Licence applications	Within 12 hrs of relevant SMP activation (Step 14)	• Proposed monitoring locations • SMP methods	

Step	Responsibility	Action	Timeframe[#]	Resources	Date/Time Complete
17	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	**Determine personnel requirements:** • Identify number and competencies of personnel required for monitoring teams for each SMP based on: o activated SMPs o number of locations to be monitored o number of locations where pre-spill baseline data needs to be collected o timing of hydrocarbon spill and overlap with sensitive receptors in activated SMPs o logistical and equipment resource constraints. • Arrange additional personnel if required.	Within 12 hrs of activation if pre-impact data is needed.**	Information from Astron: • Capability report • Training matrix • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • sensitive receptor information • oil spill trajectory modelling • response strategies and priority protection areas • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc).	
18	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	**Determine equipment requirements:** • Identify number and competencies of equipment required for each SMP based on: o activated SMPs o number of locations to be monitored o number of field teams and timing of mobilisation to the field o logistical and equipment resource constraints. • Arrange additional equipment resources if required.	Within 12 hrs of activation if pre-impact data is needed.**	Information from Astron: • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc).	

Step	Responsibility	Action	Timeframe#	Resources	Date/Time Complete
19	Astron MC, Operations Officer, PLO & Technical Advisors	**Prepare and submit Monitoring Action Plan** (mission, objectives, strategies, tactics, tasks), including scope of works. **Prepare and submit cost estimate.** **Prepare and submit logistics request:** • Allocate personnel and equipment resources to field teams for relevant SMPs. • Submit SOW and logistics request for each activated SMP to Santos IMT for approval.	Within 24hrs of request for SoW (Step 15) for relevant SMP if pre-impact data is needed.**	Information from Astron: • Resource chart • relevant SMPs and WMS • agreed monitoring locations • Mobilisation and Logistics Form (incorporating SOW) • Monitoring Action Plan. Information from Santos IMT: • request for SoW • agreed monitoring locations.	
20	Santos IMT (ETL)	Santos to approve SOW, provide purchase order and initiate logistical arrangements.	Within 24 hours of SOW submission (Step 19).	Astron Mobilisation and Logistics Request	
21	Astron MC	Advise field personnel by email meeting invite, or phone if not in office.	Within 24 hours of SOW approval (Step 20).	Field team allocation	
22	Astron	Conduct incident briefing with all available Astron personnel.	Within 24 hours of SOW approval (Step 22).	Briefing template Monitoring Action Plan	
Phase 3 – Mobilisation					
24	Astron PLO	GIS and device preparation requests (field maps, data capture) submitted, and discussed with Geospatial team.	Within 24 hours of SOW approval (Step 22).	https://voyager/	
25	Astron Operations Officer	Conduct field team overview briefing, allocate tasks.	Within 36 hours of SOW approval (Step 22).	Briefing Template	

Step	Responsibility	Action	Timeframe#	Resources	Date/Time Complete
26	Field Team Leaders	Compile SMP grab packs, GIS information, field equipment, and prepare and submit HSE documentation to Santos IMT.	Within 48 hours of SOW approval (Step 22).	Information from Astron • SoW • Grab packs, SMP WMS and HSE documentation • GIS information/field maps • field equipment. Information from Santos IMT: • booking and logistics confirmations.	
27	Astron Technical Advisors	Conduct scope specific pre-mobilisation briefings.	Prior to mobilisation.	Pre-mob Briefing Template	
28	Santos ETL	Santos to approve HSE plan.	Within 24 hours of receiving HSE Plan.	Mobilisation and Logistics Form HSE plan	
29	Astron PLO	Personnel mobilised to site.	Within 72 hrs of SOW approval (Step 22) if pre-impact data is needed.**	Approved SOW	
Phase 4 – Response Operations					
30	Astron MC	Conduct Monitoring Action Plan review with MCT and Technical Advisors and communicate to Santos IMT (ETL).	Daily	Monitoring Action Plan template	
31	Astron PLO	Hold post-demobilisation debrief with field teams.	Within 3 days of demobilisation.	Demob Meeting Template	
32	Santos ETL	Santos to arrange approval of Monitoring Action Plan revisions and any additional mobilisation/logistics requirements.	Daily or as required	Monitoring Action Plan Mobilisation and Logistics Form	
33	Astron Field Team Leaders	Provide activity reports to Santos ETL.	Daily	Daily Activity Report Template	

Timeframes are indicative and may be require adjustment where activities are dependent on information availability or affected by logistical constraints

*The Scientific Monitoring Plan (EA-00-RI-10099) provides the most up to date list of SMPs and activation criteria. Refer to the OPEP for operational water quality monitoring requirements.

**If post-spill, pre-impact data is not required then timeframes will be specific to each SMP. The lead times for resourcing, preparation of SoW and mobilisation of field teams may be longer depending on the timing of the spill, likely trajectory and life stages of receptors present or likely to be impacted.

For example, in SMP4 if post-spill, pre-impact data collection is not required then mangrove decline is likely to take several weeks to occur and there is lower priority for mobilisation of field teams for this SMP within the 72 hr timeframe. In this case, mobilisation within 30 days may be more appropriate.

Abbreviations

EMBA – Environment that May Be Affected
IMT – Incident Management Team
OMP – Operational Monitoring Program
OPEP – Oil Pollution Emergency Plan
Santos – Santos Energy Australia Limited
SMP – Scientific Monitoring Plan/Program
SoW – Scope of Works
WMS – Work Method Statement

Appendix P: Scientific Monitoring Capability

Scientific Monitoring Assurance and Capability Assessment

Assurance arrangements

Astron Environmental Services (Astron) is currently Santos' primary Monitoring Service Provider for the implementation of SMPs 1-12. A contractual arrangement exists with Astron to maintain standby arrangements as per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) and have the resourcing capability to implement a first-strike response at all times. Astron maintains a relationship with a primary sub-contractor (BMT) for the provision of scientific monitoring for those SMPs where Astron does not have the required capability. Between Astron and BMT, capability exists to deliver first strike resourcing against SMPs 1-12.

Assurance on the continued maintenance of capability is provided through the delivery of monthly capability reports. These reports are generated by the Astron and BMT Planning and Logistics Officers and delivered to the Santos Spill Response Adviser along with a summary of any changes in resourcing or, and if required, how gaps in resourcing have been managed. Since the establishment of the scientific monitoring contract in 2015 Astron has always demonstrated through this process that it has the required capability to meet first strike resourcing as per the standby services contract.

Santos ensures that Astron/BMT standby arrangements are adequate through its exercise and auditing program. Santos regularly conducts exercises and tests with Astron and BMT to ensure that Santos IMT roles and Astron/BMT monitoring roles are familiar with the SMP activation arrangements while providing spot checks on resource availability. Santo has previously also undertaken an audit of Astron against its Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162). Assurance activities to date have demonstrated a high degree of compliance with standby service requirements.

Continuous improvement

Santos is committed to further improving its oil spill scientific monitoring capability. To that end, Santos is participating in a Joint Industry Operational and Scientific Monitoring Plans project, governed through an APPEA-Industry Steering Committee. This project, being progressed throughout 2021, is working towards a joint-industry capability for implementing a common suite of oil spill operational and scientific monitoring plans. The project aims to deliver efficiencies in implementing and testing oil spill scientific monitoring arrangements while increasing the level of resourcing and capability available to participating companies.

Baseline Data and Capability Assessment

Santos is committed to undertaking a review of the status, availability, currency and suitability of existing baseline data for oil spill scientific monitoring sources every 2 years. The latest review was undertaken in March 2019 by Astron (Baseline Data Review document QE-00-BI-20001) and looked at all high biodiversity value receptors in the Santos EMBA. Following this an additional assessment was undertaken in September 2019 (DC-40-RI-20017) to determine whether existing baseline data is sufficient and accessible for sensitive receptors that could be impacted from worst case Commonwealth waters spills scenarios associated with operational activities at or around Devil Creek pipeline/Reindeer platform, Varanus Island and Ningaloo Vision facilities. While the baseline review in 2021 is ongoing as part of this review Astron, separately, has broaden the scope of the assessment done in September 2019 by including three additional protection priority areas that could be impacted due to a worst-case oil spill from Bedout well drilling campaign as described in *Oil Spill Scientific Monitoring – Baseline Data Review Part 1 - Priority Protection Area Update, February 2021 Doc No. SO-91-RI-20114*. This study concentrated on sensitive receptor areas with minimum hydrocarbon contact times of less than seven days as indicated by stochastic spill modelling; it is considered that contact within seven days would require an enhanced understanding of available baseline data to ensure a timely response.

The assessment of baseline data included:

1. A review of the following parameters for each program identified:
    - Integrated Marine and Coastal Regionalisation of Australia
    - Custodian- contact point for data
    - Spatial extent

- Variables available for monitoring
- Methods applied to monitoring
- Year of most recent data capture
- Total duration of monitoring program
- Data completeness (number of years monitored as proportion of program duration)
- How often data is captured
- Appropriateness of variables (Judgement as to whether variables are appropriate for future oil spill monitoring)
- Is there any clear indication that the monitoring will continue?

2. The quality of the following parameters was then ranked as high, medium, low or unknown:
   I. Year of most recent capture:
      - 2015-2018 (if a single data capture has occurred in the last two years, then the overall program can be considered of high quality) = high
      - 2009-2014 = medium
      - <2009 = low

   II. Duration:
      - >4 years = high
      - 2-4 years = medium
      - 1 year = low

   III. Data completeness:
      - 100% = high
      - 75-99% = medium
      - <75% = low

   IV. Frequency of capture
      - Annually = high
      - Bi-annually = medium
      - <Bi-annually = low

   V. Appropriateness of parameters
      - High/medium/low

      Appropriateness of parameters was based on reference to the Scientific Monitoring Plan's targeted states for each receptor and considering whether the monitoring parameters were sufficient to compare against these states. Parameters were considered highly appropriate if all targeted states for a receptor could be quantified, of medium appropriateness if only some states could be quantified and low if the monitored parameters had little relevance to the targeted states of an individual receptor.

3. An overall assessment of each study program was then made as follows:
      - All parameters rated high = overall 'good'
      - At least one parameter rated medium = overall 'fair'
      - At least one parameter rated low = overall 'poor'
      - Unknown = overall not enough data to rate

The above assessment process was also performed across monitoring programs which specified at least one of the priority protection areas within their monitoring sites. For Priority protection areas, the above assessment was then used to determine if 1) the baseline data available could be used to detect change in the state in the event of a significant impact - Classified as "good" in the above assessment (i.e., data was current, of reasonable duration and frequency, and employed appropriate methodologies) or 2) the existing baseline data is unlikely to be suitable to detect change in state – classified as "fair" or "poor" by the above assessment (i.e., the data was dated, infrequent, of limited duration and/or relied on inappropriate methodologies). Following this assessment, a Protection Priority Area by SMP matrix summarising recommendations on baseline data status and recommendations for further action was developed (Table 1) based on three categories:

- Not applicable – SMP is not applicable to the priority protection area as sensitive receptor does not occur.
- Survey - current monitoring/knowledge is considered sufficient (i.e., could be used to detect change in state in the event of a significant impact) and is considered a lower priority for post-spill pre-impact data collection.
- Priority survey – current monitoring is not in place or not practicable; post-spill pre-impact baseline data collection should be prioritised.

The assessment determined for the majority of sensitive receptors within the priority protection areas (Montebello Islands, Barrow Island, Lowendal Islands, Ningaloo, Muiron Islands and Dampier Archipelago) specific post-spill pre-impact monitoring should be prioritised, noting that alternative approaches exist for detecting impacts where it is not feasible to conduct first-strike pre-impact baseline surveys, for example, impact versus multiple control sites and/or a gradient approach. Among the additional three protection priority areas assessed, including Bedout Island, Eighty Mile Beach and Imperieuse Reef MP, number of high quality, long term monitoring programs with recent data is limited, particularly for Bedout Island. In several cases, remote sensing data could be obtained retrospectively to a spill, for the quantification of baseline conditions, and post-hoc monitoring designs could contribute to interpretation of environmental impact and ecosystem recovery. These experimental design approaches are described within the Oil Spill Scientific Monitoring Plan (EA-00-RI-10099).

Based on the assessment of priority survey areas/receptors outlined in **Table 1** a capability assessment was undertaken to understand whether existing scientific monitoring capability would be sufficient to mount a first-strike monitoring program to gather baseline data within a short-timeframe (<7 days), noting that in the event of very short contact timeframes mobilisation of scientific monitoring teams to priority receptor sites may not be possible within contact timeframes and experimental designs not relying on pre-impact baseline would have to be employed.

Given that **Table 1** lists Protection Priority areas that could be contacted within 7 days based on stochastic modelling data (i.e., the outcomes of 100s of spill modelling simulations rather than a single spill event) it was not considered appropriate or credible that baseline monitoring would have to occur at all areas over this timeframe. For the purposes of the assessment it was considered credible that only one of the four broad regions: 1) Barrow/ Montebello/ Lowendal Islands; 2) Ningaloo Coast/ Muiron Islands or; 3) Dampier Archipelago 4) Bedout Island/ Eighty Mile Beach/Imperieuse Reef MP would potentially require priority baseline monitoring within the seven-day time period.

Table 2 outlines the required scientific monitoring capability for rapid response in Region No.4 (Bedout Island/ Eighty Mile Beach/Imperieuse Reef MP), and Astron's actual capability. When determining actual team capability, personnel were only allocated to a single SMP team, unless otherwise stated.

The results of the Baseline Data Review document (QE-00-BI-20001) and subsequent baseline and capability assessment of protection priority areas summarised herein (but detailed further in DC-40-RI-20017 and SO-91-RI-20114) has been provided within the Environment Functional Team Folder on the Emergency Response Intranet page so that this information is accessible to guide Santos IMT Environmental roles and monitoring provider roles in the event of activating oil spill scientific monitoring.

Table 1: Summary of recommendations for further action based on review of available baseline data

SMP	Priority Protection Areas								
	Montebello Islands	Barrow Island	Lowendal Islands	Ningaloo	Muiron Islands	Dampier Archipelago	Bedout Island	Eighty Mile Beach	Imperieuse Reef Marine Park
Water Quality (SMP1)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Survey	Survey
Sediment Quality (SMP2)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Survey	Survey
Sandy Beaches/Rocky Shorelines (SMP3)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Survey	Survey
Mangroves (SMP4)	Survey	Survey	Survey	Survey	Not applicable	Survey	Not applicable	Survey	Not applicable
Intertidal Mudflats (SMP5)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Survey	Survey
Benthic Habitats (SMP6)	Priority survey	Survey	Priority survey	Survey	Survey	Priority survey	Priority survey	Survey	Survey
Seabirds/ shorebirds (SMP7)	Priority survey	Survey	Survey	Survey	Survey	Priority survey	Priority survey	Survey	Priority survey

SMP	Priority Protection Areas								
	Montebello Islands	Barrow Island	Lowendal Islands	Ningaloo	Muiron Islands	Dampier Archipelago	Bedout Island	Eighty Mile Beach	Imperieuse Reef Marine Park
Marine megafauna (SMP8)	Survey	Survey	Priority survey	Survey	Survey	Survey	Survey	Survey	Survey
Marine reptiles (SMP9)	Priority survey	Survey	Survey	Survey	Survey	Survey	Priority survey	Priority survey	Not applicable
Seafood Quality (SMP10)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority Survey	Priority Survey	Priority Survey
Fish, Fisheries & Aquaculture (SMP11)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority Survey	Priority Survey	Priority Survey
Whale sharks (SMP12)	Not applicable	Not applicable	Not applicable	Survey	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Table 2: Capability assessment for rapid sampling of Bedout Island, Eighty Mile beach and Imperieuse Reef MP areas within seven days

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Required capability for rapid response (per Priority Protection Area)</th><th colspan="2">Actual Team Capability</th></tr>
<tr><th>Bedout Island</th><th>Eighty Mile Beach</th><th>Imperieuse Reef MP</th><th></th><th></th></tr>
<tr><td>Water Quality (SMP1)</td><td>1 team of 3 personnel
• experienced at water quality sampling</td><td>Rapid priority response not required</td><td>Rapid priority response not required</td><td rowspan="2">3 teams of 2 available</td><td rowspan="2">6 potential field team members all with water sampling experience and vessel based sediment sampling experience (3 FTLs, 2 TMs and 1 FS), 1 office based TA and 3 office support</td></tr>
<tr><td>Sediment Quality (SMP2)</td><td>1 team of 3 personnel
• scientist with experience in deep sea sediment sampling
• scientist with infauna identification capacity</td><td>Rapid priority response not required</td><td>Rapid priority response not required</td></tr>
<tr><td>Sandy Beaches/Rocky Shorelines (SMP3)</td><td>1 team of 2 personnel
• experienced at benthic habitat and marine macrofauna surveying</td><td>Rapid priority response not required</td><td>Rapid priority response not required</td><td rowspan="2">3 teams of 2 available</td><td rowspan="2">6 potential field team members all with shoreline assessment experience (3 FTLs and 2 TMs and 1 FS), 1 office based TA and 3 office support</td></tr>
<tr><td>Intertidal Mudflats (SMP5)</td><td>1 team of 2 personnel
• experienced at benthic habitat surveying and infauna sampling</td><td>Rapid priority response not required</td><td>Rapid priority response not required</td></tr>
</table>

Receptors	Required capability for rapid response (per Priority Protection Area)			Actual Team Capability	
	Bedout Island	Eighty Mile Beach	Imperieuse Reef MP		
Mangroves (SMP4)	Not applicable	Rapid priority response not required [2]	Not applicable	Not required	-
Benthic Habitats (SMP6)	1 team of 3-4 personnel minimum 3 people per team including: • senior marine scientist with experience in benthic habitat assessment • divers or ROV operators	Rapid priority response not required	Rapid priority response not required	2 teams of 2 available	4 potential field team members all with benthic habitat assessment experience (2 FTLs [1 is ADAS diver], 1 TM [with ROV operator experience] and 1 FS), 1 office-based TA and 3 office support
Seabirds/ shorebirds (SMP7)	1 team of 2 personnel • at least one member of each team is an experienced ornithologist	Rapid priority response not required	1 team of 2 personnel • at least one member of each team is an experienced ornithologist	4 teams of 2 available	11 potential field team members (4 FTLs (experienced ornithologists), 5 Moderate Experience, 2 Low Experience)
Marine megafauna (SMP8)	Rapid priority response not required	Rapid priority response not required	Rapid priority response not required	2 aerial survey teams of 2 available 2 vessel-based survey teams of 2 available	9 potential field team members (7 FTLs (experienced wildlife observers), 2 Relevant Experience)

Receptors	Required capability for rapid response (per Priority Protection Area)			Actual Team Capability	
	Bedout Island	Eighty Mile Beach	Imperieuse Reef MP		
Marine reptiles (SMP9)	1 team of 2 personnel (aerial)[1] • experienced wildlife observers 1 team of 2 available (vessel)[1] • both experienced wildlife observers 1 team of 2 personnel (ground-based)[4] • at least one member with experience in turtle survey techniques	1 team of 2 personnel (aerial)[1] • both experienced wildlife observers 1 team of 2 available (vessel)[1] • both experienced wildlife observers 1 team of 2 personnel (ground-based)[4] at least one member with experience in turtle survey techniques	Not applicable	2 aerial survey teams of 2 available 3 vessel-based survey teams of 2 available 3 ground-based teams of 2 available	14 potential field team members (10 FTLs (7 experienced wildlife observers and 3 turtle survey experience), 5 Relevant Experience)
Seafood Quality (SMP10)	1 team of 3 personnel • experienced fish identification and necropsy	1 team of 3 personnel • experienced fish identification and necropsy	1 team of 3 personnel • experienced fish identification and necropsy	3 teams of 3 available	9 potential field team members with fish identification and necropsy experience and/or BRUV experience (3 FTLs, 4 TMs and 2 FS), 1 office based TA and 3 office support
Fish, Fisheries & Aquaculture (SMP11)	1 team of 3 personnel • marine scientist with ROV/BRUV operation experience. • experienced fish identification and necropsy	1 team of 3 personnel • marine scientist with ROV/BRUV operation experience. • experienced fish identification and necropsy	1 team of 3 personnel • marine scientist with ROV/BRUV operation experience. • experienced fish identification and necropsy		
Whale sharks (SMP12)	Not applicable	Not applicable	Not applicable	Not required	-

[1]Aerial and vessel surveys could be conducted by the same team. The aerial-based surveys would be conducted first and then this would help inform target areas for vessel-based surveys.

[2]Remote sensing data would be collected for mangroves, with no field team required to be mobilised.

Appendix Q: Forward Operations Guidance

Forward Operating Base (FOB)

For a significant Level 2/3 response requiring coordination of resources to be deployed to the field, Santos will establish an FOB. For a level 2/3 spill crossing from Commonwealth to State waters (cross-jurisdictional spills) DoT will establish an FOB.

For a Bedout Multi-Well Drilling activity spill response, Santos will establish an FOB at the Santos Dampier facilities leased from Toll Energy. These facilities are located in Toll Energy's Yard 1 and Yard 2 on Streckfuus Road Dampier; the facilities consist of a conference room and multiple offices that could be used as break-out rooms. The Toll Energy Dampier facilities are connected to the Santos internet and telephone system. These facilities are also available to the DoT to establish an FOB for State based response.

Additional FOBs may be set up as operational requirements dictate. Based on shoreline areas that might be impacted, potential additional FOB locations include Port Hedland, Broome and Exmouth. **Table 1** to **Table 4** list local facilities with operational value for response in Port Hedland, Broome, Exmouth and Dampier respectively.

The IMT will develop a communication strategy to support the FOB/s and forward staging areas.

Table 1: Port Hedland facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Port of Port Hedland	Pilbara Ports Authority	Staging area for vessel loading for spill response and equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Port Hedland International Airport	Australian Government	Air freight spill response equipment. Storage sheds for oil spill response equipment Office facilities for Aviation-based Command Centre
The Esplanade Hospitality Inn Ibis Styles Cooke Point Holiday Park Kings at the Landing The Lodge Motel South Hedland Motel Others	Various (independent)	Spill responders and IMT accommodation Accommodation and messing for clean-up crew
Toll Ipec Freight Transport	Toll	Transfer yard for truck-based equipment deliveries and waste management, Boom Maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging and repairs Oiled wildlife response centre Laydown/storage area Bunded washing facility
Go Marine Group Offices	Go Marine	FOB OCC Offices

Table 2: Broome facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Port of Broome	Kimberley Ports Authority	Staging area for vessel loading for spill response and equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Broome International Airport	Australian Government	Air freight spill response equipment Storage sheds for oil spill response equipment Office facilities for Aviation-based Command Centre
Broome Heliport	Australian Government	Air freight spill response equipment Storage sheds for oil spill response equipment Office facilities for Aviation-based Command Centre
Seashells Broome Moonlight Bay Suites Bayside Holiday Apartments Mangrove Hotel Blue Seas Resort Others	Various (independent)	Spill responders and IMT accommodation Accommodation and messing for clean-up personnel
Toll Mermaid Supply Base 1 Toll Mermaid Supply Base 2	Toll and Mermaid	FOB OCC Office Transfer yard for truck-based equipment deliveries and waste management, Broome Maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging and repairs Oiled wildlife response centre Laydown / storage area Bunded washing facility for oil booms
Civmec Logistics Supply Base	Civmec	Transfer yard for truck-based equipment deliveries and waste management, Boom maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging and repairs Oiled wildlife response centre Laydown / storage area Bunded washing facility for oil booms
Quest Marine Services	QMS	Marine-based response Command Centre and Staging Area
Toll offices	Toll	FOB OCC Offices
Local boat ramp at Broome Town Jetty	Broome Council	Load out for near-shore marine based operations Boat launching

Table 3: Exmouth facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Harold E. Holt Naval Base	Australian Government Department of Defence	Forward Operations Base Storage of oil spill response equipment Vessel loading for spill response equipment and waste management
Exmouth Marina	Shire of Exmouth	Staging area for vessel loading for spill response equipment and waste management
Learmonth Airport	Australian Government Department of Defence	Air freight spill response equipment.
Exmouth light airstrip	Exmouth council	Air freight spill response equipment. Dispersant operations base
Logistic Services Yard	Exmouth Freight Services	Transfer yard for truck-based equipment deliveries and waste management, Boom Maintenance and Cleaning Facility Response equipment storage
Tantabiddi/Bundegi Boat Ramp areas	Shire of Exmouth	Staging/storage area Load out for near-shore marine based operations Boat launching
Bhagwan/Jetwave/Base Marine Yards Exmouth	Exmouth	Storage/Laydown and Staging Area Materials consolidation Marine equipment storage, staging & repairs

Table 4: Dampier facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Dampier Cargo Wharf	Pilbara Ports Authority	Staging area for vessel loading for spill response equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Toll Dampier Supply Base	Toll Energy Logistics Pty Ltd	Staging area for vessel loading for spill response equipment and waste management
Karratha Airport	Australian Government Department of Defence	Air freight spill response equipment
Devil Creek accommodation	Santos WA/Sodexo	Spill responders and IMT accommodation

Searipple Village	Searipple Karratha	Accommodation & messing for clean-up crew
Toll Energy Yard	Toll Energy Logistics Pty Ltd	Transfer yard for truck-based equipment deliveries and waste management, Boom Maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging & repairs Oiled wildlife response centre Laydown / storage area Bunded washing facility for oil booms
Local boat ramp at Dampier Yacht Club	Leased to Dampier Yacht Club	Load out for near-shore marine based operations Boat launching

Forward Staging Areas

Staging areas for shoreline operations will be set up at shoreline response locations under the direction of the DoT as the Control Agency for shoreline response activities. Wildlife treatment facilities may also be set-up under the direction of DoT and DBCA to clean and rehabilitate oiled wildlife.

Transport

Transportation on shoreline locations will be supported by 4x4 vehicles and all-terrain vehicles. These can be supplied by locally and nationally through hire/purchase 3rd parties.

Mobile plant

Mobile plant and equipment for mechanical clean-up can be provided from suppliers in Dampier, Port Hedland, Broome, Exmouth, Karratha or Perth as required.

Decontamination

Decontamination areas (HDPE lining provided through the provider of PPE) will be constructed for maintaining the integrity of the 'Zones' at shoreline Staging Areas, location and terrain permitting and as directed by the DoT as Control Agency for the shoreline response. Contaminated water from the decontamination areas will be regularly pumped out. All contaminated wastewater will be decanted into suitable transportable medium provided by Santos' WSP for removal.

Ablutions

Staging Areas may be supported by toilet / ablution solutions; these solutions will be dictated by the location and terrain of the clean-up operations. Available facilities include:

+ Portable Toilets;
+ Trailer Mounted Toilets; and
+ Transportable Toilets.

These solutions are chemical and fresh water based and supported by weekly / fortnightly flushing servicing. The requirement of the situation will dictate if this service is supplied out of Karratha or Perth. Santos' WSP can provide disposal as required of wastewater from ablutions.

Security

To ensure that Staging Areas are secure, Santos can provide temporary fencing to contain operations / equipment during the clean-up; suppliers of temporary fencing are available in Karratha, Dampier, Port Hedland and Broome, or larger quantities may need to be sourced from Perth. If required, specialist service providers will be engaged.

Messing

Messing and catering facilities can be provided through one of Santos' current service providers, under local arrangements as determined by capacity and facilities geographically available.

Freight movement

The transportation of all equipment and service from all stockpiles and centres can be facilitated through Santos' third-party logistics providers.

Cleaning and repair

Cleaning and repair of booms and other operational equipment this can be carried out in bunded areas at the forward staging area or supply base facilities.

Suppliers

All material, associated equipment and services will be sourced, where possible, through existing Santos suppliers. Service Orders will be raised if other/new suppliers are to be engaged to provide services etc. in the event of an oil spill.

Accommodation

There are four key components to the clean-up operations: marine, aviation, land and emergency response team. Accommodation options for field responders and FOB personnel will be dictated by proximity to their respective activity areas, to ensure maximum utilisation of the shift time available.

Mainland accommodation is available at Dampier/ Karratha, Onslow and Exmouth. Santos' Devil Creek accommodation close to Karratha may also be used.

Where possible local facilities will be utilised to accommodate response personnel, however transportable accommodation and messing facilities can be supplied through contract suppliers if required.

Transportation to respective work sites would be facilitated via modal and multimodal transport solutions, dictated by the geographical constraints of each site. Under current contractual arrangements, Santos has access to transportation providers for Land, Air and Marine operations. In general, from accommodation locations to operational areas transport would be via road using the services of our third-party supplier. Should additional services be required to meet the demand, this would be engaged under a Service Agreement as determined and authorised by the IMT.

Providoring

Providoring arrangements, when utilising local facilities would be covered under Service Orders / Purchase Order Terms and Conditions, however if required Santos has existing contracts with local who could be used for additional providoring support. These supplies would be transported to the respective spill response staging area by one of Santos' third-party logistics providers.

The providoring requirements for transportable and remote messing would be provided directly through Sodexo and BRT respectively, including the transportation thereof.

Personal protective equipment (PPE)

Santos would utilise the services of specialist providers of PPE for clean-up operations. All PPE would be sourced in Perth and transported by one of QE's third-party logistics providers to the forward operating centres.

In the event of a spill incident Santos would engage the services of a third party to provide and maintain inventory for the duration of oil spill operations.

The disposal of contaminated PPE is provided by Santos' WSP.

PPE requirements for spill responders is detailed in the Santos Oil Spill Response HSE Management Manual (SO-91-RF-10016).

Radio communications

Santos would utilise the services of a specialist communication provider to hire hand-held and vehicle mounted UHF radios to support response and clean-up personnel. Portable deployed repeater stations (battery or mains powered) can be positioned along the shoreline to provide a 'voting' system for transmitting and receiving during the clean-up operation. Communication equipment will be supplied through local, national, and international suppliers as the operational situation dictates.

For Exmouth region response operations Santos would request the use of Woodsides radio communication trailers based in Perth. These trailers are licenced for locations in Exmouth and along the Ningaloo coast and permit land, sea and air radio communications.