Santos

Ningaloo Vision Operations Oil Pollution Emergency Plan (Van Gogh and Coniston-Novara fields)

PROJECT / FACILITY	Ningaloo Vision
REVIEW INTERVAL	60 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s Managerial/Technical/Site	Approver
4	**Senior Adviser – Oil Spill Response**	**Team Lead – Security & ER**	**General Manager – HSE**

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REV No	DATE	REVISION
A	10/7/13	Internal review
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3.1	31/08/17	Internal update, including: Apache to Santos WA name change Updated Santos WA spill response arrangements Updated DoT spill response arrangements
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4	27/3/20	5-year regulatory revision – submission to NOPSEMA

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DoT	●	
AMSA	●	
OSRL	●	
Internet – Public Notices	●	
Intranet – Emergency Preparedness	●	

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</table>

Parameter	Description			Further Information
	FPSO collision with third-party vessel (surface spill)	Van Gogh[1] crude	8,630	
	Surface diesel release (surface spill)	Marine Diesel Oil	1,787	
Hydrocarbon Properties	Van Gogh[1,2] crude Density kg/m^3 at 15°C = 952.3 Dynamic viscosity (cSt) = 31.21 @ 70° C API Gravity = 17.0 Marine Diesel Oil (MDO) Density kg/m^3 at 25°C = 829 Dynamic viscosity (cP) = 4 @ 25° C API Gravity = 37.6			**Appendix A**
Weathering Potential	**Van Gogh[1] crude** is a heavy crude oil with a relatively high degree of persistence in the marine environment. Under moderate winds (5m/s), 80% of the initial surface slick is expected to remain after 5 days. **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	Ningaloo Coast north, Muiron Islands, Ningaloo Coast south, Montebello Islands, Barrow Island and Outer Shark Bay Coast			**Section 6.7**

[1] Van Gogh crude refers to crude oil from either Van Gogh, Coniston or Novara wells which is applicable for the well leak scenario or a blend of up to all three of these oils for the flowline and cargo tank release scenarios.

[2] Properties taken from Intertek (2019) assay of Van Gogh crude oil which represents a blend of crude from Van Gogh, Coniston or Novara wells. These properties are representative of a blend of up to all three oils or each oil separately.

2 First Strike Response Actions

The initial response actions to major incidents at the Ningaloo Vision FPSO are outlined within the Ningaloo Vision Incident Response Plan (NV IRP) (TV-22-IF-00005) and are under the direction of the designated On-scene Commander. The NV IRP includes site- and role-specific information relevant to the initial stages of an incident response including raising the alarm, mustering of personnel, ESD of facility infrastructure and medical evacuation. The NV IRP nominates the On-scene Commander as the Ningaloo Vision Offshore Installation Manager (OIM) when the FPSO is connected to the DTM. When the FPSO is disconnected from the DTM and operating as a ship at sea, the Marine and Safety Supervisor (MSS) is the Vessel Master and On-scene Commander.

For spills from support vessels and offtake tankers, 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 Plans (SOPEPS)).

Response information contained within this OPEP is concerned primarily with a large scale (Level 2/3) hydrocarbon spill where the Perth-based IMT and CSTs are engaged for support. Level 1 spills do not typically require the stand-up of the IMT/CST for support, however on-site response actions to monitor the spill and regulatory requirements for reporting these spills still apply. 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 (NV Incident Response Plan or vessel-specific procedures, as applicable)	On-scene Commander/ Vessel Master
Immediate	Control the source using site resources, where possible	Implement site source control procedures (NV Incident Response Plan or Vessel SOPEP, as applicable)	On-scene Commander/ Vessel Master
30 minutes of incident being identified	Notify Santos Offshore Duty Manager	Verbal communication to Offshore Duty Manager's 's duty phone	On-scene Commander
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
60 minutes	Gain situational awareness and begin onsite spill surveillance	Level 1 spills may only require use of onsite resources to conduct monitor and evaluate activities (e.g. vessel surveillance and tracking buoys). Refer Activate the Monitor and Evaluate Plan (**Section 10**).	On-scene Commander Incident Commander
Refer timeframes Go to **Section 7**	Make regulatory notifications within regulatory timeframes	Activate the External Notifications and Reporting Procedures Go to **Section 7**	Initial notifications by Environment/ Safety Team Leads
Level 2/3 spills (in addition to actions above)			

When (indicative)	Activations		Who
	Objective	Action	
Immediately once notified of spill (to Incident Commander)	Activate IMT, if required	Notify IMT	Duty Manager Incident Commander
IMT Actions (0-48 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 (OSROs) and Support Organisations, as required	Go to **Section 7**	Initial notifications by Environment/ Safety Team Leads OSRO (AMOSC and OSRL) activation by designated call-out authorities (Incident Commanders/ Duty Managers)
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 10.5**) Operational Water Quality Monitoring **(Section 10.7)**	IMT Operations Team Leader IMT Logistics/ Supply Team Leaders IMT Environment Team Leaders

When (indicative)	Activations		Who
	Objective	Action	
		Shoreline and Coastal Habitat Assessment (**Section 10.8**)	
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 (Drilling Team Leader as appropriate to scenario) IMT Logistics/ Supply Team Leaders
Activate on Day 1 for applicable scenarios Refer **Section 12** and/or **13**	Reduce exposure of shorelines and wildlife to floating oil through mechanical/ chemical dispersion	For crude 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 NEBA	Review situational awareness and spill trajectory modelling Review strategic NEBA and begin operational NEBA (**Section 6.7**)	IMT Environmental Team Leader
Day 1	Develop forward operational base/s to support forward operations	Begin planning for forward operations base as per Forward Operations Plan. **Appendix P**	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	IMT Safety Team Leader

When (indicative)	Activations		Who
	Objective	Action	
		Refer Oil Spill Recovery Safety Management Plan (QE-91-RF-10016)	
If/when initiated Refer **Section 16**	Protect identified shoreline protection priorities	Activate Shoreline Protection and Deflection Plan. Go to **Section 16**	IMT Operations Team Leader IMT Logistics/ Supply Team Leaders IMT Environment Team Leader
If/when initiated Refer **Section 18**	Prevent or reduce impacts to wildlife	Activate the Oiled Wildlife Response Plan. Go to **Section 18**	IMT Environment Team Leader IMT Operations Team Leader IMT Logistics/ Supply Team Leaders
If/when initiated Refer **Section 20**	Assess and monitor impacts from spill and response	Activate the Scientific Monitoring Plan – Go to **Section 20**	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 17**	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 19**	IMT Operations Team Leader IMT Logistics/ Supply Team Leaders
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 WA will maintain control for those activities for which it is the designated Control Agency/ Lead IMT. • Depending on the specifics of the spill AMSA and/or DoT may be relevant Control Agencies (refer **Section 4.2**).		Control Agency IMT Santos WA to provide the following roles to DoT MEECC/IMT for State waters response: CMT Liaison Officer IMT Liaison Officer Intelligence Support Officer

When (indicative)	Activations		Who
	Objective	Action	
	• Where another Control Agency has taken control of aspects of the response, Santos WA will provide support to that Control Agency. Santos WA's support to DoT for a State waters response is detailed in **Section 5.2.3**.		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 (FOB)

3 Introduction

This document is the accompanying Oil Pollution Emergency Plan (OPEP) to the *Ningaloo Vision Operations Environment Plan (EP) WA-35-L* (*TV-00-RI-00003*) 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 WA recovers oil from the Van Gogh, Coniston and Novara oil fields in production licence area WA-35-L using the Ningaloo Vision floating production, storage and offloading (FPSO) facility.

Oil is recovered through production wells and subsea equipment that directs production liquids to the FPSO for processing and storage. As part of the operational activities, produced water and gas (besides gas required for fuel and gas lift) are reinjected and a tanker offloads the recovered oil on a regular basis. Support vessels provide logistical support for loading of supplies, offloading of wastes, oil spill response and carrying out of maintenance and inspection activities.

Refer to Section 2 of the *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003)* for detail on the activity.

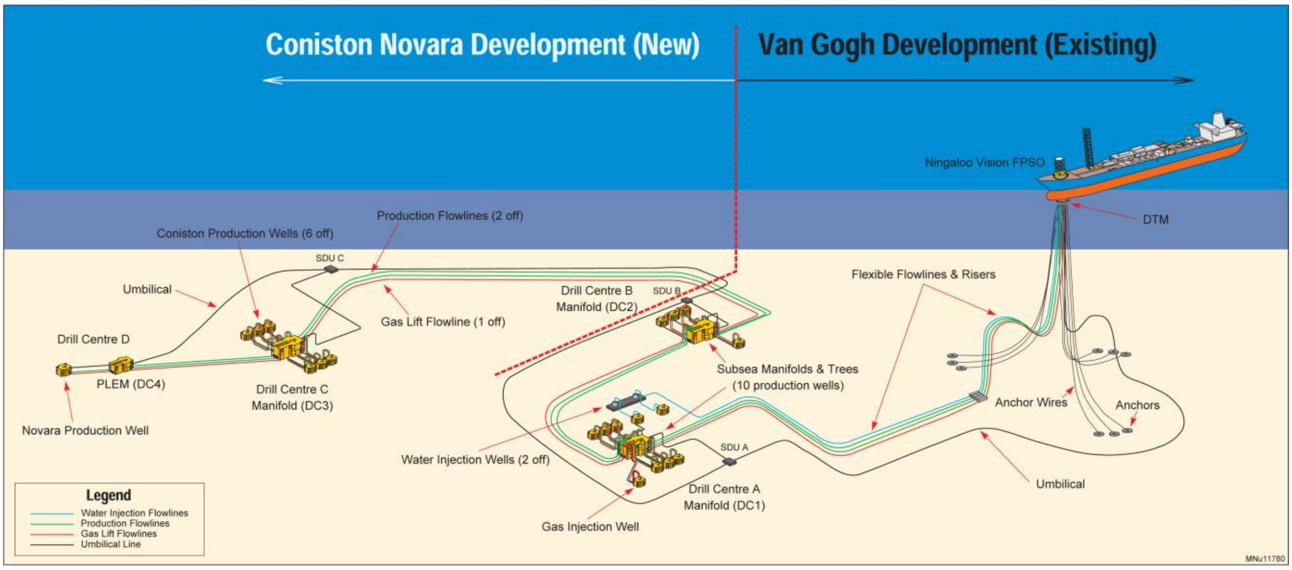

Figure 3-1: Schematic of the Ningaloo Vision FPSO and subsea infrastructure

3.2 Purpose

The purpose of this Oil Pollution Emergency Plan (OPEP) is to describe Santos WA's response to a hydrocarbon spill during operation of the Ningaloo Vision FPSO and associated subsea infrastructure.

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 the Australian Maritime Safety Authority (AMSA) and the WA State Hazard Plan for Maritime Environmental Emergencies (MEE).

This OPEP is to be read in conjunction with the *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003)* 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 WA *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003)* and will remain valid for the duration of life of the EP. Operations include the commissioning of new wells associated with the Van Gogh and Coniston Novara reservoirs. If improved preparedness measures are identified within this time frame the OPEP will be revised accordingly.

The response strategies outlined in this OPEP have been developed by Santos WA 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 Net Environmental Benefit Assessment' (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 WA's Incident Management Team (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 WA 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; and
+ 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 Van Gogh, Coniston and Novara fields are located within Production Licence WA-35-L in Commonwealth waters, 45 km north-northwest off the Cape Range Peninsula in Western Australia. It is located 53 km north-northwest of the Exmouth township and 29 km from the northern boundary of Ningaloo Marine Park (see **Figure 3-2**). The development is positioned in water depths ranging from 340 m in the east of the production licence to 400 m depth in the west, with the FPSO moored in a water depth of 341 m AHD and the two manifolds in respectively 367.5 m (DC1) and 362 m (DC2) AHD.

Section 3 of the *Ningaloo Vision Operations Environment Plan (EP) (TV-00-RI-00003)* includes a comprehensive description of the existing environment. A summary of nearest regional features and distances from the Van Gogh field and Coniston / Novara fields are provided in **Table 3-1**.

Table 3-1: Distances from Van Gogh/ Coniston Novara fields to key regional features

Regional Feature	Distance from Coniston / Novara fields	Distance from Van Gogh Field (and direction)
Ningaloo Marine Park (boundary) – State waters	36 km S	30 km S
Ningaloo Reef proper	48 km SSE	43 km SSE
State/Commonwealth waters boundary	41 km SE	35 km SE
Muiron Islands Marine Management Area	38 km SE	35 km SE
Muiron Island South	45 km SE	41 km SE
Barrow Island	146 km NE	141 km NE
North West Cape (mainland WA)	50 km SSE	44 km SSE
Exmouth (Mainland WA)	65 km S	59 km S

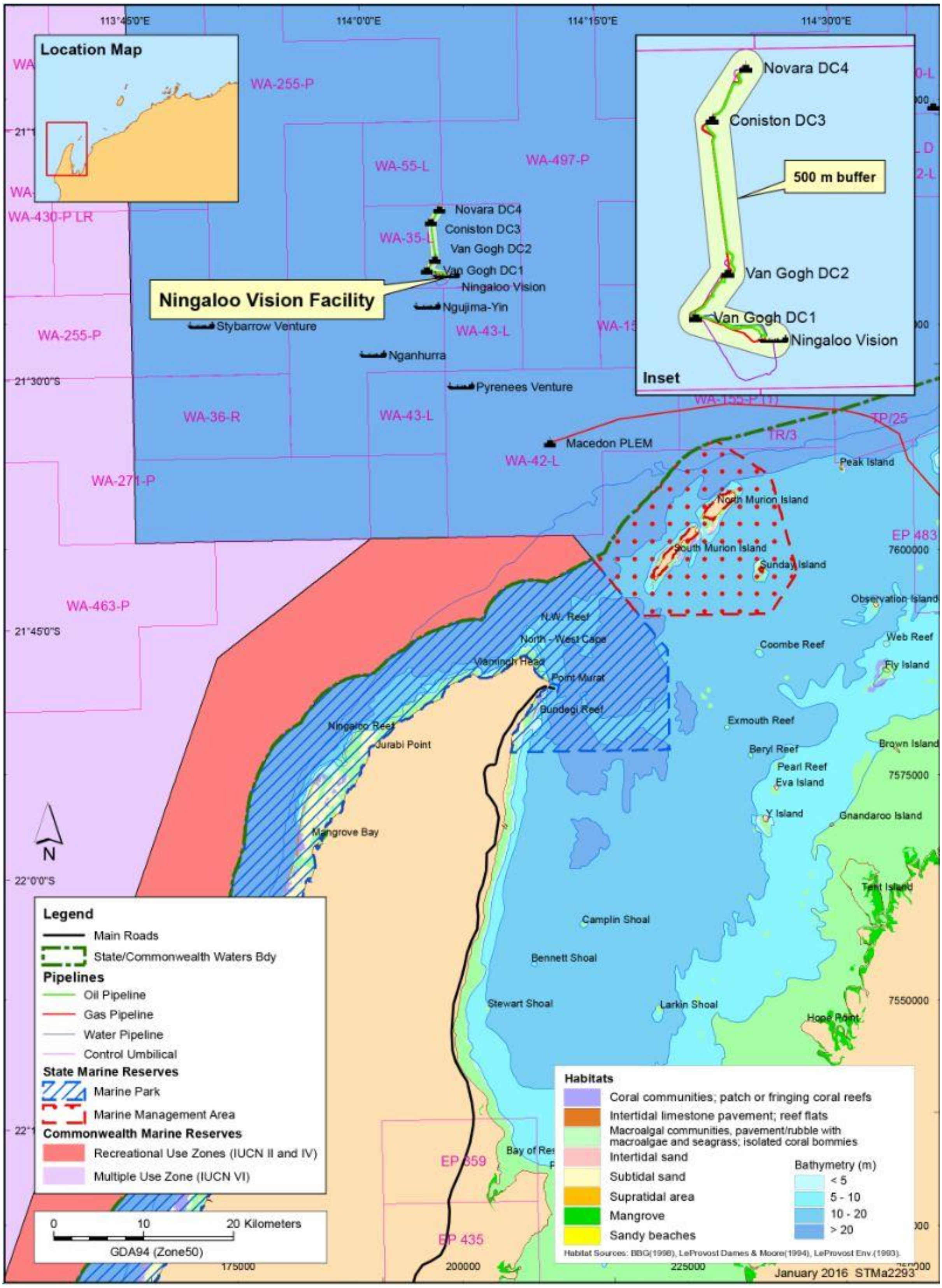

Figure 3-2: Ningaloo Vision location map and regional features

3.5 Interface with Internal Documents

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

+ Incident Command & Management Manual (QE-00-ZF-00025);
+ Santos Energy Incident and Crisis Management Bridging Procedure;
+ Ningaloo Vision Operations Environment Plan (TV-00-RI-00003);
+ Ningaloo Vision Incident Response Plan (TV-22-IF-00005);
+ Berthing and Terminal Handbook (TV-22-IG-00067);
+ Offtake Operational & Pilotage Procedure (NV-91-IG-10010.03);
+ Bunkering Operations Procedure (NV-91-IG-10006.03);
+ Ningaloo Vision Shipboard Oil Pollution Emergency Plan (SOPEP) (NV-00-ZF-100001);
+ Incident Response Telephone Directory (QE-00-ZF-00025.020);
+ Incident Reporting Guideline Environmental Approvals Supporting Information (QE-91-ZF-10003);
+ Refuelling and Chemical Management Standard (QE-91-IQ-00098);
+ Source Control Emergency Response Plan (DR-00-ZF-10001);
+ Van Gogh Well Operations Management Plan (DR-91-ZG-10006);
+ Coniston Novara Well Operations Management Plan (DR-91-ZG-140);
+ NWA Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053);
+ Oil Spill Response HSE Manual (QE-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 (QE-00-BI-20001); and
+ Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001).

4 Oil Spill Response Framework

4.1 Spill Response Levels

Santos WA uses a tiered system of incident response levels consistent with State and National incident response plans including the State Hazard Plan: Maritime Environmental Emergencies and the National Plan for Maritime Environmental Emergencies (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 WA Incident Command and Management Manual (QE-00-ZF-00025) and further detailed in **Table 4-1** below for hydrocarbon spills.

Table 4-1: Santos WA 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 WA 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 Incident Response Team (IRT) 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 WA 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 Controlling 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; and
+ 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 Ningaloo Vision operations, 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 vs a facility spill the following guidance is adopted:

+ A vessel is a ship at sea to which 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; and
+ The Ningaloo Vision FPSO is considered a facility when connected to the Detachable Turret Mooring (DTM) and a vessel when off-station. Subsea infrastructure spills and spills during the transfer of oil to a berthed offtake tanker are also classified as facility spills under the OPGGS Act.

Table 4-2: Jurisdictional Authorities and Control Agencies for Ningaloo Vision 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 WA)	DoT	Petroleum Titleholder (Santos WA)	AMSA
	2/3	DoT	DoT	Petroleum Titleholder (Santos WA)	AMSA
Jurisdictional Authority	1/2/3	DoT	DoT	NOPSEMA	AMSA

[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.

4.3 Petroleum Activity Spill in Commonwealth Waters

For an offshore petroleum activity spill in Commonwealth waters the Jurisdictional Authority is 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 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 WA) is responsible for responding to an oil spill incident as the Control Agency in Commonwealth waters, in accordance with its OPEP.

Santos WA 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, Santos WA 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 Controlling Agencies will exist: DoT and the Petroleum Titleholder (Santos WA), each with its own Incident Management Team (IMT) and Lead IMT responsibilities.

The arrangements between DoT and Santos WA 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 WA 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 Controlling Agency, at which time Santos WA 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 WA providing first strike response and all necessary resources (including personnel and equipment) as a Supporting Agency.

5 Santos WA Incident Management

The Santos WA Incident Management Team (IMT) (Perth), Crisis Support Team (CST) (Perth) and Crisis Management Team (CMT) (Adelaide) 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 Controlling Agency as the incident progresses. The Santos WA response structure to a major emergency incident is detailed in the Incident Command and Management Manual (ICMM) (QE-00-ZF-00025) and Santos WA Energy Incident and Crisis Management Bridging Procedure (SQBP). The ICMM and SQBP describes response planning and incident management that would operate under emergency conditions – describing how the Santos WA IMT operates and interfaces with the CST 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, CST and CMT will be dependent on the severity and type of spill and the obligations of Santos WA and other agencies/authorities in the coordinated spill response.

Santos WA's incident response structure relevant to a Ningaloo Vision incident includes:

+ Ningaloo Vision Incident Response Team (IRT);
+ Santos Offshore Incident Management Team (IMT) – Perth based to coordinate and execute responses to an oil spill incident;
+ Santos Offshore Crisis Support Team (CST) and Santos corporate Crisis Management Team (CMT) - to coordinate and manage threats to the company's reputation and to handle Santos WA's corporate requirements as an operator; and
+ Other field-based command, response and monitoring teams for implementing strategies outlined within the OPEP.

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

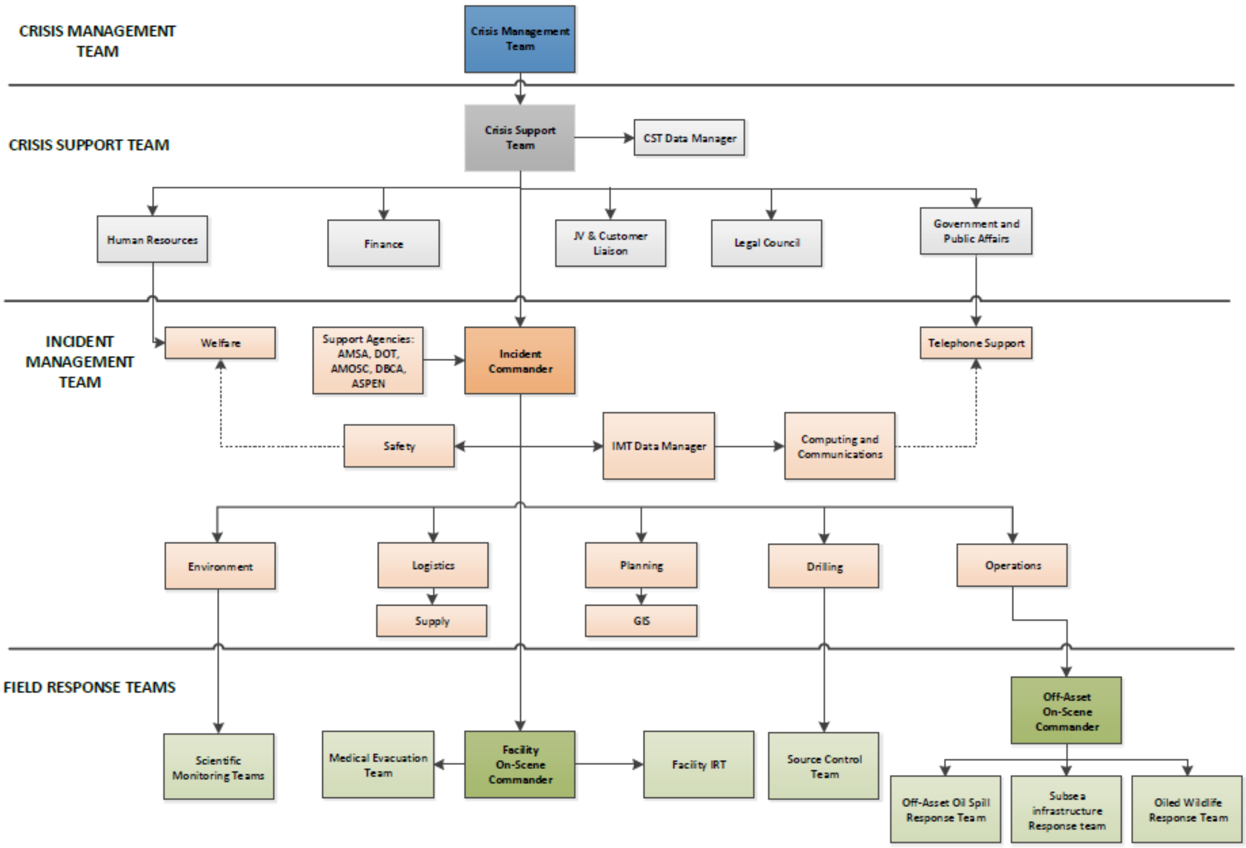

Figure 5-1: Santos WA Incident Response Organisational Structure

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

5.1 Roles and Responsibilities

The tables below provide an overview of the responsibilities of the Santos WA CST (**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 WA 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 two roles to the Santos WA CST/IMT in a coordinated response. These are also outlined for reference (**Table 5-4)**.

Santos

Table 5-1: Roles and Responsibilities in the Crisis Support Team (CST)

CST Member	Main Responsibilities
CST Leader	+ Notify Santos WA Crisis Duty Manager + Provide incident briefing and ongoing updates to CMT + Identify reputational issues and relevant local stakeholders + Set objectives and tasks for CST functional roles
Legal Counsel	+ Advise CST Leader on on-going legal aspects + Manage insurance issues + Liaise with CMT Legal & Insurance
Government Relations/Media Advisor	+ Liaise with Santos WA CMT GPA Team with respect to overall media strategy + Liaise with State government agencies and other local stakeholders + Manage messaging to Santos WA employees + Activate Santos WA external call centre arrangements + Manage release of communications briefs to the external call centre
JV Coordinator / Customer Liaison	+ Manage all communication between Santos WA and JV partners/ customers + Liaise with the GPA to ensure consistent message with JVs and Customers
Finance	+ Track costs and advise CMT Finance and JV Partners of financial commitments in the response + Liaise with CMT Finance Team with respect to access to funds
Human Resource Team Leader	+ Liaise with CMT HR Team + Keep CST updated of personnel activities + Validate media and holding statements releasable information with regards to Santos WA personnel matters + Work with CST Public Affairs on content of internal statements to staff + Put EAP 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 (NOK) notifications for affected personnel (excluding Police managed fatalities) + Determine NOK 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 EAP counselling at airports and homes where required – HR personnel to attend where possible

CST Member	Main Responsibilities
CST Data Manager	+ Ensure CST Centre resources are in place and functional + Distribute manuals, contact lists and supporting information to CST personnel + Records and collects all information associated with the response to the incident + Maintain filing system for Incident Response

Table 5-2: Roles and Responsibilities in the Incident Management Team (IMT)

Santos WA IMT Member	Main Responsibilities
Incident Commander	+ Coordinate all onshore support in accordance with the 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 Incident Action Plans + Oversee implementation of MoUs and contracted support for 'mutual aid' + Ensure co-ordination with external organisations/police, etc. + Prepare and review strategic and tactical objectives with the CST + Liaise with the CST and provide factual information + Set response termination criteria in consultation with regulatory authorities
Planning Team Leader	+ Collect and document situational awareness information of the incident + Develop, document, communicate and implement Incident Action Plans to achieve incident objectives + Determine the status of action/s or planned activities under the Incident Action Plans and assess and document performance against the objectives. + Assess long term consequences of incident and plan for long term recovery + Manage the 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 + Liaise with contractors or third parties + Mobilise additional Santos WA staff and external experts to form Technical Support Team + Assist Planning Team Leader with overall general plan preparation and preparation of Incident Action Plans + Implement Incident Action Plans + Manage field response teams and activities
Logistics Team Leader	+ Mobilise response equipment, helicopters, vessels, supplies and personnel

Santos WA IMT Member	Main Responsibilities
	+ Provide transport and accommodation for evacuated personnel + Oversee the implementation of the Waste Management Plan throughout a Tier 2 or Tier 3 oil spill response. + Liaise with the Supply Team to activate supply contracts and arrange procurements + Coordinate authorities for search and rescue
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 Incident Action Plans + 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
Welfare Team Leader	+ Obtain personnel status involved in the incident + Review POB lists and clarify accuracy through Safety Team Leader + Obtain list of Contactor Companies involved in the incident and obtain 3rd-Party Contractor contact to advise of situation and safety of personnel when appropriate + Liaise with 3rd-Party Contractor contact regarding their personnel and organise handover + Obtain employee’s emergency contact list (NOK) to advise of situation and safety of personnel when appropriate + Take instructions from the CST HR Team Leader + Work with Logistics Team Leader to arrange transport for affected families to hospitals etc. + Assist with arrangements through EAP to support families/employees
Safety Team Leader	+ Manage notification to Designated Safety Authorities and liaise as required + Assist in the development of Incident Action Plans + 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

Santos WA IMT Member	Main Responsibilities
	+ 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
GIS Support	+ 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

Table 5-3: Roles and Responsibilities in the Field-Based Response Team

Field-Based Position	Main Responsibilities
Ningaloo Vision On-Scene Commander	+ Commands the onsite response to NV incidents, including oil spills, using onsite resources, including the Facility IRT + Notifies the Perth based Incident Commander of Level 2/3 incidents, including oil spills, requiring offsite support + Single point of communications between facility/site and IMT
Ningaloo Vision Incident Response Team (IRT)	+ Respond to incidents under the instruction of an Incident Response Team Leader in accordance with actions developed by the NV On Scene Commander.
Off-Asset On Scene Commander	+ Coordinates the field response as outlined in the Incident Action Plan developed by the IMT + Commands a Forward Operating Base (FOB) for the coordination of resources mobilised to site
Off-Asset Oil Spill Response Teams	+ Undertake oil spill response activities as defined in Incident Action Plans and Oil Pollution Emergency Plans.
Source Control Team	+ Respond to incidents involving well loss of containment to stop the flow of oil to sea + Refer to the Source Control Emergency Response Plan (DR-00-ZF-1001) 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

Field-Based Position	Main Responsibilities
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 WA's CST/IMT

DoT roles embedded within Santos WA's CST/IMT	Main Responsibilities
DoT Liaison Officer	+ Provide a direct liaison between the Santos WA CST and the MEECC + Facilitate effective communications between DoT's SMEEC and the Incident Controller and Santos WA' appointed CST Commander and Incident Controller + 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 WA + Facilitate the provision of technical advice from DoT to Santos WA's Incident Controller as required
Media Liaison Officer	+ Provide a direct liaison between the Santos WA Media team and DoT IMT Media team + Facilitate effective communications and coordination between the Santos WA 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 WAWA Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures

Table 5-5: Santos WA Personnel Roles Embedded within the State Maritime Environmental Emergency Coordination Centre (MEECC)/ Department of Transport (DOT) IMT

Santos WA roles embedded within the State MECC/ DoT IMT	Main Responsibilities
CST Liaison Officer	+ Provide a direct liaison between the Santos WA and the State Maritime Environmental Emergency Coordination Centre (MEECC) + Facilitate effective communications and coordination between the Santos WA CST Commander and the State Maritime Environmental Emergency Coordinator (SMEEC) + Offer advice to SMEEC on matters pertaining to Santos WA crisis management policies and procedures
Deputy Incident Officer	+ Provide a direct liaison between the DoT IMT and the Santos WA IMT + Facilitate effective communications and coordination between the Santos WA Incident Commander and the DoT Incident Controller + Offer advice to the DoT Incident Controller on matters pertaining to the Santos WA incident response policies and procedures + Offer advice to the Safety Coordinator on matters pertaining to Santos WA safety policies and procedures particularly as they relate to Santos WA employees or contractors operating under the control of the DoT IMT
Intelligence Support Officer	+ As part of the 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 WA IMT + Assist in the interpretation of modelling and predictions originating from the Santos WA IMT + Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Santos WA IMT + Facilitate the provision of relevant mapping from the Santos WA IMT + Assist in the interpretation of mapping originating from the Santos WA IMT + Facilitate the provision of relevant mapping originating from the Santos WA IMT
Deputy Planning Officer	+ As part of the 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 WA IMT + Assist in the interpretation of the Santos WA OPEP from Santos WA + Assist in the interpretation of the Santos WA IAP and sub plans from the Santos WA IMT + Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the Santos WA IMT + Assist in the interpretation of Santos WA's existing resource plans

Santos WA roles embedded within the State MECC/ DoT IMT	Main Responsibilities
	+ Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the Santos WA IMT + (Note this individual must have intimate knowledge of the relevant Santos WA OPEP and planning processes)
Environmental Support Officer	+ As part of the Planning Team, assist the Environmental Officer 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 WA OPEP and relevant TRP plans + Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the Santos WA IMT + Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Santos WA IMT
Public Information Support & Media Liaison Officer	+ As part of the Public Information Team, provide a direct liaison between the Santos WA Media team and DoT IMT Media team + Facilitate effective communications and coordination between Santos WA 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 WA media policies and procedures + Facilitate effective communications and coordination between Santos WA 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 WA community liaison policies and procedures + Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the Santos WA IMT
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 WA's existing OSRL, AMOSC and private contract arrangements + Collects Request Forms from DoT to action via the Santos WA IMT + (Note this individual must have intimate knowledge of the relevant Santos WA logistics processes and contracts)
Facilities Support Officer	+ As part of the Logistics Team, assist the Logistics Officer Supply in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters

Santos WA roles embedded within the State MECC/ DoT IMT	Main Responsibilities
	+ Facilitate the acquisition of appropriate services and supplies through Santos WA's existing private contract arrangements related to waste management + Collects Waste Collection Request Forms from DoT to action via the Santos WA 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 WA's existing OSRL, AMOSC and private contract arrangements + Facilitate the communication of financial monitoring information to the Santos WA 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 WA
Deputy On Scene Commander (FOB)	+ Provide a direct liaison between Santos WA's Forward Operations Base/s (FOB/s) and the DoT FOB + Facilitate effective communications and coordination between Santos WA On Scene Commander and the DoT On Scene Commander + Offer advice to the DoT On Scene Commander on matters pertaining to Santos WA 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 WA employees or contractors + Offer advice to the Safety Coordinator deployed in the FOB on matters pertaining to Santos WA safety policies and procedures

5.2 Regulatory Arrangements and External Support

5.2.1 Australian Marine Oil Spill Centre (AMOSC)

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 WA requirements, as outlined in Santos WA 's *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 WA, BHPB, Chevron and Woodside have signed a Memorandum of Understanding (MOU) that defines the group's mutual aid arrangements. Under this MoU, Santos WA, 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)

The 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 on +61 2 62306811.

A Memorandum of Understanding (MOU) has been established between Santos WA 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 National Plan for Maritime Environmental Emergencies (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 WA agrees to notify AMSA immediately in the interests of facilitating the most efficient and effective response to the incident.

5.2.3 WA Department of Transport (DoT)

In the event that a Level 2/3 that enters, or has potential to enter, State waters, the HMA (DoT Marine Safety General Manager or proxy) will take on the role as the State Maritime Environmental Coordinator (SMEEC) and DoT will take on the role as a Control Agency.

Santos WA will notify the DoT Maritime Environmental Emergency Response (MEER) unit as soon as reasonably practicable (within 2 hours of spill occurring). On notification, the HMA will activate their Maritime Environmental Emergency Coordination Centre (MEECC) and the DoT Incident Management Team (IMT).

For facility oil spills entering State waters (i.e. across jurisdictions) both Santos WA and DoT will be Control Agencies. Santos WA 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: https://www.transport.wa.gov.au/imarine/oil-spill-contingency-plans.asp).

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

Annex 1 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 WA during a cross jurisdictional response, a Joint Strategic Coordination Committee (JSCC) will be established. The JSCC will be jointly chaired between the SMEEC and a nominated senior representative of Santos WA and will ensure alignment of objectives and provide a mechanism for de-conflicting priorities and resourcing requests.

As with a single jurisdiction response, Santos WA will be responsible for ensuring adequate resources are provided to DoT as Control Agency, including 10x 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.

Figure 5-2 shows the cross jurisdictional organisational structure for a petroleum facility spill where both the Santos WA IMT and DoT IMT will provide a coordinated response.

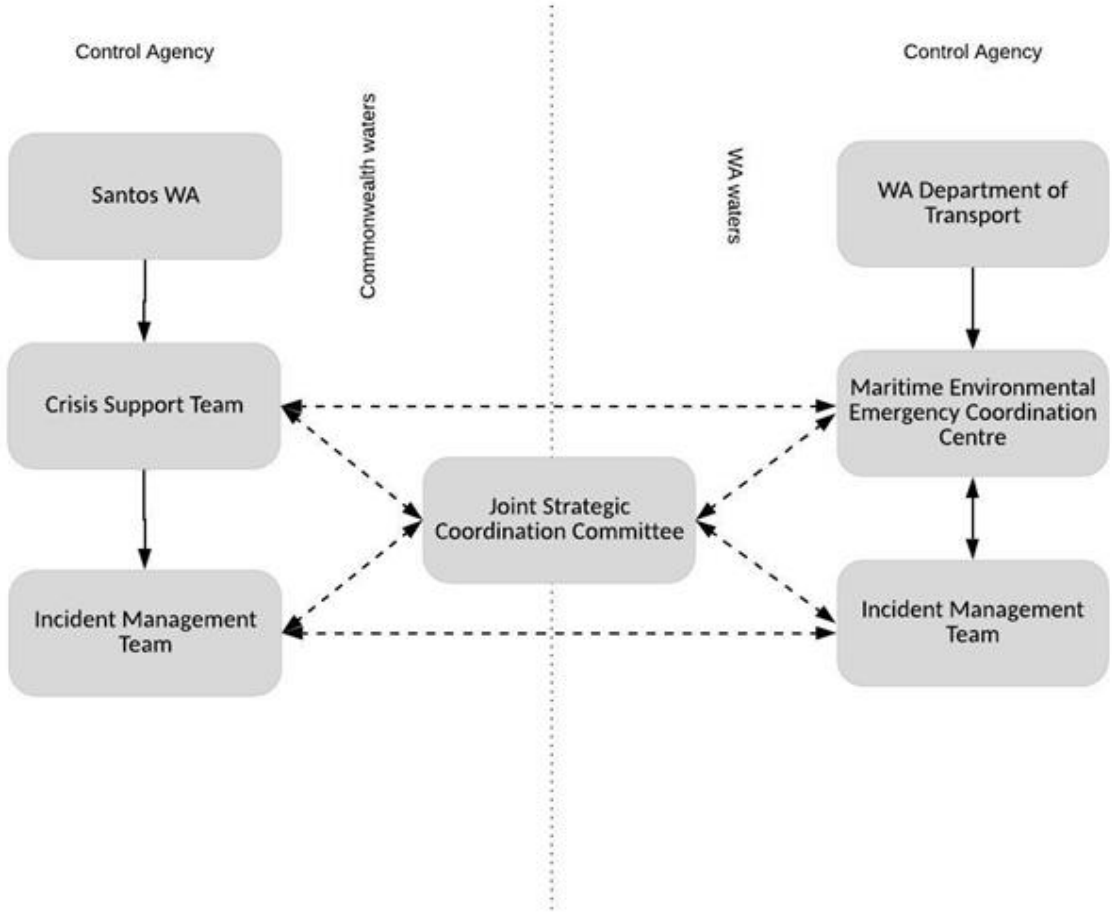

Figure 5-2: Santos WA incident management structure for Commonwealth waters Level 2/3 facility oil pollution incident entering State water

5.2.4 WA Department of Biodiversity, Conservation and Attractions (DBCA)

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 WA 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 (ESC) to support the State Maritime Environmental Emergency Coordinator 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 (OSRL)

Through an associate membership, Santos WA has access to spill response services from Oil Spill Response Limited (OSRL) with offices in Perth, Singapore, UK and at other various locations around the. In the event of a Level 2/3 response, Santos WA 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 (SLA). Santos WA also has access to additional dispersant stockpiles held by OSRL through a Global Dispersant Stockpile (GDS) Supplementary Agreement.

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.
+ 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.
+ 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: https://www.transport.wa.gov.au/imarine/oil-spill-contingency-plans.asp).
+ Shipboard Oil Pollution Emergency Plans (SOPEP)

- Under 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 (WAOWRP)
  - 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 Ningaloo Vision operations.
+ Oil Spill Response Limited (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 Controlling Agencies (e.g. DoT) and third party spill response service providers.

5.5 Training and Exercises

5.5.1 Incident Management Team and Crisis Support Team Training and Exercises

Santos WA provides training to its personnel to fill all required positions within the IMT and Crisis Support Team (CST).

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

Table 5-6: Training and Exercise Requirements for CST/IMT Positions

CST Role	Exercise	Training
CST Leader	1 x Level 3 exercise annually or 3 x Level 3 desktop exercises annually.	+ PMAOMIR320 + AMOSC – Oil Spill Response Familiarisation Training
CST Members: Finance Team Leader GPA Team Leader JV Coordinator/ Legal Team Leader Data Manager		
IMT Role	**Exercise**	**Training**
Incident Commander Operations/ Drilling Team Leader	1 x Level 2 exercise annually or 3 x Level 2 desktop exercises annually.	+ PMAOMIR320; + PMAOMIR418; and + AMOSC – IMO3 Oil Spill Command & Control;

Planning Team Leader Logistics Team Leader Environmental Team Leader		+ PMAOMIR320; and + AMOSC – IMO2 Oil Spill Management Course
Safety Team Leader Supply Team Leader GIS Team Leader Data Manager HR/ Welfare Team Leader		+ PMAOMIR320; and + 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 2 years). AMOSC – IMO1 Oil Spill Operators Course	12
Santos WA Facility Incident 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 Incident Response Plan On-scene commander to have AMOSC – Oil Spill Response Familiarisation Training.	One IR team per operational facility per shift.
Santos WA 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.	AMOSC Core Group Workshop (refresher training undertaken every 2 years).	As defined in Core Group Member Reports Min.84

Responder	Role	Training	Available Number
	For providing incident management (IMT) and operations (field response) assistance.	AMOSC – IMO1 Oil Spill Operators Course and/or IMO2 Oil Spill Management Course	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 4)	Refer OPEP Section 15 and Appendix M.		
Monitoring Service Provider: Monitoring Coordination Team (MCT) and SMP Teams	Monitoring Coordination Team (MCT) SMP 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 – 5 personnel SMP 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 Controlling Agency:

+ National Plan: National Response Team (NRT) – 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 NRT is trained and managed in accordance with the National Response Team Policy, approved by the National Plan Strategic Coordination Committee (AMSA, 2013b); and

- State Hazard Plan for Maritime Environmental Emergencies (MEE) : State Response Team (SRT) and northwest Regional Response Team (RRT) – Oil pollution response teams available to assist under the jurisdiction of the DoT. SRT and RRT members remain trained and accredited in line with the State Hazard Plan (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 WA AMOSC Core Group Responders and then industry Core Group Responders.

5.5.3 Response Testing

Following acceptance of an OPEP, notifcation 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 1 year.

CST and 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 WA conducts IMT/CST 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 WA 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 WA as a sole responder and through Santos WA's 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 WA Training and Induction Database (Learning Management System). Key actions arising from exercises are recorded and tracked through the Santos WA 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 (QE-92-HG-10001) is reviewed and revised annually.

5.5.5 Oil Spill Response Audits

Oil spill response audits will follow the Santos WA Assurance Procedure (QE-91-IQ-10022) and are scheduled as per the Santos WA 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 WA 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 2 years. The intent of this audit is to provide assurances to Santos WA of OSRL's ability to respond to an oil spill incident as per its service level agreement (SLA).

The objectives and frequency of oil spill response testing and auditing relevant to Varanus Island Commonwealth 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 (QE-00-ZF-00025.20)
IMT/CST Workshops	To refresh IMT & CST roles and responsibilities and provide familiarisation with OPEP processes and arrangements.	As per Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001)	All workshops undertaken are recorded in Santos WA's Learning Management System.
OPEP Desktop and Activation Exercise	Desktop Exercise To familiarise IMT with functions and process in response to a simulated oil spill scenario Activation Exercise To activate full IMT/CST in response to oil spill scenario and test arrangements contained within OPEP	As per Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001) Minimum of one oil spill response activation oil spill exercise per year.	All exercises undertaken are recorded in Santos WA's Learning Management System. Key recommendations are recorded are tracked in Santos WA's Action Tracking System.
Response arrangement tests	Tests of response arrangements outlined within the OPEP either as part of desktop/ activation exercises or as standalone desktop tests	As per Incident and Crisis Management Training and Exercise Plan (QE-92-HG-10001)	Test reports are recorded
Equipment deployment exercises/ tests	To focus on Santos WA's 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 (QE-92-HG-10001)	Reports are generated for exercises and recorded in Santos WA's Learning Management System. Key recommendations are recorded are tracked in Santos

Exercise	Objective	Frequency	Recording and review
		The following Santos-owned equipment is inspected and/or tested Tracker buoys Offshore boom/ nearshore boom Power packs Vessel dispersant spray systems	WA's Action Tracking System. Tracker Buoy tests are recorded.
AMOSC audit	To test deployment readiness and capability of AMOSC.	Every 2 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 2 years.	Undertaken by Santos WA 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 Ningaloo Vision operations. Of the credible spill scenarios identified in the *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003)*, a sub-set 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 Ningaloo Vision operations;
+ 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; and
+ 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 *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003)*.

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 Ningaloo Vision operations

Worst-case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)	Release duration	Maximum extent of surface hydrocarbons >1g/m^2
Production Well Leak (subsea spill)	Van Gogh Crude	10,236	100 days	~400 km
Flowline rupture (subsea spill)	Van Gogh Crude	1,681	24 hours	~350 km
FPSO collision with third-party vessel (surface spill)	Van Gogh Crude	8,630	1 hour	~450 km
Surface diesel release (surface spill)	Marine Diesel Oil	1,787	1 hour	~280 km
Surface Heavy Fuel Oil release (surface spill)	Heavy Fuel Oil	950	1 hour	~300 km

6.2 Response planning thresholds

Environmental impact assessment thresholds are addressed in **Section 7.5.3** 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 N**)
>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 50g/m^2.

Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50-100g/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) 1-3 (EMSA, 2010) (Table 13-2).

6.3 Stochastic spill modelling results

Table 6-3 presents the spill modelling results 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.

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.

Results for the various scenarios have only been included if there was:

+ A greater than 5 % probability of 100 g/m^2 of hydrocarbons accumulated on the shoreline, as this is both the threshold for response and impact.[3]

Modelling results for dissolved and entrained oil for the worst case scenarios have not been included given there are limited response strategies that will reduce subsurface impacts.

Refer to **Section 7.5** of the EP for further description on selection of oil exposure values presented in **Table 6-3**.

[3] Santos uses a minimum threshold of 100g/m^2 (which equates to an oil thickness of 0.1mm) to determine the lower limit for effective shoreline clean-up operations.

Table 6-3: Worst-case Spill Modelling Results for Ningaloo Vision Operations

Spill Scenario			Receptor/s						
Event	**Oil Type**	**Maximum volume (m^3) /duration**	**Location**	**Total contact probability (%) >10g/m^2**	**Minimum arrival time >10g/m^2 (days)**	**Total contact probability (%) >100 g/m^2**	**Minimum arrival time >100 g/m^2 (days)**	**Maximum total accumulated oil ashore (tonnes) >100 g/m^2**	**Maximum length of shoreline oiled (km) >100 g/m^2**
Production Well Leak (subsea spill)	Van Gogh Crude	10,236/ 100 days	Ningaloo Coast North	100	2.4	100	2.2	446.3	204
			Ningaloo Coast South	63	8.2	18.7	8.8	37.5	85
			Muiron Islands	81	4.3	74.7	4.3	85.8	17
			Montebello Islands	28.7	14.5	15.3	13.8	15.8	21.2
			Barrow Island	38	10.6	26	11.4	31.1	38.2
			Thevenard Island	15.3	9	9.3	9	3.1	8.5
			Outer Shark Bay Coast	65.3	24.1	7.3	14.9	3.4	12.7

Spill Scenario			Receptor/s						
Event	Oil Type	Maximum volume (m^3) /duration	Location	Total contact probability (%) >10g/m^2	Minimum arrival time >10g/m^2 (days)	Total contact probability (%) >100 g/m^2	Minimum arrival time >100 g/m^2 (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m^2	Maximum length of shoreline oiled (km) >100 g/m^2
Flowline rupture (subsea spill)	Van Gogh Crude	1,681/ 24 hours	Ningaloo Coast North	80	1.3	23.4	1.3	615.4	141.6
			Ningaloo Coast South	27	6.5	<5	6.8	71.4	127.4
			Muiron Islands	23	2.8	5	2.8	39.4	11.3
FPSO collision with third-party vessel (surface spill)	Van Gogh Crude	8,630/ 1 hour	Ningaloo Coast North	56	2.2	39	2.2	1254.4	133.1
			Muiron Islands	19.3	2.1	13	1.7	308	11.3
			Ningaloo Coast South	14	4.9	5.3	4.8	258.7	127.4
Surface diesel release	Marine Diesel Oil	1,787 / 1 hour	Ningaloo Coast North	15.3	2.2	<5	2.2	176.3	19.8

Spill Scenario			Receptor/s						
Event	Oil Type	Maximum volume (m^3) /duration	Location	Total contact probability (%) >10g/m^2	Minimum arrival time >10g/m^2 (days)	Total contact probability (%) >100 g/m^2	Minimum arrival time >100 g/m^2 (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m^2	Maximum length of shoreline oiled (km) >100 g/m^2
(surface spill)									
Surface HFO release	Heavy Fuel Oil	950 / 1 hour	Ningaloo Coast North	58.7	2.2	12	2.2	424.8	110

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.

Deterministic runs were selected for each scenario based on the largest predicted oil mass stranded on all shorelines. To help further understand the predicted effectiveness of response options, deterministic realisations were run for all of the crude oil spills both with and without the inclusion of surface dispersant application to predict its effectiveness as a mitigation strategy to reduce oil on the sea surface and shorelines. Surface dispersant application was simulated using vessel and Fixed Wing Aerial Dispersant Capability (FWADC), using the parameters described in **Table 6-4** and **Table 6-5**.

Table 6-4: Surface dispersant application parameters used in modelling

Parameter	Vessel/s	Aircraft (FWADC)
Location of operational base	Exmouth Harbour	Learmonth Airport
Daily operational hours	2 hours	0.5 hours
Maximum No. sorties	1 per day	8 per day
Dispersant application rate	1:20	
Dispersant efficacy	30% for Van Gogh Crude (Refer to Appendix A: Hydrocarbon Characteristics and Behaviour	
Minimum thickness threshold for dispersant application	>50 g/m^2	
Exclusion zones	+ Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone) + State Marine Parks + State Waters + Within 10 km of water depths <20 m LAT + Within exclusion zones of offshore facilities	

Table 6-5: Predicted asset availability used in modelling

Asset type	Timeframe for deployment		
	12-24 hours	24-48 hours	>48 hours
Vessels	1	2	5
FWADC (aircraft)	0	1	2

6.5 Dispersant mitigated scenario results

Table 6-6 presents modelling results of applying surface dispersants to the crude spill scenarios (listed in **Table 6-1).** The sections below provide an explanation of the results. These results do not take into account the application of any other spill response strategy (e.g. containment and recovery).

6.5.1 Production well leak scenario

Surface dispersant application was most effective on the production well leak scenario, due to its prolonged release duration (100 days). Modelling for this scenario predicted a total shoreline loading of ~342 tonnes (unmitigated), primarily at Ningaloo Coast North (~277 tonnes). The application of surface dispersant (as per **Table 6-4** and **Table 6-5**) reduced total shoreline loading to ~112 tonnes (reduction of 230 tonnes), with Ningaloo Coast North receiving a total of ~104 tonnes (a reduction of ~173 tonnes) under the mitigated scenario.

Additionally, the simulation found that the mass of surface (floating) oil significantly reduced from a peak of ~900 tonnes (unmitigated) to ~300-400 tonnes (mitigated). However, a reduction in surface oil was accompanied by a marginal increase in the total mass of entrained droplets within the water column for the mitigated case.

6.5.2 Flowline rupture scenario

There was a moderate reduction in the predicted shoreline loadings from the application of surface dispersants for the flowline rupture scenario. Dispersants were only applied for 5-6 days following the release (release duration of 24 hours), as the minimum oil spill thickness for effective dispersant application (50g/m^2) did not occur after this period of time.

A predicted peak shoreline loading of ~544 tonnes (unmitigated), was almost entirely shown to contact Ningaloo Coast North (~543 tonnes). The application of dispersants reduced shoreline loading by ~88 tonnes. This did result in an increase in the total mass of entrained droplets from ~100 tonnes (unmitigated) to 200-300 tonnes (mitigated) within the water column for the mitigated case over the ~5-6 days of active surface dispersant response.

6.5.3 FPSO collision with third-party vessel scenario

As the duration of this scenario was only expected to be one hour, the minimum oil spill thickness for effective dispersant application (50g/m^2) was limited. The modelling results (Table 6-6) indicate that the application of dispersants led to an increase in shoreline loading at Ningaloo Coast North for this scenario, whereas there was a reduction in shoreline loading at Ningaloo Coast South (90 tonnes (unmitigated) to 3.2 tonnes (mitigated)). This scenario also predicted a significant decrease in surface (floating) oil from 2,000 tonnes to ~500 tonnes, but this resulted in a sizeable increase in entrained droplets from ~4,500 tonnes (unmitigated) to ~6,000 tonnes (mitigated).

It appears that sub-surface currents were responsible for transporting the entrained droplets towards the Ningaloo shoreline, where they were predicted to resurface. This explains the predicted increase in shoreline loading at Ningaloo Coast North for the mitigated scenario.

Table 6-6: Spill modelling results showing application of surface dispersants as a mitigation strategy

Spill Scenario			Location	Maximum mass oil ashore (tonnes)		Minimum arrival time (days)		Peak loading time (days)	
Event	Oil Type	Maximum volume (m^3) /duration		Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated
Production Well Leak (subsea spill)	Van Gogh Crude	10,236/ 100 days	Ningaloo Coast North	276.9	104	16.5	17.4	39	38.8
			Ningaloo Coast South	7	0.9	20.6	83.8	38.6	83.9
			Muiron Islands	25.5	5.5	15.9	20.1	89.7	86.8
			Montebello Islands	16.4	NC	25.9	NC	30	NC
			Barrow Island	10.2	0.3	23.4	90.5	24.3	90.5
			Thevenard Island	NC	0.4	NC	23.1	NC	23.1
			Southern Islands Coast	6.9	1.2	20.3	86.7	91.3	89.9

Spill Scenario			Location	Maximum mass oil ashore (tonnes)		Minimum arrival time (days)		Peak loading time (days)	
Event	Oil Type	Maximum volume (m^3) /duration		Unmitigated	Mitigated	Unmitigated	Mitigated	Unmitigated	Mitigated
Flowline rupture (subsea spill)	Van Gogh Crude	1,681/ 24 hours	Ningaloo Coast North	543.5	455.4	2.4	2.3	3.2	3.2
			Muiron Islands	0.8	1.1	5	4.8	10	12.7
FPSO collision with third-party vessel (surface spill)	Van Gogh Crude	8,630/ 1 hour	Ningaloo Coast North	809.5	1057.6	2.4	2.6	10.3	10.1
			Ningaloo Coast South	90.5	3.2	5.8	6.8	9.3	22.8

6.6 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 6-7**).

Note: The information contained in **Table 6-7** has been developed by Santos WA for preparedness purposes. Santos WA 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 WA providing resources and planning assistance.

Table 6-7: Evaluation of Applicable Response Strategies

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
Source Control	Spill kits	✔ 1	✔ 1	✔ 1	Relevant for containing spills that may arise on board a vessel or FPSO.
	Secondary containment	✔ 1	✔ 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 FPSO. 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 marine environment.
	Shipboard Oil Pollution Emergency Plan (SOPEP)	✔ 1	✔ 1	✔ 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 spilt.
	flowline isolation (Emergency Shutdown (ESD))	✔ 1	X	X	Triggered automatically or manually as per Ningaloo Vision Incident Response Plan.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
	Well Emergency Shutdown (ESD)	✓ 1	X	X	
	Surface well kill	X	X	X	Not applicable given all wells are subsea.
	Capping Stack	X	X	X	Capping Stacks cannot be landed and connected to subsea wellheads under the credible production well leak scenarios outlined in the EP and this strategy is therefore not considered applicable.
	Relief well drilling	✓ 1	X	X	Relevant to for production well leak. Relief well drilling is the primary method for killing the well. To be conducted as per the Source Control Emergency Response Plan (SCERP - DR-00-ZF-10001).
In-Situ Burning	Controlled burning of oil spill	X	X	X	Not applicable to gas 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	Vessel surveillance	✓ 1	✓ 1	✓ 1	Provides real-time information on spill trajectory and behaviour (e.g. weathering).

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
Plan (Operational Monitoring)					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				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				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).
	Trajectory Modelling				Can be implemented rapidly. Predictive - provides estimate of where the oil may go, which can be used to prepare and implement other responses.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					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				Can work under large range of weather conditions (e.g. night time, cloud cover etc) Mobilisation likely to be >24 hours Requires processing May return false-positives
	Operational Water Quality Monitoring				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.
	Shoreline and Coastal Habitat Assessment				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.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					Considerable health & safety considerations. Requires trained observers. Constrained to daylight. Delayed response time.
Chemical dispersion	Vessel Application	✔ 1	X	✔ 2	*Van Gogh Crude* Van Gogh crude is a persistent hydrocarbon and has been tested for amenability to dispersants (Corexit 9500, Slickgone NS and Finasol OSR 52). Testing indicated the crude to be amenable to dispersants, particularly against fresh crude, although amenability declined rapidly once the hydrocarbon had weathered (>3 days). 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, especially if hydrocarbon is relatively fresh. SSDI is only suitable for the well leak, not suitable for surface spills and not suitable for flowline rupture (because the worst case leak is a finite volume predicted to be released within 24 hours). For the well leak scenario worst case leak rate and expression of oil at the surface are expected to be well within the suitable parameters for surface dispersant application and containment and recovery for these reasons 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. The effectiveness of SSDI for low flow leak scenarios, such as the worst case well leak scenario, is
	Aerial Application	✔ 1	X	✔ 2	
	Subsea dispersant injection (SSDI)	✔ 2	X	X	

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					unknown. A potential drawback of SSDI is that it will result in smaller droplet sizes and entrainment of hydrocarbons into the water column, which may affect some oceanic and benthic organisms (e.g. fish, plankton). However, this is likely to be temporary and restricted to the top ~3m of the water column whilst SSDI is being used (RPS, 2019). This increase in entrainment is partially offset by significant increases in biodegradation rates. *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. *Heavy Fuel Oil* Some dispersants are effective on different HFO/IFO's, although effectiveness rapidly decreases as the product weathers. Testing conducted by the New Zealand Maritime Safety Authority indicated that Corexit 9500 and Slickgone EW were most effective on a range of IFOs and heavy fuel oils (Stevens and Roberts, 2003). Due to the persistent and viscous nature of this product, it is expected that repeated application or increased dispersant dosage ratios will be required to achieve the recommended treatment rate of dispersant. Consideration should be given to any impacts this may cause on sub-surface receptors and the location of spraying.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
Offshore Containment and Recovery	Use of offshore booms/ skimmers or other collection techniques deployed from vessel/s to contain and collect oil.	✔ 1	X	✔ 1	*Van Gogh Crude* Likely to be effective on Van Gogh Crude, as it is a more persistent hydrocarbon and is likely to have a sufficient thickness on the water for some time after release due to its relatively low rates of weathering. If metocean weather conditions are unsuitable for containment and recovery (>1.8m for offshore systems and >1.0m for nearshore systems), then this will result in significantly higher rates of weathering in the product. *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. *Heavy Fuel Oil* HFO is a persistent hydrocarbon and is likely to have a sufficient thickness on the water for some time after release due to its relatively low rates of weathering. The drawbacks of this strategy include production of significant volumes of waste due to the collection of water with floating oil, however this can be mitigated to some extent if decanting is permitted.
Mechanical Dispersion	Vessel prop-washing	✔ 2	✔ 2	X	Safety is a key factor and slicks with potential for high VOC emission are not suitable.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					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. It is not considered to be effective on HFO given this oil is resistant to entrainment. 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.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					Mechanical dispersion will be considered for petroleum activity sourced spills at the discretion of the On-Scene Commander/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.
Protection and Deflection	Booming in nearshore waters and at shorelines	✔ 1	✔ 2	✔ 1	Considered if operational monitoring shows or predicts contact with sensitive shorelines. *Van Gogh Crude* Modelling shows high probability of contact, above impact and response thresholds for some 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 is 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*

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					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. *Heavy Fuel Oil* Heavy Fuel Oil is a persistent hydrocarbon, and once it makes contact with shorelines, it has the potential to impact sensitive receptors and create considerable volumes of waste during shoreline clean-up activities. Therefore, protecting shorelines from contact is important. Protection and deflection 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.
Shoreline clean-up	Activities include physical removal, surf washing, flushing, bioremediation, natural dispersion	✔1	✔2	✔1	Considered if operational monitoring shows or predicts contact with sensitive shorelines. *Van Gogh Crude and Heavy Fuel Oil* 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

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					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, PPE, 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 low probability of contact with shorelines. 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 priority protection areas are at risk of impacts from marine diesel.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
Oiled wildlife response	Activities include hazing, pre-emptive capture, oiled wildlife capture, cleaning and rehabilitation.	✔ 1	✔ 2	✔ 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	✔ 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)

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy			Considerations
		Van Gogh Crude	Diesel	Heavy Fuel Oil	
					+ 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.

6.7 Identify Priority Protection Areas and Initial Response Priorities

Combined spill modelling results were used to predict the Environment that may be Affected (EMBA) for Ningaloo Vision operations (refer **Section 3.1** of the Ningaloo Vision Operations Environment Plan WA-35 – L (Van Gogh/Coniston/Novara Fields)). The EMBA is the largest area within which impacts from hydrocarbons spills associated with this activity, could extend. Within the EMBA, Santos WA has determined Hot Spots (key areas of high ecological value that have the greatest potential to be impacted by a Ningaloo Vision operational spill) for which detailed oil spill risk assessment as been conducted (refer **Section 7.5.6.3** of the Ningaloo Vision Operations Environment Plan WA-35 – L). From these Hot Spot areas, priority protection areas for spill response have been identified (as per **Section 7.5.6.4** of the Ningaloo Vision Operations Environment Plan WA-35 – L). Protection priority 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 6-8 to **Table 6-12** 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 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 production well leak scenario, Ningaloo Coast has the shortest time to shoreline contact (modelled to be 2.4 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 mangroves (Mangrove Bay and Yardie Creek), turtles (nesting seasons higher priority and listed in tables below) and World Heritage Area values. As the spill progresses, additional priority protection areas are likely to be impacted, however, modelling predicts time to impact ranges from 4.3 days at Muiron Islands to 24 days for Outer Shark Bay Coast. 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.

Table 6-8: Initial Response Priorities during a Production Well Leak (subsea spill of Van Gogh Crude)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
Ningaloo Coast	World Heritage Area	5	5	N/A	N/A	508[6]	2.4	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles – loggerhead (Endangered), green (Vulnerable)	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-Mar with peak in late Dec/early Jan			High
	<u>Marine mammals</u> Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr-Aug Humpback whale migration: Jun-Jul			Medium

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

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

[6] Total for Ningaloo North and Ningaloo South (469m^3 + 39m^3)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar-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: Sept-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
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site, significant Green turtle	4	3	Loggerhead – south island	Turtle nesting and breeding Nov-Mar with peak in late Dec/early Jan	89	4.3	High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	(Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence							
	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-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
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	32.7	10.6	Medium
	Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne	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	Year-round, peaking Oct - Jan			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Beach, loggerheads and hawksbill			John Wayne Beach have loggerhead and hawksbill turtle nesting				
	Birds Migratory birds (important habitat); 10th of top 147 bird sites, Highest population of migratory birds in Barrow Island Nature reserve (south-south east island), Double Island has important bird nesting (shearwaters, sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sept-Feb			Medium
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct			Low
	Socio-economic Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations	5	5	Reverse Osmosis plant and port on eastern side of Island	N/A			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	16.6	14.5	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-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-Aug Humpback whale migration: Jun-Jul			Low
	<u>Birds</u> Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sept-Feb			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (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)	2	2	Widespread	Year-round			Low
Thevenard Island	Turtles –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-Mar with peak in late Dec/early Jan	3.2	9	Medium
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Birds Migratory seabirds Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sept-Feb			Low
	Socio-economic Eco-tourism (Mackerel Islands Resort) Very significant for recreational fishing, diving	1	1	Widespread	Year-round			Low
Outer Shark Bay Coast	World Heritage Area	5	5	N/A	N/A	3.5	24.1	Medium
	Marine mammals Humpback whale migration path and resting area. Dugongs (breeding and foraging)	3	2	N/A	Humpback whale migration: Jun-Jul			Low
	Cultural Heritage Cape Inscription (Dirk Hartog Island) earliest European landing in Australia (Dirk Hartog on 1616)	4	3	Cape Inscription	N/A			Low
	Socio-economic	1	2	Widespread	Year round			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[4]	DoT Ranking (Dissolved oil)[5]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Tourism, fishing, campsites and Surf Point Sanctuary Zone, sightseeing, Steep Point							

Table 6-9: Initial Response Priorities during a Flowline Rupture (subsea spill of Van Gogh Crude)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[7]	DoT Ranking (Dissolved oil)[8]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
Ningaloo Coast	World Heritage Area	5	5	N/A	N/A	722	1.3	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles – loggerhead (Endangered), green (Vulnerable)	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-Mar with peak in late Dec/early Jan			High
	<u>Marine mammals</u> Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr-Aug Humpback whale			Medium

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

[8] 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)[7]	DoT Ranking (Dissolved oil)[8]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
					migration: Jun-Jul			
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar-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: Sept-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
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site,	4	3	Loggerhead – south island	Turtle nesting and	41.5	2.8	High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[7]	DoT Ranking (Dissolved oil)[8]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	significant Green turtle (Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence				breeding Nov-Mar with peak in late Dec/early Jan			
	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-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

Table 6-10: Initial Response Priorities during a FPSO collision with third-party vessel (surface spill of Van Gogh Crude)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[9]	DoT Ranking (Dissolved oil)[10]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
Ningaloo Coast	World Heritage Area	5	5	N/A	N/A	1,592	2.2	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles – loggerhead (Endangered), green (Vulnerable)	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-Mar with peak in late Dec/early Jan			High
	<u>Marine mammals</u> Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr-Aug Humpback whale migration: Jun-Jul			Medium

9 Provision of Western Australian Marine Oil Pollution Risk Assessment - Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017)

10 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)[9]	DoT Ranking (Dissolved oil)[10]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	<u>Sharks and rays</u> Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar-Jul			Medium
	<u>Birds</u> 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: Sept-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
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site, significant Green turtle (Vulnerable) nesting	4	3	Loggerhead – south island	Turtle nesting and breeding Nov-Mar with peak in late Dec/early Jan	324	1.7	High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[9]	DoT Ranking (Dissolved oil)[10]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence							
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			High
	Seabird nesting	2	1	Widespread	Nesting: Sept-Feb			Low
	Humpback whale (Vulnerable) migration	3	2	N/A	Jun-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

Table 6-11: Initial Response Priorities during a surface MDO release (surface spill)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)[12]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
Ningaloo Coast	World Heritage Area	5	5	N/A	N/A	176	2.2	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles – loggerhead (Endangered), green (Vulnerable)	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-Mar with peak in late Dec/early Jan			High
	Marine mammals Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr-Aug Humpback whale migration: Jun-Jul			Medium

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

[12] 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)[11]	DoT Ranking (Dissolved oil)[12]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar-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: Sept-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

Table 6-12: Initial Response Priorities during a surface HFO release (surface spill)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[13]	DoT Ranking (Dissolved oil)[14]	Key locations	Relevant key periods	Maximum time-averaged oil ashore (m^3) $>100g/m^2$	Minimum arrival time (days)	Initial response priority
Ningaloo Coast	World Heritage Area	5	5	N/A	N/A	424	2.2	High
	Mangroves	3	3	Mangrove Bay Yardie Creek	N/A			High
	Turtles – loggerhead (Endangered), green (Vulnerable)	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-Mar with peak in late Dec/early Jan			High
	<u>Marine mammals</u> Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	3	2	N/A	Pygmy blue whale migration: Apr-Aug Humpback whale migration: Jun-Jul			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 time-averaged oil ashore (m^3) >100g/m^2	Minimum arrival time (days)	Initial response priority
	Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	2	3	N/A	Whale sharks – Mar-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: Sept-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

6.8 Net Environmental Benefit Analysis (NEBA)

The IMT use the NEBA process to inform the development and refinement of IAPs, 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 6.7 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 WA and DoT, consultation will be required during the NEBA process such that there is consistency in the sensitivities prioritised for response across the Controlling 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 6-13** to **Table 6-15**). While not all spill response activities included in the strategic NEBA would be under the control of Santos WA 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 6-8** to **Table 6-12);** and
+ 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 WA ER Intranet site. To complete the Operational NEBA:

+ All ecological and socioeconomic sensitivities identified within the spill trajectory area are recorded; and
+ Potential effects of response strategies on each sensitivity are assessed in terms of their benefit or otherwise to the socioeconmonic sensitivities.

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 6-13: Strategic NEBA Matrix Table - Van Gogh Crude

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
Ningaloo Coast										
Turtle nesting – loggerhead, green										
Mangroves – Mangrove Bay and Yardie Creek									N/A	
Coral and other subsea benthic primary producers - largest fringing reef in Australia, lagoonal, intertidal and subtidal corals, Seagrass and macroalgae bed									N/A	
Whale sharks and manta rays										
Tourism - significant fishing/ charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)										

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
Seabird nesting - incl. breeding areas at Mangrove Bay, Mangrove Point, Point Maud, Mildura wreck and Fraser Island										
Humpback/ Pygmy blue whale migration										
Muiron Islands										
Turtle nesting – major loggerhead site, significant Green turtle nesting site										
Coral and other subsea benthic primary producers									N/A	
Seabird nesting										
Humpback whale migration										
Tourism - significant fishing/charter boat tourism										
Montebello Islands										

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
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										
Barrow Island										
Turtle nesting – particularly flatback (western side) and										

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
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	
Seabird nesting - incl. Double Island										
Migratory shorebirds - particularly Bandicoot Bay										
Aboriginal listed sites incl. pearling camps										
Thevenard Island										
Turtle nesting – green, hawksbill and flatback turtles										
Coral and other subsea benthic primary producers								N/A	N/A	

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
Seabird nesting										
Eco-tourism (Mackerel Islands Resort) and recreational fishing, diving										
Outer Shark Bay Coast										
Humpback whale migration path and resting area. Dugongs (breeding and foraging)										
European heritage site at Cape Inscription										
Tourism, fishing, campsites and Surf Point Sanctuary Zone, sightseeing, Steep Point										
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.									

Table 6-14: Strategic NEBA Matrix Table - Marine Diesel Oil

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
Ningaloo Coast										
Turtle nesting – loggerhead, green										
Mangroves – Mangrove Bay and Yardie Creek									N/A	
Coral and other subsea benthic primary producers - largest fringing reef in Australia, lagoonal, intertidal and subtidal corals, Seagrass and macroalgae bed									N/A	
Whale sharks and manta rays										
Tourism - significant fishing/ charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)										

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
Seabird nesting - incl. breeding areas at Mangrove Bay, Mangrove Point, Point Maud, Mildura wreck and Fraser Island										
Humpback/ Pygmy blue whale migration										
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.									

Table 6-15: Strategic NEBA Matrix Table – Heavy Fuel Oil

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
Ningaloo Coast										
Turtle nesting – loggerhead, green										
Mangroves – Mangrove Bay and Yardie Creek									N/A	
Coral and other subsea benthic primary producers - largest fringing reef in Australia, lagoonal, intertidal and subtidal corals, Seagrass and macroalgae bed									N/A	
Whale sharks and manta rays										
Tourism - significant fishing/ charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)										

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
Seabird nesting - incl. breeding areas at Mangrove Bay, Mangrove Point, Point Maud, Mildura wreck and Fraser Island										
Humpback/ Pygmy blue whale migration										
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.									

6.9 Response Resources ALARP Assessment

A detailed ALARP assessment on the adequacy of resourcing available to support spill response strategies and control measures is presented in **Table 6-16**.

Table 6-16: ALARP assessment of the resourcing for spill response strategies

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
Source Control-Relief Well Drilling	Contract/MoUs for source control personnel Santos WA Drilling and Completions Source Control Team APPEA MoU for mutual assistance for relief well drilling MODU Capability Register	Santos WA's Drilling and Completions Source Control Team will work in collaboration with external Source Control specialists whom will be mobilised within 3 days of the LOWC. The monthly monitoring of the availability of MODUs, and the APPEA MoU for mutual assistance for relief well drilling, enable access to suitable MODUs and associated personnel. It could take up to 34 days to have a MODU onsite. This is due to the time required for the MODU to suspend current operations, prepare, and move to the relief well location. A Safety Case Revision for the relief well MODU will be submitted within 14 days of the LOWC. The critical path time allowed for the actual writing of the document is 3 days. The remaining estimated time would be used for gathering post-	Santos WA base case timeframe for the drilling of a relief well is 77 days. Access to source control specialists is not considered limiting nor a factor in the base case timeframe. A MODU on standby close to the well location for the duration of any drilling operations reduces the timeframe to mobilise a MODU to site which potentially reduces the overall timeframe to limit the hydrocarbon released.	The total cost of having a MODU on standby is about $600,000 per day. If adopted this cost is paid regardless if there is a loss of containment event or not.	The likelihood of a LOWC is considered rare and the cost and the additional safety and environmental risks of having another MODU and support equipment/personnel on standby is considered grossly disproportionate to the environmental benefit gained. The current source control arrangements are considered adequate to provide the required function.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		event data, mobilising the workforce and conducting a HAZID. 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 HAZID.			
Monitor and Evaluate- Aerial Surveillance	Helicopter services available through Santos WA's primary contracted supplier based out of Karratha. Activation of aerial surveillance using helicopter pilots will occur within 3 hours of notification of the spill. Trained Aerial Observers (7) will be available from Day 2 of the incident, following activation (based in Perth and Santos WA facilities).	Given location of spill sites, mobilisation of helicopters from Karratha/ Exmouth is considered adequate for surveillance. Endurance is not considered a limiting factor at these locations. Current arrangements can provide for 2 passes (am and pm) of the spill area per day. This has been exercised as part of major spill exercises. Trained Aerial Observers can mobilise to Karratha or Exmouth for Day 2 operations. Day 1 surveillance and recording using helicopter pilots considered adequate for initial situational awareness.	Resource not considered limiting. Primary supplier on contract with additional providers available to provide desired overpass frequency. Santos WA trained observers can be provided on rotation from Day 2.	No additional preparatory costs as helicopters are currently contracted for day-to-day operations to and from Santos WA facilities. In the event that additional passes are required due to data gaps, the cost of the additional flights will be added to the cost of the response.	There is no value in increasing dedicated overpasses; therefore, the arrangements are considered ALARP. However, opportunistic aerial surveillance can be provided through the shared use of aircraft deployed for other purposes.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
Monitor and Evaluate- Vessel Surveillance	On-hire vessels supporting Santos WA's VI and Ningaloo Vision facilities. Vessel of opportunity from other operators. Additional vessels contracted through Santos WA vessel providers out of Exmouth and Dampier. Santos WA has access to automatic identification system live-vessel tracking portal to establish vessel availability. Vessel surveillance will be activated within 90 minutes for available on-site (at VI) vessels.	On-contract vessels performing duties at Ningaloo Vision and VI may be available, as well as vessels of opportunity from other petroleum operators. Additional mobilisation from Exmouth/Dampier can be made through Santos WA's contracted vessel providers. This strategy is not designed to perform 'whole of spill' coverage, which is provided by aerial surveillance (i.e., it is a secondary strategy).	Based on the close proximity of the activity to Exmouth, dedicated additional vessels for the purpose of oil spill surveillance is not considered to be required. Surveillance will also be conducted through a number of complementary strategies (aerial surveillance, oil spill trajectory modelling, tracker buoys).	The current vessel arrangements are considered to provide the required function. Dedicated vessels on standby for vessel surveillance would cost tens of thousands of dollars per day and are not considered required.	There is no benefit in having additional dedicated surveillance vessels, given surveillance can be performed from any vessel; and these duties will be shared amongst spill response vessels.
Monitor and Evaluate- Oil Spill fate Modelling	24/7 standby Oil Spill Trajectory Modelling (OSTM) service provider. OSTM provider will be contacted immediately	OSTM provider 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	Predictive oil spill modelling will be used to forecast (using real-time data) the trajectory and fate of the spill. Resource is not considered limiting with	Santos WA pays for the provision of the standby service by OSTM provider. This is considered to provide the required function.	There is no benefit in having additional modelling capability given that OSTM provider have staff based across Australia

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	(within 2 hours) upon notification of a Level 2 or 3 spill (as per **Section 4.1** of this OPEP). Spill modelling to be initiated within 24 hours. Upon activation, OSTM provider will provide trajectory models within: 2 hours for OILMAP model for offshore and open ocean; and 4 hours for OILMAP operation for near-shore.	suddenly. Operational surveillance data (aerial, vessel, tracker buoys) will be provided to OSTM provider to verify and adjust fate predictions of the spill and improve predictive accuracy.	no environmental benefit from dedicating additional modelling capability.		and can provide 24/7 coverage.
Monitor and Evaluate-Tracker Buoys	Up to 12 Santos WA tracker buoys (at different Santos WA facilities); two are immediately available on NV FPSO and deployment can be at a staggered rate determined by the need to track oil	In addition to aerial surveillance, tracker buoys are an additional strategy to provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance). 12 buoys are sufficient to enable timely retrieval and redeployment. Two are available on the NV FPSO	Additional buoys are available through secondary suppliers (e.g., AMOSC, OSRL and AMSA – more than 20 buoys available) if required. Dedicated vessels are not required given that	Santos WA has 12 buoys linked to a satellite-tracking website designed for first strike deployment across its operational facilities. No additional buoys need to be purchased by Santos WA given secondary availability through	The number of buoys immediately available and the availability of secondary buoys within days is sufficient to cover tracking of oil fronts, especially given the spread of oil will be limited within the initial days of the spill.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	heading towards sensitive receptors. Subscription to tracker buoy tracking website. Santos WA on-hire vessels and vessels of opportunity for buoy deployment. Subject to weather and vessel availability, the tracker buoys can be mobilised within 2 hours upon request from the IMT or on-scene commander.	Vessels for buoy deployment will be Santos WA on-hire vessels and other operators of vessels of opportunity. Vessels can be shared across this and other tasks (e.g., surveillance and tracker buoy deployment).	the need is met through vessel sharing.	AMSA, AMOSC, OSRL within days. There is no additional upfront cost for accessing these secondary buoys.	Therefore, no additional requirements and the response is considered ALARP.
Monitor and Evaluate- Satellite Imagery	Contract in place with third party provider to enable access and analysis of satellite imagery	Suitable imagery can be accessed through existing contracts with AMOSC and OSRL. The most appropriate images for purchase will depend on the extent and location of the spill. Frequency of reporting is subject to satellite overflight schedule.	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. Given the adequate provision of satellite imagery and analysis through a third-party	Not considered required.	The current satellite imagery arrangements are considered adequate to provide the required function.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
			provider there is no requirement for additional resources.		
Monitor and Evaluate-Water Quality Monitoring (operational and scientific)	Fluorometers (for hydrocarbon detection) within subsea gliders or towed fluorometers. CTD (conductivity, temperature, and depth) meters, including fluorometry and dissolved oxygen sensors. Water sampling equipment (e.g., Niskin bottles, jars). Water quality monitoring personnel. Glider Field Engineer for deployment and recovery. Dedicated vessels for towed fluorometers, CTD meter deployment, water sampling.	CTD meters with fluorometers and water sampling equipment available locally and to be arranged through Santos WA's contracted scientific monitoring provider. Contractual standby arrangements are in place for rapid activation, planning and deployment of operational water quality monitoring personnel. Mobilisation of personnel within 72 hours of approved monitoring action plan. Equipment mobilisation times from third party providers are also within this time frame. Santos WA has field tested deployment of subsea gliders and data transfer using local provider (Blue Ocean Monitoring) with access to gliders within Australia and the USA. Gliders and towed fluorometers are available through contract	There are locally available subsea gliders and access to towed fluorometers. Water sampling equipment and CTD meters are also available locally and within Australia. Water sampling equipment is not considered a bottleneck to deployment. Given multiple access avenues to equipment, dedicated equipment (i.e., purchased or standby on-hire equipment) is not considered required. Deployment personnel will initially be provided through Santos WA's contracted monitoring provider. Local subsea glider and personnel	Santos WA's contracted scientific monitoring provider is on an existing standby footing in Perth with mobilisation time of personnel to site within 72 hours following approved monitoring action plan based on incident specifics. An enhanced standby with vessels, equipment and personnel all prepositioned for immediate deployment would cost in the order of tens of thousands of dollars per day. Similarly, subsea gliders set-up and prepositioned on standby for immediate deployment would cost in in the order of tens of thousands of dollars.	The existing arrangements are considered sufficient to provide targeted operational water quality monitoring to priority sites as identified through oil spill modelling and surveillance.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Vessels of opportunity (vessel sharing) for subsea glider deployment. Oil sample collected using a vessel of opportunity and analysed on VI or in Perth.	with OSRL – located in Singapore.	are through OSRL contract.		
Monitor and Evaluate – Shoreline and Coastal Habitat Assessment	Spill response teams (AMOSC core group, State Response Team) Santos WA GIS resources Santos WA contracted vessels and vehicles available as required for shoreline access	Shoreline Assessment strategies will be implemented under the direction of DoT as the HMA. AMOSC contract to facilitate mutual aid arrangements for access to Oil Spill Responders. Santos WA will make available AMOSC Core Group Responders for shoreline and coastal habitat assessment positions. Existing detailed sensitivity mapping of the Ningaloo Coast has occurred and is available on the Santos WA ER Intranet site – notwithstanding this	Personnel and equipment for shoreline and coastal habitat assessment is not considered limiting and deployment could occur prior to shoreline contact. The pre-positioning of personnel and/or pre-assessment of shorelines prior to a spill is considered of limited benefit since: • Existing sensitivity mapping exists which provides background information on	Not considered required.	The existing arrangements are considered sufficient to provide a first strike shoreline and coastal habitat assessment in addition to supporting DoT.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		would need to be ground-truthed again in a spill event. A collision with the FPSO and crude oil spill under worst case environmental conditions could result in contact by oil to coastal areas (above 100 g/m^2) at the Muiron Islands (1.7 days), Ningaloo coast north (2.2 days) and Ningaloo coast south (4.8 days). First-strike deployment arrangements would come from AMOSC staff and Industry Core Group personnel based in Perth or NW Australia. This includes Santos WA AMOSC Core Group personnel. Santos WA maintains the capability to mobilise shoreline and coastal habitat assessment to site 24 hours following initiation.	habitats and access points. • Shorelines will change constantly with seasonal variations so any detailed pre-assessments would have to be done regularly. • Equipment requirements are low, and travel times are not considered a key limiting factor.		
Monitor and Evaluate – Wildlife Reconnaissance (aerial/ vessel surveillance.	Spill response teams (Santos WA and AMOSC core group, State Response Team)	First strike wildlife reconnaissance will rely on personnel conducting monitor and evaluate activities (aerial and vessel surveillance) with all wildlife sightings reported (including wildlife contacted	Having experienced fauna observers and dedicated helicopters and vessels on standby for targeted fauna surveys from the very start of the spill could	The cost of personnel, helicopters and vessels on standby for this purpose would cost in the order of	The current arrangements, in terms of using monitor and evaluate surveillance to provide the initial wildlife reconnaissance,

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
Shoreline and coastal habitat assessment)	Santos WA and AMOSC Core Group Aerial Observers. Santos WA contracted helicopters, vessels and vehicles available as required. Third party Scientific Monitoring Wildlife aerial observers	with hydrocarbons or at risk of contact) in or near the spill trajectory and during shoreline and coastal habitat assessments. Access to experienced fauna aerial observers and targeted fauna surveys will occur through activation of the third-party scientific monitoring provider as per scientific monitoring arrangements. This may occur within 72 hours following an approved monitoring action plan	result in improving the quality of data initially received.	tens of thousands of dollars per day.	followed by targeted fauna surveys with experienced fauna observers as part of the scientific monitoring program, are considered adequate. The cost of having dedicated personnel and helicopter(s)/vessels on standby is considered grossly disproportionate to the environmental benefit gained.
Mechanical dispersion	On-hire vessels supporting Santos WA's VI and Ningaloo Vision facilities. Vessel of opportunity from other operators.	Mechanical dispersion may be beneficial depending upon the state of the hydrocarbon, weather conditions and proximity of oil to sensitive receptors. It is a strategy that therefore depends on situational awareness gathered at the time of the incident. This strategy targets discrete patches of oil in an opportunistic manner and can be undertaken by vessels	Given there will be on-hire vessels supporting the activities and the central location of activity relative to Exmouth and Dampier, dedicated additional vessels specifically for the purpose of mechanical dispersion are not considered to be required, particularly given this strategy can	The current vessel arrangements are considered to provide the required function given this strategy is applied opportunistically. Vessels and crew on standby would cost tens of thousands of dollars per day and is not considered required based on the	The strategy depends on conditions at time of the spill and can be delivered by vessels co-tasked with other activities. Therefore, the ongoing vessel access arrangements and vessels contracted are considered adequate.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		performing other duties. Dedicated vessels are therefore not considered to be required. Mechanical dispersion may be considered for targeted small breakaway patches of crude but may have limited effectiveness. It is not considered to be effective on HFO given this oil is resistant to entrainment.	be tasked through vessel sharing.	limited value they would provide.	
Surface chemical dispersant application	Access to the Australian stockpiles of chemical dispersants is via AMOSC and AMSA. Access to international stockpiles is via OSRL Contracts that allow access to world-wide dispersant stockpiles. Vessels spray systems (4) are owned and maintained by Santos and located in Exmouth and Dampier. Access to Fixed Wing Aerial Dispersant Aircraft and associated personnel (from	Dispersant addition modelling indicates that dispersant supplies sufficient for worst case oil treatment can be met through Australian stockpiles within required timeframes. Additional international stockpiles are in excess of 5,000 m^{3}. Access to aircraft and personnel through AMOSC under contract conditions. Aircraft on contract and 4 hours wheels up from notification. Aircraft in WA and NT can be onsite within 24 hours. Santos regularly tests the mobilisation, set-up and operation of vessel spray	Additional resources are not considered necessary however having equipment/personnel at port or site location on standby could potentially deliver dispersants more quickly and allow more oil treated in the first days (up to 48 hours) of a response – the benefit of this is greatest for rapid release of oil where oil may be of reduced treatability after this period.	Resource levels are considered adequate however prepositioning could result in some benefit – this would require however full standby of personnel/ equipment/ vessels/ aircraft etc to be effective – i.e. all components of the operation are required to be ready to go for this to be effective. This is considered to be on the order of 10s to thousands of dollars per day.	The equipment and personnel are available within rapid timeframes under current arrangements. Small improvements in timeframe from full standby arrangements at port/airbase or onsite would incur significant daily costs over the entire operations (every day of the year). These are considered disproportionate based on the risk and therefore the existing

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	AMOSC/AMSA, AFR) is through AMOSC contract. Santos contracted vessel providers (preference to Santos contracted vessel providers who have participated in surface dispersant exercises)	systems in Exmouth and Dampier using locally available vessels and crew and providing Santos Core Group and AMOSC/OSRL staff with operational experience. AMOSC and Santos Core Group can be mobilised to site within 24 hours. Dispersant modelling is based on a ramp up to 5 vessels and 2 FWADC aircraft from 48 hours which is considered achievable based on resourcing arrangements.			arrangements are considered ALARP.
Containment and Recovery	Booms plus ancillary equipment (Santos WA - Dampier and VI; AMOSC – Exmouth, Fremantle and Geelong; AMSA – Fremantle and Dampier). Boom tow-vessels. Spill response teams (AMOSC, Santos WA	First-strike deployment of containment and recovery equipment is available from Exmouth, Dampier or VI using vessels, offshore boom and oil skimmers available at these locations. Oil spill responders to operate systems are available from Perth and from NW facilities. Pending vessel availability of these system they are considered to be deployable within 24 hours.	Containment and recovery equipment and personnel are not considered limiting. Vessel availability and the waste storage and transfer arrangements on vessels is considered to be a greater restriction to operations.	The operational cost of booms, skimmers, vessels and personnel on standby to enhance the number of operations available within the first few days of a response is in the order of tens of thousands of dollars per day. To be most effective this would require supplementary vessels for waste	The equipment and personnel are available within rapid timeframes under current arrangements. Small improvements in timeframe from full standby arrangements (i.e. all components for a containment and recovery operation available immediately) would incur significant daily costs over the

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	and AMOSC core group, OSRL). Waste receptacles from contracted waste service provider.	Santos WA systems are tested regularly with local vessels/crew and Santos WA core group responders to provide familiarity with equipment. Further equipment is available from AMOSC stocks in Fremantle and Geelong and through AMSA stocks in Australian stockpile locations. Pending vessel availability the stocks of equipment and operations personnel are considered to meet the resourcing requirements for an ongoing incident (e.g. prolonged well leak). Waste service provider based in Karratha and can supply waste receptacles through contracted suppliers within short notice.		transfer and storage also on standby increasing the cost significantly.	entire operations (every day of the year). These are considered disproportionate based on the risk and therefore the existing arrangements are considered ALARP.
Protection and deflection	Shoreline and nearshore booms plus ancillary equipment (Santos WA – VI; AMOSC – Exmouth, Fremantle and	Shoreline and nearshore booms provided by Santos WA or through AMOSC or AMSA are available from Exmouth, VI and Dampier within relatively close proximity to shorelines	Boom equipment is not considered limiting. Under most scenarios mobilisation of protection equipment could occur before	Having all required resources (incl spill response personnel) would involve costs in	The cost of having dedicated personnel and equipment on standby is considered grossly disproportionate to the

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Geelong; AMSA – Fremantle and Dampier). Boom tow-vessels. Vehicles. Spill response teams (AMOSC, Santos WA and AMOSC core group, OSRL). Ningaloo Coast shoreline sensitivity and access data/maps and Tactical Response Plans in place for the deployment of booms along Ningaloo Coast.	potentially contacted as predicted by modelling. Combined, multiple kilometres of boom are available from these locations. Mutual aid arrangements through AMOSC also provide access to additional booms from other operators. For operations along Ningaloo Coast equipment would be deployed initially from Exmouth stockpiles with personnel from AMOSC, Santos WA and AMOSC core group deployed from Perth or NW facilities. Mobilisation of equipment through Exmouth logistics provider on contract to Santos WA can occur immediately while response personnel deploy to location. Guidance would be from Ningaloo Coast TRPs. Worst case shoreline contact minimum timeframes to Ningaloo Coast coastal areas are from 24+ hours – this is on a similar time frame to the	contact – under worst case timeframes contact times and mobilisation times are similar. There could be potential benefit (time saving) in having all required resources (including personnel) on standby to respond in a quicker timeframe however this is considered minor. Pre-deploying boom at sensitive locations creates potential for impacts which weighed against the low risk of an oil spill and a spill reaching the location within short timeframes is deemed to be unacceptable	the order of thousands of dollars per day. If large vessels are required – i.e. for transport of equipment to Muiron Islands, the standby cost is in the order of 10s of thousands per day.	environmental benefit gained considering the availability of equipment close to contact locations personnel mobilisation from 24 hours to site.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		earliest achievable equipment mobilisation. For any operations required at offshore islands of Montebello/ Barrow/ Lowendals first-strike deployment arrangements would come from personnel and equipment based at VI. This includes Santos WA AMOSC Core Group personnel, IRT members and shoreline/nearshore booming equipment held at VI.			
Shoreline clean-up	Manual clean-up and flushing equipment (Santos WA, AMOSC, AMSA, hardware supplies). Staging infrastructure. Clean-up team leaders. (Santos WA, AMOSC core group, AMSA). Clean-up labour personnel (labour hire as required).	Shoreline clean up strategies will be implemented under the direction of DoT as the HMA with Santos WA providing resources as required. The greatest predicted shoreline loading is from the FPSO collision with third-party vessel with 1254.4 tonnes (>100 g/m^2) accumulating at the Ningaloo coast North. Applying a bulking factor of 10x waste – total waste removal would be 1,254 m^3 assuming all oil is accessible and net benefit is achieved by removing. Within	The main limitation of undertaking a shoreline clean-up response is based around access for plant and personnel to locations and supporting arrangements for these personnel. Frontline resources are not considered limiting in terms of availability and timeframes for resource deployment is considered adequate. There is considered to be limited benefit in	Clean-up resources are not considered limiting.	The current level of resources available are considered to be appropriate. There is a limit to the number of personnel and equipment that can be mobilised– both in terms of transportation, access and support arrangements and in terms of safety of responders and environmental impact.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Vessels for transport (Santos WA contracted vessel providers). Waste receptacles from contracted waste service provider.	the capacity of Santos WA arrangements with AMOSC, AMOSC core group and labour hire company this volume can be cleaned with a manual workforce of team leaders and responders. The use of mechanical aids available through hire arrangements can also be used where applicable and environmentally beneficial. For operations along Ningaloo Coast and Muiron Islands equipment would likely be deployed initially from Exmouth stockpiles with personnel from AMOSC, Santos WA and AMOSC core group deployed from Perth or NW facilities. Additional equipment is available from Karratha, Fremantle as well as local supplies (hardware) and hire equipment (mobile plant) as required. Mobilisation of equipment through Exmouth logistics provider on contract to Santos WA can occur immediately	having personnel on standby for this strategy.		

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		while response personnel deploy to location. Guidance for clean-up at priority areas at Ningaloo Coast and Muiron Island available from shoreline assessments which can leverage off shoreline sensitivity mapping of the Ningaloo coast. A sustained clean-up would potentially involve relatively large numbers of bulk clean-up personnel through labour-hire arrangements, led by clean-up team leaders. Santos has arrangements through a labour hire company which can provide up to 2000 personnel within a 2 week time period suitable for shoreline clean-up. This is considered over and above requirements based on worst case modelling.			
Waste management	Assorted waste receptacles and trucks from waste service provider.	Santos WA's waste service provider is contracted to provide first-strike and ongoing waste storage, transport and disposal requirements commensurate with a worst-	Waste contractor has access to sufficient resources for the worst-case waste requirements associated with the	Contracted resources are considered greater than required to respond to a worst-case scenario.	Resources are considered to be adequate based on worst-case modelled waste requirements.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Temporary waste tanks available through AMOSC and AMSA stockpiles (including AMOSC Exmouth stockpile). Waste service provider– project manager, local responsible personnel and operations personnel. Vessels for waste transport from offshore islands through Santos contracted providers.	case spill across Santos WA's operations and drilling activities. These resources are over and above those required for the worst-case scenarios described in this OPEP for Ningaloo Vision operations.	activity; there is no benefit to acquiring additional resources specifically for the activity. Additional equipment to manage shoreline clean-up waste on offshore islands can be accessed and replenished from the mainland during an ongoing response.		
Oiled wildlife response	Oiled wildlife response kits and containers available from AMOSC, AMSA, DBCA or DoT in Darwin, Broome, Exmouth, Karratha, Fremantle, or Kensington. Oiled Wildlife Response personnel Level 2 to 4 as per the	In Commonwealth waters, Santos WA is the control agency for an OWR in consultation with DBCA. If a spill crosses into State waters an OWR will be implemented under the direction of DoT as the HMA and Santos WA will assist the response. An operational NEBA would direct efforts for maximum	Prehire and/or prepositioning of staging areas and responders may enhance response times and hence the overall success of an OWR. Particularly for the crude oil spill scenario, the number of wildlife oiled is likely to	The cost of personnel (Level 1 responders) on standby is in order of $1,500 per person per day. This is a guaranteed cost regardless of whether a spill occurs or not. Given that personnel on this level can be arranged within relatively short timeframes there is not	The cost of setting up staging areas and having responders on standby is considered grossly disproportionate to the environmental benefit gained. The overall OWR capability Santos WA can access through AMOSC, AMOSC core

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	WA Oiled Wildlife Response Plan (AMOSC, AMOSC-activated Oiled Wildlife Response contractors, Industry Mutual Aid, DBCA. OSRL-activated Oiled Wildlife Response advisors, "Sea Alarm"). Untrained resources (level 1) through personnel-hire arrangements Level of escalation of the oiled wildlife response is under authority of the DoT incident controller with technical input from the DBCA – Oiled Wildlife Advisor.	effectiveness and ensure the response effort itself does not cause more harm. The minimum modelled contact times of accumulated hydrocarbons above 100 g/m^2 and floating hydrocarbons > 10 g/m^2 is 1.3 days at the Ningaloo coast North. The worst case volume on this receptor 1254.4 tonnes. For this scenario widespread physical oiling to wildlife could result in a level 6 OWR over time **(Section 16).** Santos WA will provide all necessary resources to assist DoT, mainly, and initially, through its access to AMOSC oiled wildlife resources. In the event of large-scale OWR, further specialised OWR equipment and personnel will be accessed through AMOSC and OSRL. Equipment and personnel required for the development and operation of staging areas/ treatment facilities can be provided locally. The Pilbara Region OWR Plan provide detail of	increase over time in association with the presence of the hydrocarbon in the environment. For this reason, the OWR should be scalable as initially only small numbers of animals are likely to be recovered. As Santos WA has access to OWR kits through 3rd party agreements that can be mobilised in a timely manner, it is not considered to be necessary to increase equipment. The available OWR kits are strategically positioned within WA enabling flexibility on locations for staging areas to be established.	considered sufficient environmental value in having dedicated OWR responders on standby. This is further supported by OWR being undertaken in consultation with relevant agencies (e.g. DoT, DBCA and DoEE) which is expected to be more of a limiting factor with regards to time than mobilising additional resources.	group, Santos WA Workforce hire, DBCA and wildlife carer network are considered adequate. Further advice and international resources available through OSRL/Sea Alarm

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		local organisations and suppliers for personnel and equipment. Labour hire agencies would be used to provide large numbers of level 1 responders that would undergo an induction and basic training. Mobilisation of OWR personnel and equipment to site will start to occur in 24-48 hours following notification of actual or imminent impact to wildlife. This will occur through access to AMOSC oiled wildlife resources.			

7 External Notifications and Reporting Procedures

The Ningaloo Vision Incident Response Plan (TV-22-IF-00005) identifies the initial incident notifications and actions to be conducted by onsite personnel, including notifying the incident to the Process Control Room (PCR) and On-scene Commander (Ningaloo Vision OIM).

For oil spill incidents, the On-scene Commander will notify Perth office 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 (QE-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 WA 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).

Table 7-1: External Notification and Reporting Requirements (Commonwealth and State Water)

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 2 hours Written report as soon as practicable, but no later than 3 days	*Petroleum and Greenhouse Gas Storage Act 2006* Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 (as amended 2014)	A spill associated with Ningaloo Vision Operations 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/
NOPTA (National Offshore Petroleum Titles Administrator) & DMIRS (WA Department of Mines, Industry Regulation and Safety)	Written report to NOPTA and DMIRS within 7 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 Department of Mines, Industry Regulation and Safety (DMIRS)	• Verbal phone call within 2 hours of incident being identified • Follow up written notification within 3 days	Guidance Note on Environmental Non-compliance and Incident Reporting	A spill incident associated with Ningaloo Vision 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/E

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
					nvironment-reports-and-6133.aspx
AMSA and DoT spill reporting requirements					
AMSA Rescue Coordination Centre (RCC)[2]	Verbal notification within 2 hours of incident	Under the MoU between Santos WA and AMSA	Santos WA 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] (Maritime Environmental Emergency Response (MEER) Duty Officer)	• Verbal notification within 2 hours • Follow up with POLREP as soon as practicable after verbal notification • If requested, submit SITREP 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 WA 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)	WA DoT POLREP: https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf WA DoT SITREP: https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf
Protected areas, fauna and fisheries reporting requirements					
Commonwealth Department of the Environment and Energy (DoEE)	Email notification as soon as practicable	Environment Protection and Biodiversity Conservation Act 1999	If 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

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
(Director of monitoring and audit section)					
Department of Biodiversity Conservation and Attractions (Pilbara Regional Office)	Verbal notification within 2 hours	DBCA consultation	Santos WA 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 Advisor)	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 2 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 Advisor)	Notification by IMT Environmental Team Leader (or delegate)	Not applicable
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)

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
					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 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 WA regulatory reporting requirements Santos WA will meet the requirement of reporting a marine oil pollution incident by reporting oil spills assessed to have an environmental consequence of moderate or higher in accordance with Santos WA's environmental impact and risk assessment process outlined in **Section 5** of the EPs. .

2- Santos WA 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.

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 (OSROs) that have pre-established roles in assisting Santos WA in an oil spill response. It is not an exhaustive list of all providers that Santos WA may use for assisting an oil spill response. The Company Incident Response Telephone Directory (QE-00-ZF-0025.02) 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 Company Incident Control room and online (intranet procedures and emergency response pages).

Table 7-2: List of spill response support notifications

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos WA person responsible for activating
AMOSC, AMOSC Duty Manager	As soon as possible	Verbal Service Contract	Santos WA is a Participating Company in AMOSC and can call upon AMOSC personnel and equipment (including oiled wildlife). Under the AMOSPlan, Santos WA 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)

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos WA person responsible for activating
Babcock Helicopters	Within 2 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 2 hours of incident having been identified	Verbal	Mutual aid resources (through AMOSC mutual Aid Arrangement)	**Phone call**	Incident Commander (or delegate)
Exmouth Freight & Logistics	When equipment from movements are required in Exmouth and Dampier	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	Verbal and written	Astron has been contracted by Santos to provide Standby	**Step 1.** Obtain approval from Incident Commander to activate Astron for Scientific Monitoring	IMT Environment

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos WA person responsible for activating
	are met (**Section 20**)		Services for Scientific Monitoring Plans (SMPs) 1-11. This includes provision of personnel and equipment. Aston annually reviews the SMPs for continual improvement.	**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	Team Leader (or delegate)
Intertek Geotech (WA) Environmental Services and Ecotoxicology	When characterisation of oil is activated (**Section 10.5**)	Verbal	Oil analysis including GC/MS fingerprinting	**Phone call**	IMT Environment Team Leader (or delegate)
Oil Spill Response Limited (OSRL), OSRL Duty Manager	If spill requires additional resources or technical expertise	Verbal OSRL Mobilisation Authorisation Form	Santos WA has a Service Level Agreement with OSRL, which includes the provision of support functions, equipment and personnel to meet a wide range of scenarios 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 4.** Upon completion of the OSRL incident notification form, OSRL will plan and place resources on standby.	Designated call-out authorities (including Incident Commanders and CST Leaders)

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos WA person responsible for activating
RPS Group	As soon as practicable	Verbal and written	Santos WA 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 WA, if required, as part of contracting arrangements with RPS Group	Contact RPS Group Duty Officer	IMT Environment Team Leader (or delegate)
Wild Well Control (WWC)	Within four hours of a production well leak incident having been identified	Production well leak only Verbal	Well intervention services. Under contract.	**Step 1**. Following Santos management confirmation of a subsea loss of containment, the Incident Command Team (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	Drilling Team Leader

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos WA person responsible for activating
				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.	

8 Incident Action Plan

Santos WA incident response personnel use the incident action planning process to develop Incident Action Plans (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 objectives;
3. Develop the plan;
4. Prepare and disseminate the plan; and
5. Execute, evaluate and revise the plan.

The Santos WA IMT will use the IAP process to determine and document the appropriate strategies as more information becomes available during an incident response. The IAP is to be used by the IMT for each operational period following the initial first-strike assessments, notifications, and activations undertaken by Santos WA.

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

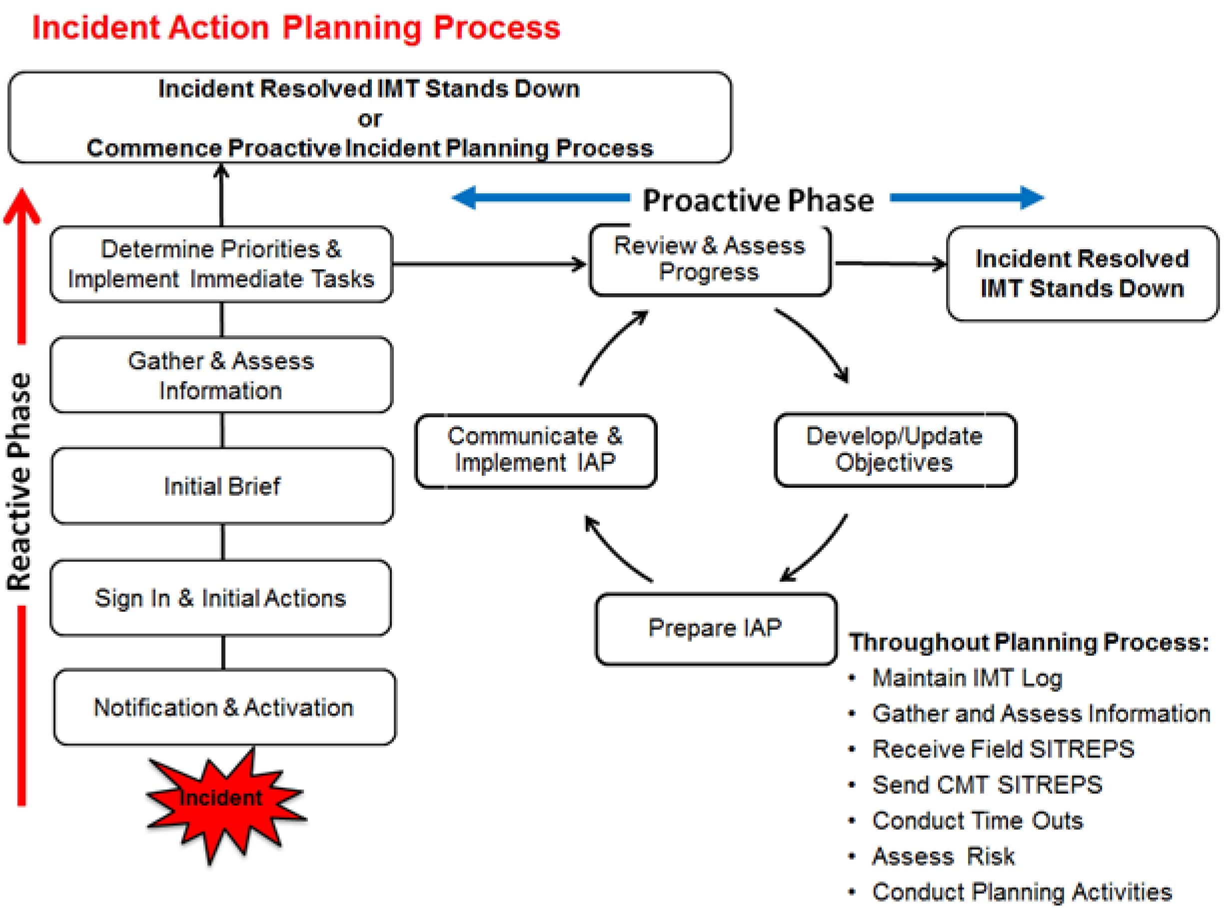

Figure 8-1: Incident Action Plan process

The IAP process facilitates the determination of appropriate strategies as more information becomes available during a spill event. The IAP is used for each operational period following the initial incident response actions defined in **Section 8**. An operational period is defined as the period scheduled for execution of actions specified in the IAP. The IAP is refreshed when conditions change. There can be multiple objectives and action plans occurring simultaneously within an IAP.

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 WA's 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, beach masters, team leaders, laboratory chemists, etc.) who report on the effectiveness of the response strategies.

Gain situational awareness

In order to review the applicability of the contingency response strategies contained within this OPEP to the actual and real incident characteristics, and assess the response strategies using NEBA to achieve impacts that are ALARP, the IMT must first gain situational awareness by obtaining answers to the following:

+ What type of hydrocarbon has been spilt?
+ What is the expected behaviour of the hydrocarbon that has been spilt?
+ How much has been spilt?
+ Is the source under control?
+ Where is the hydrocarbon going?
+ Is there anything in the path of the predicted hydrocarbon travel zones?
+ Can the hydrocarbon be approached or are there safety concerns?
+ Can the hydrocarbon be contained?
+ Can the hydrocarbon be dispersed?
+ Will shoreline impact occur and clean-up be required?
+ Can wildlife be affected and require response?

Some of this information can be obtained from personnel who reported the spill (e.g. via the POLREP), and some will need to be determined after information is received from monitor and evaluate and/or operational monitoring activities **(Section 10).**

8.1 Developing an Incident Action Plan (IAP)

IAP forms and processes are documented in the *Incident Command and Management Manual* (QE-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.

8.2 Environmental Performance

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

Table 8-1: Environmental Performance – Incident Management

Environmental Performance Outcome	Manage incident via a systematic planning process		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Incident Management	Incident Action Plan	**Response Implementation**	
		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

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 at Ningaloo Vision facilities, the Ningaloo Vision Incident Response Plan (TV-22-IF-00005) outlines 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 Shipboard Oil Pollution Emergency Plan (SOPEP), the SOPEP will provide any relevant initial actions to control the source of the spill.

For the ongoing response to a production well leak incident, the Source Control Emergency Response Plan (SCERP) (DR-00-ZF-10001) is to be consulted as the primary source of information. This plan includes:

+ Assessment of suitable surface locations;
+ Relief well trajectory and casing design;
+ Dynamic kill simulation results;
+ Rig requirements and availability; and
+ Equipment availability (casing and wellhead).

No obstacles to achieving the stated relief well timeline have been identified.

The sections below provide an outline of source control activities noting that the Ningaloo Vision Incident Response Plan (TV-22-IF-00005), Vessel SOPEP and SCERP (DR-00-ZF-10001), where applicable, will provide a higher level of detail for specific incidents.

9.1 Spills from Refuelling, Cargo Loading or FPSO Topside Equipment Failure

Table 9-1 provides the environmental performance outcome, initiation criteria and termination criteria for this tactic. 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 9-1: Refuelling, Cargo Loading or FPSO Topside Release – 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	**Diesel**	**Crude**	**HFO**
	✔	✔	X
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.** All refuelling operations will comply with Ningaloo Vision Bunkering Operation Procedure (NV-91-IG-10006.03). For Coniston, Novara and Van Gogh crude oil export (from FPSO to tanker) offtake activities will take place in line with the Ningaloo Vision Offtake Operational

Procedure (NV-91-IG-10010.03).

During bunkering and cargo loading activities, pipe/hose rupture, coupling failure, or tank overfilling can cause unplanned hydrocarbon release. Once the leak is detected, pumps will be turned off and bunkering/ cargo loading will cease as per the Ningaloo Vision Incident Response Plan (TV-22-IF-00005). The hydrocarbon remaining in the transfer line may escape to the environment as well as any hydrocarbon released prior to the transfer operation being stopped.

If a rupture or leak occurs in the topside processing equipment, subsea and topside valves will be shut off and production will cease in accordance with the Ningaloo Vision Incident Response Plan (TV-22-IF-00005). Shut off valves are regularly serviced and tested to ensure they will work properly if required. Released oil will be captured in the FPSO's bunding system, which have closed drainage systems that can deliver drainage water (which may contain hydrocarbon contamination) to a designated storage tank. The FPSO also has a closed drainage system for capture of leaks or vessels on the vessel. The mitigation measures to be followed include:

+ Pumping/processing operations ceased immediately following the spill;
+ System receiving product is immediately shut down following a spill;
+ Drainage network is closed as soon as practicable following the spill to prevent discharge to the ocean;
+ Recover hose and identify leak;
+ Make necessary repairs;
+ Use spill kit to clean-up spills on the vessel; and
+ Store any clean up waste in bunded area for onshore disposal.

Sorbent materials will be used from spill kits on-board the vessel to mop up hydrocarbon on deck. Soiled sorbent materials will be bagged and disposed to shore as a controlled waste. Fluids collected on the FPSO are processed and treated to meet the OIW content specification of < 30 mg/l prior to discharge. Areas used for the permanent or temporary storage of bulk fuels and/or chemicals are fully bunded with deck drainage sealed (secondary containment) to prevent accidental discharges to the ocean. Bunding located beneath the refuelling hose connections, operational equipment, fuel tanks on the supply vessel and closed drains on the FPSO will isolate a spill that falls in these areas from the marine environment.

Section 9.4.2 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-2: Implementation Guidance – Refuelling, Cargo Loading or FPSO Topside Release

Action		Consideration	Responsibility	Complete
Initial Actions	In the event of a loss of production hydrocarbons from FPSO topside production equipment, consult the Ningaloo Vision Incident Response Plan (TV-22-IF-00005)		Facility On Scene Commander	❑
	For refuelling and chemical transfers between support vessels and between support vessels and offshore platforms, consult the Refuelling and Chemical Management Standard (QE-91-IQ-00098)	+ For spills during pumping operations, pumping activity to cease immediately; + Isolation of damaged, leaking equipment; + Where drainage is open to the marine environment, drainage is to be isolated as soon as practicable following the spill to prevent discharge to the ocean (the Vessel Master or On-scene Commander will confirm that the drainage network is closed on the vessel before washing down the deck after excess oil has been cleaned up); + Use of onsite spill kit resources (i.e. sorbent material) to clean-up spills; + Recovery of dropped container where practicable, where containers of hydrocarbons are dropped during vessel to platform transfers; + Disposal of contaminated waste to licenced waste contractor; and + Isolation and repair of damaged, leaking equipment.	Vessel Master/ Facility On Scene Commander	❑

9.2 Hydrocarbon Storage or Fuel Tank Rupture

Table 9-3 provides the environmental performance outcome, initiation criteria and termination criteria for this tactic. 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 9-3: Fuel Tank Rupture – 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	Level 2/3 incident (to be determined by On-Scene Commander)		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
Termination criteria	The cargo in the ruptured fuel or storage tank is secured and release to the marine environment stopped		

9.2.1 Implementation Guidance

Implementation guidance is summarised in **Table 9-4.** In the event hydrocarbon (Diesel, Coniston, Novara and/or Van Gogh crude) is released from a vessel (including FPSO or offtake tanker) due to a ruptured fuel tank, the relevant vessel specific procedures will be applied. For offtake tankers and 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.

For vessel collision involving the Ningaloo Vision FPSO the Ningaloo Vision SOPEP (NV-00-ZF-100001) and Ningaloo Vision Incident Response Plan (TV-22-IF-00005) will be followed.

Section 9.4.2 lists the Environmental Performance Standards and Measurement Criteria for this tactic.

Table 9-4: Implementation Guidance – Fuel Tank Rupture

	Action	Consideration	Responsibility	Complete
Initial Actions	The vessel's Shipboard Oil Pollution Emergency Plan (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; + Trimming or lightening the vessel to avoid further damage to intact tanks; and/or + Attempt repair and plugging of hole or rupture	Vessel Master	❑

9.3 Subsea Flowline Rupture

Table 9-5 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. 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 9-5: Subsea Flowline Rupture - 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	Subsea flowline rupture or leak		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	X	✔	X
Termination criteria	The cargo in the ruptured subsea flowline has been isolated and release to the marine environment stopped		

9.3.1 Implementation Guidance

The implementation guidance is found in **Table 9-6.**

Section 9.4.2 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Equipment

Where safe to do so, an inspection class ROV will be mobilised to visually identify any subsea incident location. Inspection class ROV's are readily available in Western Australia, although the suitability of any particular ROV will be dependent on conditions at the incident site, e.g. water depth, metocean conditions, prevailing weather.

Typically an ROV could be available for deployment from a WA port within 2-14 days.

An alternative third party vessel could be available within 3-21 days depending on the specification required to work at the subject location.

Personnel

Supervisory personnel required for any vessel deployment are to be sourced from Santos WA's Perth or Ningaloo Operations team and local contract personnel. A minimum competency and experience, appropriate to the task, will be assessed by the IMT prior to undertaking the task.

Table 9-6: Implementation Guidance – Subsea Flowline Rupture

Action		Consideration	Responsibility	Complete
Initial Actions	In the event of a subsea flowline rupture or leak, consult the Ningaloo Vision Incident Response Plan (TV-22-IF-00005)		On Scene Commander	❑
	The IMT will initiate a site survey within 24 hours of the incident being detected that will collect relevant site specific information. Reasoned responses will be initiated when the assessment is complete.	Variables to be considered in the assessment are: + Flowline construction, including presence of mechanical fittings, in-line valves/manifolds; + Flowline contents composition; + Flowline inventory volume; + Flowline operational history; + Pressure & temperature; + Location of leak, proximity to topside structures, other subsea assets; + Opportunities to visually identify leak site; + Topography; + Inventory displacement by produced formation water (or inert fluid), e.g. treated or raw seawater, nitrogen.	Incident Commander	❑
Ongoing actions	The IMT will collate, assess and handover above information to Facilities Engineering Manager. Santos WA engineers will devise a solution and a project team will be assigned to implement the recovery and repair phase(s) using the engineering solution.		Incident Commander	❑

9.4 Production Well Leak

Table 9-7 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 9-7: Production Well leak - 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	Production Well leak		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	X	✔	X
Termination criteria	The primary well is contained and killed to prevent any further release of hydrocarbon to the environment.		

A spill of up to a maximum of 10,236 m^3 is assessed as credible from a Production at either the Van Gogh, Coniston and Novara subsea wells.

9.4.1 Emergency shutdown

The FPSO's ESD System (refer Ningaloo Vision Well Operations Management Plan (WOMP) (DR-91-ZG-10048) is in place to isolate and limit the loss of hydrocarbons from a subsea well control incident. The Ningaloo Vision Incident Response Plan (TV-22-IF-00005) outlines first strike actions, including emergency shut downs, for subsea oil spill incidents. As per the Ningaloo Vision Operations Safety Case (TV-9T-RF-007) the gas lift system is to be isolated and depressurised following isolation and depressurisation of hydrocarbons.

9.4.2 Relief Well Implementation Guidance

Relief well drilling as the primary source control strategy to control a well leak at Van Gogh, Coniston and Novara subsea wells that cannot be controlled through onsite systems. For all production well leak events, the installation of a subsea Capping Stack is not considered applicable (refer **Table 6-7**).

The Santos WA Source Control Emergency Response Plan (SCERP) (DR-00-ZF-10001) outlines the overarching process for planning and mobilising personnel and equipment into the field for the purpose of drilling a relief well. Campaign specific Source Control plans are developed prior to any well intervention activities as per WOMP requirements and a register of these plans is saved in the Santos WA document control system. A high level summary of relief well Implementation actions is provided in **Table 9-8**.

Table 9-8 : Implementation Guidance – Production well leak

Action		Responsibility	Complete
Initial Actions	Implement the Source Control Emergency Response Plan (SCERP) (DR-00-ZF-10001)	IMT Drilling Team Leader	❑
	Notify Santos WA 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	❑
	Design Relief Well, using relief well pre-planning work, as applicable, and have prepared in time to procure equipment and personnel prior to MODU arrival on location	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	Drilling Team Leader	❑
Ongoing actions	Design Relief Well, using relief well pre-planning work, as applicable, and have prepared in time to procure equipment and personnel prior to MODU arrival on location	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	Drilling Team Leader	❑
	Monitor progress of relief well drilling and communicate to IMT	IMT Drilling Team Leader	❑

9.4.3 Relief Well Planning

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

+ SPE Calculation of Worst Case Discharge (WCD) 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; and
+ UKOG 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.

The worst case credible production well leak volume 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 WA 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 and drill; an indicative schedule is provided in **Table 9-9**.

For noting, production well leak spill volumes have, in some instances, been based on a more conservative 100-day relief well drilling period to remain consistent with previous Commonwealth and State water Environment Plans for Ningaloo Vision Operations.

Table 9-9: Schedule for MODU arriving onsite

Production well leak		
Task	**Duration (in days)**	**Controls**
Event reported – begin mobilisation 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 (SCERP – DR-00-ZF-10001) + Regional MODU tracking + APPEA Memorandum of Understanding (MOU): Mutual Assistance
Continue preparations for relief well and rig mobilisation	21	+ Stood-up Relief Well Team (as per SCERP) + Pre-complete 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 Memorandum of Understanding (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	

The ability to achieve the above time-line is assessed prior to any well intervention activities as a part of the campaign specific source control plan. Currently 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 DISC Source Control Response Industry (SCRI) Working Group. The SCRI working group is an APPEA DISC 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 though "mutual aid" initiatives and drive continuous improvement by implementing fit-for-purpose and effective source control emergency response strategies.

Santos WA tracks the MODU activity within the region and updates the tracker on a monthly basis. The relief well rig capability register includes the following information;

+ 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;
- BOP specifications;
- BOP/LMRP connector specifications;
- Mud pumps specifications/capability;
- Choke and Kill line IDs;
- Storage capability (i.e. diesel, base-oil, brine, drill-water, potable water, bulks); and
- NOPSEMA safety case (yes/no).

The campaign specific source control plan (including relief well study) for any well intervention activity, will verify the rig well kill capability and access to the relief well drilling location for the rig types operating within the region that Santos would expect to have access to.

An 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 production well leak, however the critical path time allowed for the actual writing of the document is 3 days. The remaining estimated time would be used for gathering post-event data, mobilising the workforce and conducting a HAZID. 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 HAZID.

9.5 Source Control Environmental Performance

Table 9-10 indicates the Environmental performance outcomes, controls and performance standards for the Source Control response strategy.

Table 9-10 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	Source Control Emergency Response Plan	A Source Control Emergency Response Plan is in place during activity	Source Control Emergency Response Plan
	(Well specific) Source Control Plan	A (well specific) Source Control Plan is in place prior to a well intervention or drilling activity taking place	(Well specific) Source Control Plan
	MODU Capability Register	A MODU Capability Register is maintained during the activity	Rig Capability Register
	Arrangements for source control emergency response personnel	Arrangements for access to source control personnel are maintained during the activity	Contract/MoUs for source control personnel
	Vessel Spill Response Plan (SOPEP/SMPEP)	Support vessels have a shipboard oil pollution emergency plan (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 – production well leak	Drilling and Completions Source Control Team	Drilling and Completions Source Control Team mobilised within 24 hours of production well leak	Incident Log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within 5 days of production well leak	Incident Log
	Well Control Specialists	Well control specialists mobilised within 72 hours of production well leak	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 MODU	MODU for relief well drilling to be onsite by Day 34 from the start of a well release.	Incident Log
	Source Control Emergency Response Plan (DR-00-ZF-10001)	Relief well drilling implemented in accordance to the Source Control Emergency Response Plan (DR-00-ZF-10001) during a production well leak	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
Source Control – production well and pipeline/flowline	Ningaloo Vision Incident Response Plan (NV IRP) (TV-22-IF-00005)	Actions to control loss of containment from production well/ flowline are in accordance with the relevant facility incident response plan	Incident log

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; and
+ 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 On-Scene Commander)		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 the FPSO and 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. 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.

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

Table 10-2: Implementation Guidance – Vessel Surveillance

	Action	Consideration	Responsibility	Complete
Initial Actions	Notify nearest available Support Vessel to commence surveillance	Current Santos WA on hire vessels or Vessels of Opportunity (VOO) can be used. AIS vessel tracking is available through ER intranet page	On-Scene Commander Operations Lead	❑
	Source additional contracted vessels if possible need for assistance		Logistics Team Leader	❑
	Record surface slick location and extent, weather conditions, and marine fauna. Complete vessel surveillance forms, located in **Appendix D** 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	❑

Action		Consideration	Responsibility	Complete
	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 vessels - incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited	1 required initially - can be undertaking other duties.	Vessels of Opportunity - refer Vessel Tracking Software Reports	Pending availability and work commitments. Immediately if vessel and crew on contract for Santos. Same or next day if vessel is available to hire and MSA exists.

10.2 Aerial Surveillance

Table 10-4 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-4: 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 10-5 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-6** provides a list of resources that may be used to implement this strategy. 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.

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

Table 10-5: Implementation Guidance – Aerial Surveillance

Action		Consideration	Responsibility	Complete
Initial Actions	Contact Learmonth and Karratha airports and determine best location to establish Air Support Base		Logistics Team Leader	❑
	Contact contracted aviation provider- provide details of incident and identify location of nearest available aircraft and mobilise to agreed airport/Air Support Base	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 (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.)	Operations Team Leader Logistics Team Leader	❑

Action		Consideration	Responsibility	Complete
		+ wildlife, habitat or other sensitive receptors observed + basic metocean conditions (e.g. sea state, wind, current) + photographic/video images		
	Source available Santos WA Aerial Observers, arrange accommodation/logistics and deploy to Forward Operations/ Air base location.	Santos WA 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 2 overpasses per day of the spill area are completed.	Flying time to the Ningaloo Vision FPSO is 25 minutes each way from Exmouth and 70-80 minutes from Karratha. 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 E**) and Aerial Surveillance Surface Slick Monitoring Template. Calculate volume of oil (**Appendix F**). Take still and/or video images of the slick	Thickness estimates are to be based on the Bonn Agreement Code (Santos WA Procedure Index)	Aerial Observer	❑
	Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (**Appendix G**)		Aerial Observer	❑

Action		Consideration	Responsibility	Complete
	Record shoreline habitat type and degree of oiling by completing the Shoreline Aerial Reconnaissance Log (**Appendix H**)	Thickness estimates are to be based on the Bonn Agreement Code (Santos WA Procedure Index)	Aerial Observer	❑
	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	❑
	Mobilise additional aircraft and trained observers to the spill location to undertake ongoing surveillance activities		Logistic Team Leader	❑
	Update common operating picture with surveillance information and provide updates to spill trajectory modelling provider		Planning Team Leader GIS Team Leader	❑

Table 10-6: Aerial Surveillance Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Rotary Wing Aircraft & flight Crew	Santos WA contracted provider/s (primary provider currently Babcock)	2 contracted (1 primary + 1 back-up) + additional as required	Karratha (primary base) Learmonth Onslow	Wheels up within 1 hour for Emergency Response.
Aerial Surveillance Crew	Santos aerial observers AMOSC Industry Mutual aid	7 x Santos 7 AMOSC staff 5 AMOSC Core Group 54 Additional trained industry personnel	Perth & VI (Santos aerial observers) Australia wide	Santos trained personnel - next day mobilisation to airbase 12+ hours
Drones and pilots ** secondary response to assist shoreline and vessel-based surveillance	AMOSC OSRL- 3rd Party UAV provider Local WA hire companies	2 2 x Qualified remote pilots, however response is on best endeavour 10+	Geelong Perth Perth and regional WA	12 hours OSRL - depending on the port of departure, 1-2 days if within Australia

10.3 Tracking Buoys

Table 10-7 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-7: 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 On-scene Commander		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 10-8 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-9** provides a list of resources that may be used to implement this strategy. 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.

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

Table 10-8: Implementation Guidance – Tracking Buoys

	Action	Consideration	Responsibility	Complete
Initial Actions	Organise vessel to mobilise 2 x tracking buoys from NV FPSO to the spill site	Personnel and vessel safety is priority Current Santos WA on hire vessels or Vessels of Opportunity (VOO) can be used. AIS vessel tracking is available through ER intranet page.	On-scene Commander/ Operations Team Leader	❑
	Deploy 2x 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 WA ER intranet site	On-Scene Commander 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 WA operations (Santos WA presently has 12 Tracker Buoys located on the NWS)		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	❑

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 10-9: Tracking Buoys Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Fastwave Voyager tracking buoys x 12	Santos	2 4 6	Ningaloo Vision Varanus Island Dampier	NV buoys - Immediate for NV incident VI/ Dampier buoys - 24-48 h pending vessel availability
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 10-10**)

Table 10-10: AMOSC 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	38 hrs	NA	7 hrs	16 hrs

Santos

	Perth	Darwin	Exmouth	Dampier	Broome
	1250 km	3170 km		555 km	1370 km
Broome	27 hrs 2240 km	22 hrs 1870 km	16 hrs 1370 km	11 hrs 855 km	NA

10.4 Oil Spill Trajectory Modelling

Table 10-11 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-11: Oil Spill Trajectory Modelling – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

<table>
<tr><td>Environmental Performance Outcome</td><td colspan="3">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="3">Notification of a Level 2 or 3 spill</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>Diesel</td><td>Crude</td><td>HFO</td></tr>
<tr><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td>Termination criteria</td><td colspan="3">+ 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 WA 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 day-time 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 principal predictions.’

10.4.1 Implementation Guidance

Table 10-12 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-13 provides a list of resources that may be used to implement this strategy. 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.

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

Table 10-12: Implementation Guidance – Oil Spill Trajectory Modelling

Action		Consideration	Responsibility	Complete
	Initiate oil spill trajectory modelling (OSTM) by submission of an oil spill trajectory modelling request form (Santos WA Procedure Index). Request for 3-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 rpovider 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 QA/QC 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	❑
	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	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	❑

Action		Consideration	Responsibility	Complete
	concentration of floating oil, subsea oil and shoreline loading			
	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 10-13: 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.	As required	Perth- digital	2-4 hrs from activation

10.5 Satellite Imagery

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

Table 10-14: 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 (SAR) and visible imagery may both be of value.

10.5.1 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 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.

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

Table 10-15: 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 WA 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 10-16: Satellite Imagery Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
KSAT – Satellite Imagery GDS – Satellite Imagery	KSAT- Activated through AMOSC GDS- Activated through OSRL	As required	Norway- digital (KSAT)	KSAT: 1 hour- if satellite images available Access to satellite imagery on a global basis

10.6 Initial Oil Characterisation

Table 10-17 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-17: 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 diesel is a common fuel type with known properties and Van Gogh, Coniston, Novara crude oil is a production 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 10-18 provides guidance to the IMT on the actions and responsibilities for this strategy. **Table 10-19** provides a list of resources that may be used to implement this tactic. 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.

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.

Laboratory analysis

Using onsite vessels of opportunity, oil samples (2L 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 (GC/ MS) for the purpose of fingerprinting the oil constituents, is to be undertaken. Forensic fingerprinting of the released hydrocarbon, potentially allows contamination to be traced back to the source where this is otherwise unclear or in dispute.

Sampling of the released hydrocarbon is also to undertaken to provide samples for use in ecotoxicology analysis allowing the toxicity of different concentrations of the hydrocarbon to marine organisms to be assessed experimentally.

Ecotoxicology assessment of the oil will also 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 6-10 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 (SSD) fitted to the data (e.g. by using the Burrlioz software program). These species protection trigger levels will be used to aid interpretation of spill trajectory modelling outputs and inform the NEBA process.

Table 10-18: 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 H&S requirements/ controls	Refer Table 10-19 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	❑
	Continue sample collection for 14 day post release where oil is available	Initial monitoring by crew of available vessels – Once mobilised to site Santos WA 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	❑
Ongoing Actions	Continue sample collection for 14 day post release where oil is available	Initial monitoring by crew of available vessels – Once mobilised to site Santos WA 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 10-19: Initial Oil Characterisation - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Dispersant efficacy kits (shake test)	AMOSC/Santos WA	3	Exmouth, Varanus Island, Dampier[1]	Within 12 hours
Oil Fingerprinting kits	AMOSC/Santos WA	3	Exmouth, Varanus Island, Dampier[1]	Within 12 hours
Bulk oil sampling bottles	Intertek/Santos WA	As required	Perth Exmouth, Varanus Island, Dampier[1]	Within 12 hours
Contracted vessels and Vessels of Opportunity	Santos Contracted vessels - incl. Jetwave, Mermaid Marine, Bhagwan, Offshore Unlimited	1 required initially - can be undertaking other duties.	Vessels of Opportunity - refer Vessel Tracking Software Reports	Pending availability and work commitments. Immediately if vessel and crew on contract for Santos. Same or next day if vessel is available to hire and MSA exists.
NATA accredited Laboratory/ personnel for analysis	Intertek	NA	Perth	24+ hrs

[1] oil sampling kits incl dispersant shake test kits and sample bottles for laboratory analyses are currently being procured with the intent to store at Varanus Island and logistics yards at Exmouth and Dampier.

10.7 Operational Water Quality Monitoring

10.7.1 Operational Water Sampling and Analysis

Table 10-20 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-20: 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 10-21** presents the water quality sampling and analysis plan considerations.

This monitoring is complimentary to scientific water quality monitoring (SMP1) delivered through the Oil Spill Scientific Monitoring Plan in terms of methodology and required skillset and can be provided through Santos WA's Scientific Monitoring Provider **(Section 20**).

10.7.1.1 Implementation guidance

Refer to **Table 10-22** 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.

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

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Table 10-21*: 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 (IAP) 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 QA/QC samples incorporated into replicates. + Concurrent with collection of water samples a conductivity-temperature-depth (CTD) meter shall be deployed at each site along the same depth profile from which water samples are collected. The CTD will require fluorometry and dissolved oxygen (DO) 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 NATA-accredited laboratory in Perth for hydrocarbon suite analysis including polycyclic aromatic hydrocarbons (PAHs).

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; and + Final report detailing all data collected on oil properties throughout the monitoring program including relevant interpretation.

Table 10-22: Implementation Guidance - Operational Water Quality Sampling and Analysis

	Action	Consideration	Responsibility	Complete
Initial Actions	Activate Santos WA 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 10-21** 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 Safety Management Manual (QE-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 On-scene commander 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 10-23: Operational Water Quality Sampling and Analysis - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Water quality monitoring personnel	BMT Personnel (via Astron contract - BMT are subcontracted)	approx. 15 (based on capability reports)	Perth based	BMT Personnel and equipment within 72 hour from approval of work scope - pending vessel availability.
Water quality sampling equipment and water quality meters	Third party suppliers via BMT	Multiple providers identified by BMT	Australia based	

10.7.2 Continuous Fluorometry Surveys

Table 10-24 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy

Table 10-24: 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	**Diesel**	**Crude**
	✔	✔
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.

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). 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.

Towed 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 10-25 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-26** provides a summary of resources that may be used to implement this strategy. 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.

Table 10-25: 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 10-22** 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	❑
	Determined 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		Operations Team Leader Planning Team Leader Environmnet Team Leader	❑

Action		Consideration	Responsibility	Complete
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 10-26: Continuous Fluorometry Surveys - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Glider mounted and towed flurometers	Subsea gliders: Blue Ocean Monitoring (through OSRL contract) Towed flurometers (OSRL contract)	Subsea glider: Qty subjected to availability from OSRL contractor - 1 engineer from OSRL contractor to deploy and operate the Glider. Towed Fluorometers: 7 x Turner C3 fluorometers globally – 4 in Southampton, 2 in Singapore and 1 in Fort Lauderdale	Gliders based in Perth OSRL towed flurometers out of Singapore	24+ hours dependent upon availability
Glider (remote) pilot/s and deployment crew	Blue Ocean Monitoring (through OSRL contract)	Subsea glider: Qty subjected to availability from OSRL contractor - 1 engineer from OSRL contractor to deploy and operate the Glider.	Perth based pilot and deployment crew	Best endeavours. 24+ hours dependent upon availability

10.8 Shoreline and Coastal Habitat Assessment

Table 10-27 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 10-27: 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 On-Scene Commander)		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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 WA for the purposes of on-ground shoreline assessments and shoreline response activities. Santos WA 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 shore sensitivity mapping along the Ningaloo Coastline has been conducted by Santos WA in partnership with other companies and AMOSC. This information is available on the Santos WA ER Intranet site.

The information provided below is included for planning purposes and represents how Santos WA 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 WA 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 10-28 presents considerations for planning and conducting the assessments.

The implementation guide for Shoreline and Coastal Habitat and Assessment is found in **Table 10-29**.

Table 10-30 provides a list of resources that may be used to implement this strategy.

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

Table 10-28: Shoreline and Coastal Habitat Assessment Considerations

Considerations for Shoreline and Coastal Habitat Assessment	
Survey design	A shoreline assessment may include the following tasks: 1. 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 2. 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 3. 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 Hazard Management Agency (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 the following techniques: + 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. + Samples of oil and/or oiled sediments.

Considerations for Shoreline and Coastal Habitat Assessment	
	The following parameters should be assessed: + 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 10-29: 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 the Ningaloo Coastline is available on the Santos WA 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 10-30**	Incident Commander Operations Team Leader Logistics Team Leader	❑
	Assessment of shoreline character, habitats and fauna.	Refer to **Table 10-28**	AMOSC Core group and DoT	❑
	Assessment of shoreline oiling (if present).	Refer to **Table 10-28**	AMOSC Core group and DoT	❑
	Recommendations for response strategies.	Refer to **Table 10-28**	AMOSC Core group and DoT	❑

Table 10-30: Shoreline and Coastal Habitat Assessment - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos and industry AMOSC core group operations responders AMOSC staff	Santos Core Group Industry Core Group, AMOSC staff	12 (Santos core group) 60+ (industry core group ops)	Santos core group: Perth, Dampier, Varanus Is	From 24 hours for Santos Core Group Likely 24-48 hrs + for Industry Core Group and AMOSC staff

10.9 Monitor and Evaluate Environmental Performance

Table 10-31: 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**
Monitor and Evaluate	**Surveillance**	**Response Preparedness**	
	Maintenance of MSAs with multiple vessel providers	Santos WA maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	MSA with aircraft supplier	Master Services Agreement (MSA) in place with helicopter provider throughout activity	MSA with aircraft suppliers
	Santos WA trained Aerial Observers	Santos WA 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 Unmanned Aerial Vehicles (UAV) providers	Maintenance of contract for access to UAV providers	Maintenance of contract with service provider
	Surveillance	**Response Implementation**	
	Vessel surveillance	Vessel Surveillance strategy initiated within 90 minutes following request from IMT (i.e. begin to source vessels for surveillance)	Incident log
		Daily observation reports submitted to IMT until termination criteria is met	Incident log
	Vessels and aircraft compliant with Santos's Protected Marine Fauna Interaction and Sighting	Vessels comply with Santos's Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures	Completed vessel statement of conformance

	Procedure (EA-91-11-00003)	compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising the risk of collision with marine fauna	
		Aircraft comply with Santos's 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's Protected Marine Fauna Interaction and Sighting Procedure
	Aerial surveillance	Aerial Surveillance initiated within 3 hours following request from IMT	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
	Tracking Buoys	**Response Preparedness**	
	Tracking buoys available	Maintenance of 12 tracker buoys throughout the activity	Computer tracking software Tracker buoy tests

		Response Implementation	
		Tracking buoys mobilisation within 2 hours of request from On-Scene Commander or Operations Team Leader	Incident log
	Oil Spill Modelling	**Response Preparedness**	
	Maintenance of contract for emergency response modelling	Maintenance of contract for forecast spill trajectory modelling services throughout activity	Modelling services contract
	Oil Spill Modelling	**Response Implementation**	
	Oil spill modelling	Oil Spill Modelling provider will be contacted immediately (within 2 hours) upon notification of a Level 2 or 3 spill	Incident Log
		Modelling delivered to IMT within 2 hours of request to service provider	Incident Log
	Satellite Imagery	**Response Preparedness**	
	Satellite imagery	Contract in place with third party provider to enable access and analysis of satellite imagery	Contract with service provider
	Satellite Imagery	**Response Implementation**	
	Satellite imagery	Data incorporated into common operating picture and provided to spill modelling provider	Incident Log and Incident Action Plan
	Oil and Oil in Water Monitoring	**Response Preparedness**	
	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
	Entrained oil monitoring equipment and services	Maintenance of arrangements to enable access to fluorometry services throughout activity	Arrangement with provider of fluorometry equipment
	Oil and Oil in Water Monitoring	**Response Preparedness**	
	Initial Oil Characterisation	Oil samples sent to laboratory for initial fingerprinting	Incident Log
		If applicable 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 5 species' tests) within 24 hours of receiving all results	Incident Log
	Operational Oil and Oil in Water Monitoring	Identify if water quality monitoring is required within 2 hours of receiving spill and receptor information	Incident Log
		Operational water sampling and analysis surveys mobilised within 72 hours of approval	Incident Log
		Fluorometry surveys mobilised within 5 days of initiation	Incident Log
		Daily report including fluorometry results provided to IMT	Incident Log
	Shoreline Assessment	**Response Preparedness**	

	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
	Shoreline Assessment	**Response Implementation**	
	Shoreline assessment	Shoreline Assessment strategies will be implemented under the direction of DoT as the HMA	Incident Log
		Santos WA 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.
	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	Unless directed otherwise by the designated Control	IAP demonstrates requirement is met.

	considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat.	Agency (i.e. DoT) demarcation zones are mapped out in sensitive habitat areas.	
	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 spill		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	X	✔	✔
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.

Table 11-2: Containment and Recovery Application Criteria

Criteria	Recommended	Not Recommended
Spill characteristics	+ Patchy slick + Fresh or emulsified + Extended operations + Surface concentrations >50g/m^2 minimum, 100g/m^2 optimal	+ Situation dependent + Surface thickness <50 g/m^2
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 <1m for nearshore containment and recovery systems + Waves <1.8m for offshore systems + Winds <25 knots	+ Wave heights exceed 1.8m + 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. 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
Initial Actions	***Containment and recovery***			
	Identify and activate containment and recovery equipment stockpiles based on incident location. Initial equipment mobilisation from Exmouth and Dampier	Refer **Table 11-4** for location of containment and recovery resources Initial deployment from Exmouth pending vessel availability Up to date stockpile information accessed through Santos WA Emergency Response Intranet Site	Logistics Team Leader Supply Team Leader Operations Team Leader	❑
	Identify suitable deployment vessels/crew. Mobilise resources port location – Exmouth and Dampier	Refer **Table 11-4** for location of containment and recovery resources Initial deployment from Exmouth pending vessel availability Preference will be for vessels and crew that are exercised in regular Santos WA booming exercises	Logistics Team Leader Supply Team Leader Operations Team Leader	❑
	Assess the spill trajectory modelling, other operational monitoring data to identify operational area for C&R deployments.		Operations Team Leader Planning Team Leader	❑
	Confirm conditions are suitable for containment and recovery activities	Refer to **Table 11-2** for guidance	Operations Team Leader Planning Team Leader	❑
	Mobilise deployment personnel to nominated marine bases	Each vessel conducting containment and recovery is to be manned with a trained AMOSC, Santos WA or OSRL Oil Spill Responder, who is the Team Leader tasked with controlling the operations and implementing in a safe and responsible method.	Operations Team Leader Logistics Team Leader	❑

	Action	Consideration	Responsibility	Complete
		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		
	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 contain and recover activities to areas of slick of a sufficient thickness whereby contain and recover activities will be effective	Planning Team Leader Operations Team Leader	❑
	Direct containment and recovery operations to designated operational zones		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	Environment Team Leader	❑
	Ensure personnel onboard the vessels are trained in decanting procedures		Operations Team Leader	❑
	Ensure there is sufficient temporary storage for oily wastewater onboard vessel		Operations Team Leader Waste Service Provider	❑
	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	❑

Action		Consideration	Responsibility	Complete
	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 c/w accessories and powerpacks	Santos WA	Dampier container (2x 200 m booms + accessories) VI Containers 4 x 200 m boom and accessories	Dampier, Varanus Island	Within 12 hours (for Dampier or VI based deployment)
Santos Disc/Brush Skimmers (Desmi DBD16) c/w hoses/powerpacks	Santos WA	2 (1 ea. 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 (200m) – 15 Current Buster Boom System - 1 Speed Sweep system - 1 LWS 500 Weir Skimmer -6	Exmouth – 2x, Fremantle - 6x Geelong – 7x Geelong – 1 Geelong – 1 Fremantle – 3, Geelong – 3	Response via duty officer within 15 minutes of first call-AMOSC personnel available within 1 hour of initial activation call. Equipment logistics varies

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
		GT 185 Weir Skimmer	Exmouth - 1	according to stockpile location (refer **Table 10-10**)
AMSA Offshore containment and Recovery Boom AMSA Heavy Oil Skimmers	AMSA	RO Boom (200m) – 8 Vikoma Hi Sprint Boom – 4 LWS 500 Weir Skimmer – 8 DESMI Termite Skimmer -2	Karratha x 4; Fremantle x 4 Karratha x 2; Fremantle x 2 4 x Fremantle; 4 x Karratha 1 x Fremantle; 1 x Karratha	Access to National Plan equipment through AMOSC. Equipment. Logistics varies according to stockpile location (refer **Table 10-10**)
AMOSC offshore waste storage	AMOSC	Lancer Barges - 4 Deck Bladders - 5	Fremantle x 2; Geelong x 2 Fremantle x 2 Geelong x 3	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 10-10**)
AMSA offshore waste storage	AMSA	Vikoma Flexidam – 8 Canflex Sea Slug – 5 Vikom Frost Barge – 4 Covertex tow tank – 2	Fremantle x 4; Karratha x 4 Fremantle x 3; Karratha x 2 Fremantle x 2; Karratha x 2 Karratha x 2	Access to National Plan equipment through AMOSC. Logistics varies according to stockpile location (refer **Table 10-10**)
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 WA vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Personnel (field responders) for OSR strategies	AMOSC Staff	8	Fremantle x 2 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 x 10 Port Bonython (SA) x 2	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.

11.3 Resource requirements

Containment and recovery is more effective when a sufficient oil thickness can be achieved by the containment booms (minimum of $50g/m^2$), which is often limited to Group 3 and 4 (ITOPF) hydrocarbons. Whilst containment and recovery would not be suitable for Marine Diesel, it would be suitable for Van Gogh Crude and HFO. 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 (2015) has been used.

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

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

Velocity = 1 knot

Thickness of slick (Group IV) = $50g/m^2$ or 0.047mm

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

<u>BER = (300 x 0.3) x 1 x 0.047 = $4.2m^3$ per operation/hour x 12 hours of operation = 30 m^3/operation/day</u>

An assessment of potential ongoing resource requirements for a continuous spill (subsea production well leak) has been undertaken using modelling results and a daily recovery rate of 30 m^3 for one C&R operation (assumed to comprise two vessels operating in a J-sweep formation) and using modelled daily mass of oil above a 50 g/m^2 assuming no other intervention to reduce the mass of oil on surface (i.e. dispersant application). For the purposes of the assessment one C&R operation is assumed to remove 30 tonnes of oil and assumes adequate storage receptacles in place. Results are presented in **Table 11-5**

Noting that this assessment is theoretical in nature and makes general assumptions on the effectiveness on C&R effectiveness with no concurrent dispersant operations, the C&R requirements for this scenario start at 3 operations (6 vessels) on average per day for the first week , doubling to 6 operations in the second week and remaining at 6 or less operations per day, with the exception of week 4 (8 operations), week 8 (13 operations) and week 11 (7 operations) (**Table 11-5**).

Based on the resource (personnel and equipment) capability available for containment and recovery operations (**Table 11-4**), these levels could be maintained through available booms, skimmers and responder personnel. 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.

Short duration release scenarios where containment and recovery would be applied, i.e. vessel tank ruptures of crude oil and HFO, and flowline rupture of Van Gogh crude oil have also been modelled. These results indicate that oil thickness above 50 g/m^2, most suitable for containment and recovery operations, would be present only within the first 2-4 days following a worst-case vessel surface spill of crude oil and HFO, respectively. For a subsea flowline rupture, oil volume above this threshold is modelled to drop away to very low levels after 6 days. Notwithstanding these results, in an incident operational monitoring of oil distribution and thickness would be assessed and C&R operations deployed for as long as deemed to provide a net benefit. For these scenarios, timely mobilisation within the first few days of a spill would likely have greatest effectiveness – equipment stockpiles based in Exmouth and Dampier would be deployed within a timeframe allowing operations on the second day following notification pending vessel availability.

Table 11-5: Indicative Containment and Recovery Calculations for ongoing production well leak

Week	Avg daily oil mass (t) above >50 g/m^2	Indictive no. containment and recovery operations per day (2 vessels per operation and 200 m of boom)
1	83	3
2	154	6
3	131	5
4	216	8
5	153	6
6	153	6
7	130	5
8	375	13
9	114	4
10	116	4
11	195	7
12	109	4
13	107	4
14	99	4
15	44	2

11.4 Decanting

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

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; s. 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 the Australian Maritime Safety Authority (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 WA's waste service provider (refer **Section 19**) and through AMOSC and AMSA (refer Table 11-4).

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.

For containment and recovery operations near the Ningaloo Vision operational area, the use of on water transfers of waste receptacles to secondary vessel or barge has been identified as a preferential strategy to reduce potential contamination issues associated with vessels unloading waste at Exmouth Harbour, which is a small multi-use boating facility. For an ongoing response the unloading of waste collection vessels at Dampier is considered a better option.

The collection, transport and final disposal of waste brought to port locations will be provided through Santos WA's waste service provider (refer **Section 19**).

11.6 Containment and Recovery 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**	**Response Strategy**	**Control Measures**
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
	Response Implementation		
	Decanting	Decanting shall only be undertaken following approval from DoT and/or AMSA.	Incident Log
	Spill response activities selected on basis of a Net Environmental Benefit Analysis (NEBA)	Prepare operational NEBA to determine if containment and recovery is likely to result in a net environmental benefit	Incident Log
		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	IAP/Incident Log

		following period Incident Action Plan	

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	**Diesel**	**Crude**	**HFO**
	✔	✔ (applicable for targeted small breakaway patches)	**X**
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; and
+ 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 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 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 potential dangerous gasses and VOC's (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 WA 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 WA vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

12.3 Mechanical Dispersion 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 Dispersants Application - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

<table>
<tr><th>Environmental Performance Outcome</th><td colspan="3">Implement dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities</td></tr>
<tr><th>Initiation criteria</th><td colspan="3">Notification of a Level 2/3 crude spills</td></tr>
<tr><th rowspan="2">Applicable hydrocarbons</th><th>Diesel</th><th>Crude</th><th>HFO</th></tr>
<tr><td>X</td><td>✔</td><td>✔
(surface application only)</td></tr>
<tr><th>Termination criteria</th><td colspan="3">+ 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</td></tr>
</table>

13.1 Overview

The application of dispersants is considered an applicable strategy for large (Level 2/3) spills of crude oil and HFO. 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 leak). 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; and
+ 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 50-100g/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) 1-3 (EMSA, 2010) (**Table 13-2**).

Table 13-2: Bonn Agreement Oil Agreement Appearance Codes (BAOAC)

Code	Description	Layer Thickness (µm)	Litres per km2
1	Silvery sheen	0.04 to 0.30	40 - 300
2	Rainbow sheen	0.30 to 5.00	300 – 5,000
3	Metallic	5 to 50	5,000 - 50,000
4	Discontinuous true oil colour	50 to 200	50,000 – 200,000
5	Continuous true oil colour	>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. 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	Surveillance to confirm oil spill thickness supports use of dispersants (e.g. BAOAC 4-5). 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 vessel-based dispersant application equipment from the Santos WA storage locations in Exmouth (Exmouth Freight & Logistics) or Dampier Supply Base (2 x 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 2 x vessels and vessel crew from deployment locations.	Preference, where possible, will be for vessels/crew who have participated in exercises with Santos WA. Refer First Strike Information on Santos Offshore Emergency Response Intranet site Each vessel undertaking dispersant application is to be manned with a trained AMOSC, AMOSC Core Group, Santos WA or OSRL Oil Spill Responder, who is the Team Leader tasked with controlling the operations and implementing in a safe and responsible method		❑
	Mobilise AMOSC (Exmouth)/ AMSA (Karratha) dispersant stock to nominated vessel deployment location Exmouth and/or Dampier ports	Up to date dispersant stockpile inventories can be accessed via the Santos WA Emergency Response Intranet Page	Logistics Team Leader	❑

Action		Consideration	Responsibility	Complete
	Arrange logistics for oil spill responders to mobilise to site	AMOSC staff and AMOSC Core Group (incl. Santos) first priority for mobilisation to site to lead vessel spray operations.	Logistics Team Leader	❑
	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	❑
	Deploy to site and test spray oil - confirm effectiveness		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: + In waters shallower than 20 m (LAT); + Within 10 km of water shallower than 20 m; + Within exclusion zones for offshore facilities; + Within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone); and	Operations Team Leader Incident Commander Environmental Team Leader Planning Team Leader	❑

	Action	Consideration	Responsibility	Complete
		+ Within State Waters. 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.		
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 WA owned	2 containers (each c/w 3 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) 2 x Broome; 1 x Exmouth; 5 x Fremantle; 3 x Geelong 2) 1 x Exmouth; 3 x Geelong 3) 1 x Fremantle; 1 x Geelong 4) 1 x Fremantle	Response via duty officer within 15 minutes of first call-AMOSC personnel available within 1 hour of initial activation call. For equipment mobilisation timeframes refer to **Table 10-10**
AMSA Vessel Dispersant Spray System	AMSA	Ayles Fernie Boat Spray	2 x Karratha; 2 x Fremantle	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 1 hour of initial activation call. For equipment mobilisation timeframes refer to **Table 10-10**
	AMSA	20 m3 (Dampier) 100 m3 (Freo) 250+ m3 (other stockpiles)	Dampier Fremantle Other Aus stockpiles	Access to National Plan equipment through AMOSC.
Dispersant spray system vessels	Santos contracted vessel providers.	Varies – check through vessel contractors/ Santos WA vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	Preference for vessels used in Santos deployment exercises			
Personnel (field responders)	AMOSC Staff	8	Fremantle x 2 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 x 10 Port Bonython (SA) x 2	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.

14.1 Aerial Dispersant Operations

14.1.1 Implementation Guidance

Table 14-1 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 14-2** 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 14-1: Implementation Guidance – Aerial Dispersant Application

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports surface chemical dispersant application	Surveillance to confirm oil spill thickness supports use of dispersants (e.g. BAOAC 4-5). 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 WA); and + 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. 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 (AFR) 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	❑
	Using real-time or most recent visual surveillance observation data, develop	Focus on applying dispersant to areas of slick that threaten priority receptors and are of a sufficient	Operations Team Leader Planning Team Leader	❑

Action		Consideration	Responsibility	Complete
	operational zones for aerial dispersant operations	thickness whereby chemical dispersants will be effective. The base case restrictions for dispersant application are – no application: + In waters shallower than 20 m (LAT); + Within 10 km of water shallower than 20 m; + Within exclusion zones for offshore facilities; + Within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone); and + Within State Waters. 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		
	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	❑
	Maintain operational zones and provide updates to pilots on most suitable locations for aerial application		Operations Team Leader Planning Team Leader	❑

Table 14-2: Aerial Chemical Dispersants Application - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Aerotech First Response (AFR) Fixed wing aircraft, pilots and ground crew	AMOSC - Fixed Wing Aerial Dispersant Contract	6 under FWADC contract Additional aircraft potentially available through AFR	Operations from Learmonth or Onslow airbase Aircraft initially mobilised from 6 Bases around Australia: Jandakot (WA) Batchelor (NT) Parafield (SA) Scone (NSW) Ballarat (Vic) Emerald (QLD)	6 x air contractors to have wheels up in 4hrs 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 10-10**).
Air attack (& SAR) helicopter	Santos contracted helicopter provider/s	2 (contracted) + additional subject to availability	Karratha (primary base) Learmonth Onslow	Wheels up within 1 hour for Emergency Response.
Dispersant	AMOSC	75 m3 (Exmouth) Slikgone NS 15 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 1 hour of initial activation call. For equipment mobilisation timeframes refer to **Table 10-10**
	AMSA	20 m3 (Dampier) 100 m3 (Freo)	Dampier Fremantle	Access to National Plan equipment through AMOSC.

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
		250+ m3 (other stockpiles)	Other Aus stockpiles	
FWADC operational personnel incl. Air Attack Supervisor and Dispersant Coordinator	AMOSC and subcontractors via Fixed Wing Aerial Dispersant Contract	8 AMOSC staff + contractors	AMOSC Fremantle x 2 AMOSC 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.
SAR vessel (can be double use vessel)	Santos contracted vessel providers.	Varies – check through vessel contractors/ Santos WA vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

15.1 Subsea Dispersant Injection Operations

Subsea dispersant injection (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 production well leak scenario associated with Ningaloo Vision operations release rates are low and surface dispersant application which can be mobilised more rapidly 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.

15.1.1 Implementation Guidance

Table 17-1 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting 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.

Santos

Table 15-1: Implementation Guidance – Subsea Dispersant Injection

Action		Consideration	Responsibility	Complete
	Confirm operational NEBA supports subsea chemical dispersant injection	Subsea dispersant application has been identified as secondary strategy for well leak scenario only and NEBA should look at benefit of this technique over in relation to surface application. Use forecast modelling and any operational monitoring results in operational NEBA	Operations Team Leader Incident Commander Environmental Team Leader Planning Team Leader	❑
	Activate SFRT equipment Activate Oceaneering personnel for deployment	Separate contracts in place for SFRT (AMOSC) and Oceaneering	Designated call-out authority (Incident Commander) Source Control Team	❑
	Contract suitable vessel capable of deploying SFRT equipment and dispersant	Vessel capable of SFRT deployment are tracked	Logistics Team Leader Source Control Team Leader	❑
	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	❑
	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	❑

Action		Consideration	Responsibility	Complete
	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 Action	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	❑

15.2 Dispersant Efficacy Testing

Dispersant efficacy testing has been performed on Van Gogh, Coniston and Novara crude oil and indicates that available dispersants are effective in reducing the volume and concentration of surface oil (refer **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.

15.3 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 Santos WA 's Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) prior to application, are to be used. Corexit EC900A and FINASOL OSR 52 have been pre- assessed as low risk using the Santos WA 's Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) and are therefore designated as acceptable for use.

Santos WA 's Operations Chemical Selection, Evaluation and Approval Procedure requires the dispersant to be rated as 'Pose Little or No Risk to the Environment' (PLONOR), as listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), or 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) non-CHARM Grouping method and chemicals that meet the selection criteria belonging to the OCNS groups D or E are environmentally acceptable. According to the OCNS 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 non-CHARM Group rating but 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. Santos WA has already characterised the dispersant efficacy of Van Gogh, Coniston and Novara Crude Oils as described in **Appendix A.**

15.4 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.

Subsea dispersant application is considered a secondary strategy to surface dispersant application (refer to Table 6-7) . 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.

15.5 Dispersant Application Area

The base case for chemical dispersant is as follows, unless justified by the Operational NEBA. No application to occur in the following circumstances :

+ In waters shallower than 20 m (LAT);
+ Within 10 km of water shallower than 20 m;
+ Within exclusion zones for offshore facilities;
+ Within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application permitted in the Multiple Use Zone); and
+ Within State Waters.

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.

Dispersant efficacy testing indicates that efficacy on fresh Van Gogh, Coniston and Novara will be the same or better on fresh oil than weathered oil (Intertek 2012). Applying dispersant close to the source may also be beneficial in ensuring dispersants are applied efficiently, where oil is less broken into patches by wind and wave action.

15.6 Surface Dispersant Supply and Logistics Requirements

Deterministic oil spill modelling has been conducted to assess the effect of dispersants on worst case spill scenarios associated with Ningaloo Vision operations (**Section 6.5**). This work has been used to determine worst case dispersant supply requirements for each scenario.

<u>Instantaneous release dispersant requirements – vessel tank rupture</u>

For this scenario, modelling of simulated dispersant application at surface revealed a total dispersant application of 19.6 m^3 was required. Most of the dispersant application was achieved by one aircraft (15.5 m^3) and the remainder applied by two vessels. The oil slick thickness decreases quickly within ~48 hours for both mitigated and unmitigated cases. The availability of thick (>50 µm) surface oil treatment threshold is time limited as the 1-hour release yielded a pulse slick that was rapidly transported to the south out of the response zone within ~44 hours. Dispersant supply and application requirements are less than that for the production well leak as described below.

<u>Continuous release dispersant requirements – production well leak</u>

For this scenario, based on the deterministic dispersant application modelling a total of 1051m^3 of dispersant was required to be used by two aircraft and five vessels over 128 days of application. While dispersant use will vary depending on conditions and actionable oil approximately 10m^3 per day is considered appropriate amount for planning.

Sufficient dispersant stock is available for this operation through AMOSC (522m^3 across Fremantle, Broome, Exmouth and Geelong stockpiles), AMSA National Plan (254m^3), and OSRL Singapore (1400m^3) stockpiles. Based on the rate of application, current stock pile locations and supply, arrangements are considered sufficient (refer as per below).

Dispersant Supply and Logistics

There is currently sufficient dispersant stocks in Exmouth (75m^3), Karratha (20m^3), Fremantle (28m^3) and Broome (15m^3) to cover dispersant requirements for the first two weeks of a spill. These are available via AMOSC membership or AMSA MoU and are available within 24 hours (Exmouth) or within 48 hours (all other locations). Santos WA can supply all required road logistics to meet these timeframes through its contracted logistics provider. Santos WA can also provide air logistics for all other stockpiles throughout Australia and internationally.

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

15.7 Subsea Dispersant Injection Logistics

If a production well leak 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) (supplied by Santos WA) and the Subsea First Response Toolkit (SFRT), 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 (500m^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 22L/min is required. The maximum credible flow rate for the Ningaloo Vision well leak is estimated to be 641.5~bbl./day (~102m^3/day), therefore a dispersant pump rate of ~1L/min (1.8m^3/day) is expected to be required. The SFRT stockpile in Fremantle is sufficient to sustain SSDI for this scenario.

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 Day 8-12, depending on vessel availability. Santos WA tracks the availability of SFRT vessels via shipbroker reports.

15.8 Chemical Dispersant Environmental Performance

Table 17-2 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 15-2: 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**	**Control Measures**
Chemical Dispersant Application	**Response Preparedness**		
	Arrangements to enable access to surface 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 WA's contracted vessel broker	Shipbroker reports
	Response Implementation		
	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	Incident Log

		dispersant samples to be sent immediately for laboratory ecotoxicity testing of oil and chemically dispersed oil	
		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
		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 the following information: • Forecast spill modelling of oil comparing simulations with	Incident Log IAP

		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	
		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
		Dispersant Application Area will be defined as part of the IAP Must consider: • Water depth	IAP

		• Exclusion zones for offshore facilities; • Marine park zoning Proximity to State Waters	
		Surface dispersant will only be applied in the Dispersant Application Area and target oil above BAOAC 4 and 5	IAP Incident Log

16 Shoreline Protection and Deflection Plan

Table 16-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 16-1 : 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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		

16.1 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 WA 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 WA for the purposes of shoreline protection. Santos WA 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 WA's 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 dikes – 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; and
+ 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.

16.2 Implementation Guidance

Table 16-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 16-3** provides a list of resources that may be used to implement this strategy. 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 16-2: 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	❑
	Actions below are indicative only and are at the final determination of DoT as the Control Agency			
	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.	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 Pre-existing TRPs exist for 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 Offshore ER Intranet page.	Environment Team Leader	❑
	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 may include (but not be limited to) and should reference any existing TRPs:	Operations Team Leader Planning Team Leader Environment Team Leader	❑

Action		Consideration	Responsibility	Complete
		+ 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)		

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 16-3: 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 (98x 25m lengths) Zoom Boom (199 x 25m lengths) HDB Boom (2x 200 m lengths) Curtain Boom (58 x 30 m lengths) Skimmers: Passive Weir GT 185 Desmi 250 Weir Ro-skim Weir boom	Broome x 4; Exmouth x 20; Fremantle x 23; Geelong x 51 Broome x 8; Exmouth x 20; Fremantle x 30; Geelong x 141 Broome x 2; Fremantle x 18; Geelong x 40 Exmouth x 1; Fremantle x 1; Geelong x 1 Exmouth x 1; Geelong x 1 Geelong x 1 Geelong x 2	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. For mobilisation timeframes refer **Table 10-10**
AMSA nearshore boom/skimmer equipment	AMSA	Canadyne inflatable Structureflex inflatable Versatech zoom inflatable Slickbar - solid buoyancy Structureflex - solid buoyancy Structureflex - land sea Skimmers:	Karratha x 5; Karratha x 10; Fremantle x 15 Karratha x 5; Fremantle x 13 Karratha x 2 Karratha x 3; Fremantle x 10 Karratha x 30; Fremantle x 30 other locations around Aust	Access to National Plan equipment through AMOSC. For mobilisation timeframes refer **Table 10-10**

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
		None for inshore HFO or heavy crude		
Santos owned nearshore boom/ skimming equipment	Santos WA	Beach Guardian (8x 25m lengths) Zoom Boom (16 x 25m lengths) 2x Desmi DBD16 brush skimmer	Varanus Island Varanus Island 1 ea Dampier and VI	Within 12 h for deployment by vessel from VI
Personnel (field responders) for OSR strategies	AMOSC Staff	8	Fremantle x 2 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 x 10 Port Bonython (SA) x 2	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.

16.3 Shoreline Protection and Deflection Environmental Performance

Table 16-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 16-4: 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
	Response Implementation		
	Shoreline Protection and Deflection Plan	Santos WA 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
		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	IAP/Incident Log

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**
		development of following period Incident Action Plan	
		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 (NEBA)	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

17 Shoreline Clean-up Plan

Table 17-1: Shoreline Clean-up – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

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		
Initiation criteria	+ 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		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	X	✔	✔
Termination criteria	+ As directed by DoT		

17.1 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 WA 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 WA 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 Ningaloo Vision operations, shoreline contact would occur and therefore clean-up of shorelines is likely to be required.

Diesel 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.

Van Gogh crude is a Group IV heavy crude oil (**Appendix A**) with a relatively high persistence in the marine environment. Waste volumes from shoreline operations will depend on the degree of weathering and whether emulsions have formed. Emulsification potential has been shown to vary across Van Gogh crude oils (**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; and
- Sediment reworking and Surf washing – uses various methods to accelerate natural degradation of oil by manipulating the sediment.

17.2 Implementation Guidance

Table 17-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. **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 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 17-2: 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 Advisor 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) + Utility resource assessment and support (to be conducted if activity is of significant size	Environmental Team Leader Planning Team Leader Operations Team Leader	❑

Action	Consideration	Responsibility	Complete
	in comparison to the size of the coastal community) + Permits required (if applicable) + Chain of command for onsite personnel + List of resources (personnel, equipment, PPE) 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 IPEICA-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)	❑
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	Operations Team Leader Logistics Team Leader	❑

Action		Consideration	Responsibility	Complete
		AMSA administered National Response Team (as per the MoU agreement between Santos WA 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	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 end-points 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 On-Scene Commander (DoT FOB)	❑

Table 17-3: Shoreline Clean-up - Resource Capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Manual clean-up tools (shovels, rakes, wheel barrows, bags etc)	AMOSC shoreline kits	shoreline support kits first strike	Fremantle x 1 Geelong x 1	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 (**Table 10-10**)
	Santos WA	1x shoreline clean-up Container	Varanus Island	Within 12 hour for deployment from VI
	Hardware suppliers	As available	Exmouth, Karratha, Perth	
Shoreline flushing (pumps/hoses)	AMOSC	Shoreline flushing kit Shoreline Impact lance kit	Fremantle x 1, Geelong x 1 Geelong x 1	Response via duty officer within 15 mins of first call - AMOSC personnel available within 1 hour of initial activation call. For mobilisation timeframes see **Table 10-10**
Nearshore skimmers/hoses	AMOSC AMSA	See Protection and Deflection (**Table 16-3)**		
Decontamination/ staging site equipment	AMOSC	Decontamination station x 3	Fremantle x 1; Exmouth x 1; Geelong x 1	Response via duty officer within 15 mins of first call - AMOSC personnel available within 1 hour of initial activation call.

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
				For mobilisation timeframes see **Table 10-10**
	AMSA	Decontamination station x 4	Karratha x 2; Fremantle x 2	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 x 8 Vikotank (13000L)	Geelong x 4; Fremantle x 2; Exmouth x 2 Broome x 1	15 mins of first call - AMOSC personnel available within 1 hour of initial activation call. For mobilisation timeframes see **Table 10-10**
	AMSA temporary storage	Fast tanks	Karratha x 4; Fremantle x 4	Access to national Plan equipment through AMOSC
	via North West Alliance contract	Refer **Table 19-3**	Perth, Karratha	24+ hours
Personnel (field responders) for OSR strategies	AMOSC Staff	8	Fremantle x 2 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.

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMOSC Core Group (Santos)	12	Perth/ NW Aus facilities x 10 Port Bonython (SA) x 2	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.
	Santos WA contracted Work Force Hire company (e.g. Dare)	As per availability (up to 2,000)	Australia wide	Subject to availability (indicatively 72+ hours)

17.3 Shoreline Clean-up Resources

Shoreline clean-up equipment available for use by Santos WA is a combination of Santos WA 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 WA will leverage from existing contracted vessel providers.

Shoreline clean-up personnel available to Santos WA is a combination of AMOSC Staff, AMOSC Core Group Responders (comprising AMOSC trained Santos WA 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 WA's 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**) will provide information to guide the clean-up strategy and deployment of resources.

Across all credible spill scenarios, modelling has indicated that the worst-case surface release of Van Gogh Crude (8,629m^3 from the FPSO) would result in the highest potential shoreline loading of oil. Further to this, Van Gogh Crude is the most persistent and viscous of hydrocarbons that could potentially be release during Ningaloo Vision operations and would likely require the greatest level of effort to respond to. Other potentially released oils are relatively light by comparison; physical removal of other oils such as diesel may not be possible or recommended due to the degree of infiltration into sediments that could occur.

Spill modelling indicates shoreline loading of up to a maximum of ~1,260 m^3 at Ningaloo Coast north (refer **Section 6.3**). Hydrocarbons could also load onto shorelines of the Muiron Islands (maximum ~310 m^3) and Ningaloo Coast South ((maximum ~260 m^3), noting that these worst case loadings come from different model simulations.

Shoreline clean-up can be effective technique for reducing the potential for it to remobilise to other locations. However, prolonged shoreline clean-up operations or large-scale operations involving large numbers of personnel may cause adverse environmental impacts, as the constant removal of oil through mechanical or manual techniques can result in a removal of substrate (e.g. sand, pebbles). If this process is conducted over a long period of time, this may result in geomorphological changes to the shoreline profile.

Many of the shorelines predicted to be contacted are important nesting/breeding sites with high conservation values, therefore intensive clean-up operations will potentially do more damage than the oil alone. For this reason, shoreline clean-up operations at sensitive locations will involve smaller teams for a longer period and may involve techniques such as passive recovery booms (sorbents) and flooding or flushing (depending on the degree or oiling and hydrocarbon type). Although this may take longer to undertake the clean-up, it is considered that the benefits outweigh the impacts as smaller teams are more targeted, recovering more oil and less sand and debris, reducing trampling of oil into the shoreline profile and will minimise physical impacts on the coastlines and their sensitive species.

To approximate the likely waste produced and time required to conduct a manual shoreline clean-up, a conservative bulking factor of 10x has been applied to the worst-case scenario. Using the ~1,260m^3 loading, a bulking factor of 10x would result in up to 12,600 m^3 of oily waste. An estimate of required resources for clean-up can be made by applying a removal rate of 1 m^3 per person per day for manual removal. For example, 30 small teams consisting of 6 personnel (including one trained responder per team) could theoretically remove a loading of 1,260 m^3 (12,600 m^3 oily waste) in roughly 70 days. This calculation assumes oil is accessible for removal (i.e. on accessible sections of coastline) and there would be a net benefit in removing all oil.

Dependent on the nature of the oiling, habitat type, access constraints and environmental sensitivities nearby, larger teams of responders and mechanical aids can be employed to remove oil at a greater rate.

17.4 Shoreline Clean-up Decision Guides

A number of shoreline types are found within the EMBA associated with Ningaloo Vision operations, including:

+ Mangroves;
+ Rocky shores including cliffs, intertidal platforms and loose rocks;
+ Sandy beaches; and
+ Intertidal mudflats and sandflats.

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 J**

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

The DoT OSCP (2015) also provides guidance on shoreline clean-up techniques.

17.5 Shoreline Clean-up Environmental Performance

Table 17-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 17-4: 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.
	Response Implementation		
	Shoreline Clean-Up Plan	Santos WA 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
		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

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**
		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 WA will make available AMOSC Core Group Responders for shoreline clean-up team positions to the Control Agency	Incident Log
		Santos WA will make available to the Control Agency equipment from Santos WA, 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 tracts	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 WA are verified as clean and invasive species free prior to deployment to offshore islands	Documented in IAP and Incident Log.
	Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance	Unless directed otherwise by the designated Control Agency (i.e. DoT) a Heritage Advisor 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

18 Oiled Wildlife Response Plan

Note: Department of Transport (DoT) is the Control Agency and Department of Biodiversity, Conservation and Attractions (DBCA) is the Jurisdictional Authority for oiled wildlife response within State waters. Santos WA is the Control Agency for oiled wildlife response within Commonwealth waters.

Table 18-1: Oiled Wildlife Response - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implement tactics in accordance with the Western Australian Oiled Wildlife Response Plan (WAOWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanase wildlife		
Initiation criteria	Operational monitoring shows that wildlife are contacted or are predicted to be contacted by a spill		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
Termination criteria	+ Oiling of wildlife have not been observed over a 48 hour period; and + Oiled wildlife have been successfully rehabilitated; and + Agreement is reached with Jurisdictional Authorities and stakeholders to terminate the incident response		

18.1 Overview

Santos WA 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 Advisor (OWA). This team will work in conjunction with DBCA OWR capability under the direction of the DoT Incident Controller. Where Santos WA 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 WA IC.

The key plan for oiled wildlife response (OWR) in WA is the WA Oiled Wildlife Response Plan (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: MEE. The WA OWRP 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 WA OWRP provides operational guidance to respond to injured and oiled wildlife in the Pilbara region and covers the areas potentially contacted by a spill from Ningaloo Vision operations.

The sections below provide guidance to the Santos IMT on OWR stages of response and implementation. In some cases, the implementation guidance (**Table 18-5**) includes detail which is additional to what is provided in the WAOWRP. The information below should be used in conjunction with the WAOWRP.

18.2 OWR Stages of Response

The WAOWRP includes eight stages to an OWR, which are described in **Table 18-2**. If an OWR is initiated, implementation will follow these stages, as appropriate to the nature and scale of the incident.

Table 18-2: Oiled Wildlife Response Stages (adapted from WAOWRP)

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 following operational components (relevant to the scale of the OWR): + 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 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

Stage	Description
	Response Sub-plan. This decision will be made in consultation with the relevant jurisdictional authorities and support agencies

18.3 OWR Levels and Resourcing

An impact assessment threshold of 10g/m^2 for impacts on fauna from floating hydrocarbons is provided in the NV Operations 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).

Review of the worst-case spill modelling indicates that floating hydrocarbon concentrations above 10g/m2 may extend up to 250km from the spill location and have a maximum shoreline loading of 1320 m^3, at 100g/m^2, effecting 133 km along the Ningaloo Coast North. The Ningaloo Coast North includes biologically important areas for birds and major turtle nesting sites. Approximately 33 species of seabirds and shorebirds are found in the Ningaloo Marine Park (CALM and MPRA 2005). This area of coastline also includes biologically important areas for dugong breeding and foraging and whale shark foraging.

Conservative estimates for OWR planning predict a worst-case OWR for this activity will be an OWR Level 6, as defined in the WAOWRP (2014). For a Level 6 response, it is expected that up to 122 personnel will be required, with a range of skill levels (**Table 18-4** – OWR 1 = basic training to OWR 4 = OWR Advisor; Information drawn from WAOWRP). Personnel at skill levels OWR 2 - 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 1 day) for OWR personnel can be delivered as just-in-time training through an arrangement with DBCA.

Table 18-3: Indicative Oiled Wildlife Response Level (adapted from WA OWRP, 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 18-4: 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**

18.4 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 18-2** will form the key management system which will provide control and oversight over the response.

Table 18-5 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 18-5**) 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).

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 L**.

Table 18-5: 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 2 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 are sighted and are 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 Advisors)	Obtain approval from IC prior to activating AMOSC Oiled Wildlife Advisor and/or DCBA Oiled Wildlife Advisor as outlined in **Section 7.2** DoT will be the Control Agency for OWR in State waters	Environmental Team Leader	❑
	Notify DoEE if there is a risk of death or injury to a protected species (including Matters of National Environmental Significance (MNES))	Refer to **Table 7-1** for reporting requirements. A list of MNES is provided in the Existing Environment Section of the EP	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	❑
	Use information from initial assessments to prepare an Operational SIMA. Use this information to help determine: Initial OWR Response Level (1-6), as defined in the WA OWRP (**Table 18-3**)Review of the	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	Environmental Team Leader Wildlife Division Coordinator Wildlife Branch Director	❑

Action		Consideration	Responsibility	Complete
	worst-case spill modelling indicates that floating hydrocarbon concentrations above 10g/m2 may extend up to 250km from the spill location and have a maximum shoreline loading of 1320 m3, at 100g/m2, effecting 133 km along the Ningaloo Coast North. The Ningaloo Coast North includes biologically important areas for birds and major turtle nesting sites. Approximately 33 species of seabirds and shorebirds are found in the Ningaloo Marine Park (CALM and MPRA 2005). This area of coastline also includes biologically important areas for dugong breeding and foraging and whale shark foraging. Conservative estimates for OWR planning predict a worst-case OWR for this activity will be an OWR Level 6, as defined in the WAOWRP (2014). For a Level 6 response, it is expected that up to 122 personnel will be required, with a range of skill levels (**Table 18-4** – OWR 1 = basic training to OWR 4 = OWR Advisor; Information drawn from WAOWRP). Personnel at skill levels OWR 2 - 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 1 day) for	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 Advisors and any SME's as relevant (if available, but an Operational NEBA should not be delayed if they are not immediately available)		

Action		Consideration	Responsibility	Complete
	OWR personnel can be delivered as just-in-time training through an arrangement with DBCA.			
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 18-4** 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	❑
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	❑

Action	Consideration	Responsibility	Complete
		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	❑
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	❑

Action	Consideration	Responsibility	Complete
		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 2 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 mud and other tanks for water storage and oil-water systems for treating water	Wildlife Division Coordinator Wildlife Operations Officer Wildlife Facilities Officer AMOSC OWA DBCA OWA OWR field personnel Operations Team Leader	❑
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	Wildlife Division Coordinator Wildlife Veterinarian	❑

Action	Consideration	Responsibility	Complete
	temperature-controlled room. The room needs to be well ventilated to disperse the hydrocarbon fumes	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	❑

18.5 Oiled Wildlife Response Environmental Performance

Table 18-6 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 18-6: Environmental Performance – Oiled Wildlife Response

Environmental Performance Outcome	Implement tactics in accordance with the Western Australian Oiled Wildlife Response Plan (WAOWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanase 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 Oil spill Response Limited (OSRL) throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract.
			OSRL Associate Member Contract.
	Response Implementation		
	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

19 Waste Management Plan

Table 19-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 19-1 : 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	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
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		

19.1 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 WA is the Control Agency, or at the request of the designated Control Agency, Santos WA will engage its contracted Waste Service Provider (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 WA's Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053) provides detailed guidance to the WSP in the event of a spill.

Where DoT is the Control Agency, Santos WA will provide a Facilities Support Officer to the DoT IMT Logistics Unit to support the DoT IMT in coordinating waste management services.

19.2 Implementation Guidance

Table 19-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 19-3** 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 19-2: 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 (QE-00-ZF-00025.20) 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 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 Waste	Consider facilities for waste segregation at source	Logistics Team Leader Planning Team Leader	❑

Action		Consideration	Responsibility	Complete
	Management Plan – Oil Spill Response Support (QE-91-IF-10053)).			
	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 WA's Waste Management Plan – Oil Spill Response Support (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 Refer to Cedre (2016) for technical guidance on waste management techniques	Logistics Team Leader (or delegate) Planning Team Leader Facilities Support Officer (DoT IMT) Planning Team Leader 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) Facilities Support Officer (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	Facilities Support Officer (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 WA's Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053); and where	WSP Location Responsible Person or Operations Supervisor	❑

Action		Consideration	Responsibility	Complete
		relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan		
	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	❑

19.3 Waste approvals

Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos WA's Waste Management Plan – Oil Spill Response Support (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 the Department of Water and Environmental Regulation (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 (OASG), as defined in the State Hazard: MEE, to request support from relevant WA Government Agencies, including DWER, during a State waters spill response. The Santos WA's Waste Management Plan – Oil Spill Response Support (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 WA's activities.

19.4 Waste Service Provider Capability

Detailed guidance on Santos WA's Waste Service Provider responsibilities for spill response waste management is provided in the Santos' Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053).

Key responsibilities of the waste service provider include:

+ Maintaining emergency response standby preparedness arrangements, including:
  - Access to personnel, equipment and vehicles required for a first strike and ongoing response commensurate to Santos WA 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
  - Participation in exercising undertaken by Santos WA.
+ 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; and
+ 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)

19.5 Waste management resources

Santos WA 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 19-3 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.

Table 19-3 : NWA Vehicle and Equipment Availability

Plant and Equipment	No.	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m3)	NWA 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 MGB's	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
Waste storage						**48 hours**	**1 week**	**2 weeks**	**1 month**
MGB's	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 MGB'S	Able to remove 16 x 240L MGB'S simultaneously	continuous		0	2	N/A	N/A
Waste storage						**48 hours**	**1 week**	**2 weeks**	**1 month**

Plant and Equipment	No.	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m3)	NWA mobilisation schedule to meet estimated capacity			
						No. Sourced locally	No. Sourced State-wide and Nationally		
Lidded Bins	6	1,100 litres	contain various waste streams	2	13	6	N/A	N/A	N/A
Front Lift Bins	50	3 m3	various waste streams	2	300	20	30	N/A	N/A
Front Lift Bins	25	4.5 m3	various waste streams	2	225	10	15	N/A	N/A
Offshore Rated Front Load Bins	100	3 m3	various waste streams	2	600	40	60	N/A	N/A
Offshore Rated Bins	45	7 m3	various waste streams	2	630	20	25	N/A	N/A
Marrell Skip Bins	60	6-9 m3	various waste streams	2	960	20	40	N/A	N/A
Hook Lift Bins	12	15-30 m3	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

19.6 Waste Management Environmental Performance

Table 19-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 19-4: 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 Waste Service Provider for emergency response services
	Response Implementation		
	Implement Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053)	Waste Service Provider to appoint a Project Manager within 24 hours of activation	Incident Log
		Waste Service Provider shall track all wastes from point of generation to final destination	Waste tracking records
		Waste Service Provider to provide monthly waste management reports and more regular situation reports during the response until termination criteria are met	Waste reports

20 Scientific Monitoring Plan

Table 20-1: 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 Scientific Monitoring Plans (SMPs) – **Appendix M**		
Applicable hydrocarbons	**Diesel**	**Crude**	**HFO**
	✔	✔	✔
Termination criteria	Refer to individual SMPs – **Appendix M**		

Oil spill scientific monitoring is the principle tool for detecting and quantifying environmental impact and recovery to sensitive receptors from an oil spill. Santos WA is required to have an oil spill scientific monitoring plan (SMP) in place for Petroleum activities in State and Commonwealth waters.

Santos WA 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.

20.1 Objectives

The overarching objective of Santos WA 's Scientific Monitoring Plans (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 M.**

20.2 Scope

Santos WA will implement its SMPs, as applicable, for Ningaloo Vision operations 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 (ESC), Santos WA will follow the direction of DoT and provide all necessary resources (monitoring personnel, equipment and planning) to assist as a Supporting Agency.

20.3 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 Scientific Monitoring Plan.

20.4 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 Ningaloo Vision Operations **(Table 20-2).** These are detailed further in **Appendix M**; 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 20-2: Oil Spill Scientific Monitoring Plans relevant to Ningaloo Vision operations

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 Megafauna (incl. whale sharks and mammals)
SMP9	Marine Reptiles
SMP10	Seafood Quality
SMP11	Fish, Fisheries and Aquaculture
SMP12	Whale Sharks

20.5 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 WA periodically review the status, availability and suitability of existing baseline data sources related to key environmental sensitivities in its areas of operations. **Appendix O** provides further information on Santos WA baseline data reviews and outlines a baseline date assessment conducted on high priority areas for scientific monitoring in the event of a Ningaloo Vision operations oil spill.

20.6 Monitoring Service Providers

Oil Spill Scientific Monitoring will be conducted on behalf of Santos WA by a contracted Monitoring Service Providers (MSPs) and applies to the implementation of SMPs 1-11 (Table 20-2). These services are provided by Astron Environmental Services (Astron) and primary sub-contractor (BMT).

For whale sharks, in addition to the monitoring that will be undertaken as part of SMP8 Marine Megafauna, additional scientific monitoring of whale sharks along the Ningaloo Coast will be undertaken (SMP12). Santos has historically and currently supports research on the behaviour, demography and migration patterns of whale sharks at Ningaloo Reef conducted by AIMS. 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 WA's MSP provides the following scientific monitoring services to Santos WA:

+ 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 Advisors 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; and
+ Participation in audits, workshops, drills and exercise to facilitate readiness.

Appendix M provides an overview of Santos WA's processes in place to provide assurance that its oil spill scientific monitoring arrangements for SMPs 1-11 are fit for purpose to meet the worst case first-strike monitoring requirements associated with the Ningaloo Vision operations.

20.7 Activation

The SMP Activation Process is outlined in **Appendix N**. SMPs are activated as per the initiation criteria for each as outlined in **Appendix M**. The SMP Activation Form is available on the Santos WA Procedures Index and IMT Environment Team Leader folder.

The Santos WA IMT Environment Team Leader (ETL) with support from IMT Environment Team members is responsible for activating the primary MSP. The Santos WA Environment Team will assist the MSP Monitoring Coordination personnel and relevant Technical Advisors 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 Environment Team Leader will feed back to the IMT for approval.

In the event that a designated Control Agency takes command of scientific monitoring, Santos WA will follow the direction of the Control Agency providing planning and resourcing support through its MSPs as required.

20.8 Scientific Monitoring Environmental Performance

Table 20-3 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 20-3: 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**	**Response Strategy**	**Control Measures**
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 WA combined EMBA	Regular review of baseline data	Baseline data review report
	Response implementation		
	Activate Scientific Monitoring Plans	Initiation criteria of SMPs will be reviewed during the preparation of the initial Incident Action Plan (IAPs) 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 Monitoring Service Provider is to follow the process outlined in Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Incident Log
		Monitoring Service Provider shall commence activation process within 30 mins of initial notification form being received from Santos WA	Monitoring Service Provider records

		Santos WA personnel to support Monitoring Service Provider through the provision of operational monitoring information and relative location of sensitive receptors to the spill	Incident Log and Monitoring Service Provider records

21 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 following factors:

+ 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; and
+ 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 WA will complete the following tasks:

+ 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; and
+ Assess long-term environmental monitoring requirements.

22 OPEP Administration

22.1 Document Review and Revision

In line with regulatory requirements, this document shall be reviewed, updated and submitted to NOPSEMA every 5 years from date of acceptance.

The document may be reviewed and revised more frequently, if required, in accordance with the Santos WA Management of Change Procedure (EA-91-IQ-10001). This could include changes required in response to one or more of the following:

+ When major changes have occurred which 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; or
+ 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.

22.2 OPEP Custodian

The custodian of the OPEP is Santos WA Senior Adviser – Oil Spill Response

23 References

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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 Ningaloo Vision; 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 *Ningaloo Vision Operations Environment Plan WA-35-L (TV-00-RI-00003).*

Table A1: Characteristics of diesel

Hydrocarbon	Initial density (kg/m^3)	Viscosity (cP) @ 25°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)

Heavy fuel oil

Characteristics of HFO were extracted from the RPS Group oil database for similar operational temperatures to the North West Shelf (**Table A2**). HFO is a manufactured blend of hydrocarbons largely composed of low-volatile and persistent hydrocarbons to which a small proportion of higher volatility components are added. The oil has a low percentage of volatile and semi-volatile components (a total of < 6%). Approximately 11% of the volume has low volatility (boiling point between 265 and 380°C), that would require weeks to evaporate. A further 83% is composed of non-volatile components (boiling point greater than 380° C), which will not evaporate under typical environmental conditions that occur on the North West Shelf. The soluble aromatic hydrocarbons represent a low proportion of the volume of HFO, at approximately 2.2%.

HFO has high viscosity (> 3000 cSt) when fresh and the viscosity will rise through evaporation of lighter components and, consequently, will not spread as rapidly as less viscous oil types. Moreover, HFO can take up water at a ratio of 30-70% of the oil volume to form a water-in-oil emulsion (mousse), which will result in increased viscosity of the mixture. This emulsification process will inhibit evaporation rates for the oil and increase the volume of oily waste.

Table A2: Characteristics of HFO

Hydro-carbon	Initial density (g/cm³) @ 15°C	Viscosity (cP) @ 25°C	Volatiles (%)	Volatiles (%)	Semi volatility (%)	Low volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180	180–265	265–380	>380	Of whole oil < 380 °C BP
Heavy Fuel Oil	0.9749	3180	% of total	1.0	4.9	11.3	82.8	2.2
				Non-persistent			Persistent	

Source: APASA (2013b)

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 4-19 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 sea-water 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.

Van Gogh/Coniston /Novara crude oils

The Ningaloo Vision FPSO processes crude oil produced from the Van Gogh, Coniston and Novara fields. Credible oil spills associated with Ningaloo Vision operations could involve one of these oils separately or a blend of oils. A summary of Van Gogh, Coniston and Novara crude oil properties and a blend of these oils is provided in **Table A3** based on assay data.

Assay data shows the oils are highly biodegradable and contain a very small proportion of volatiles (<7%), a relatively low proportion of semi-volatile components (29-32.5%) and a high proportion of persistent compounds (60.7-67%). All oils have a negligible proportion of aromatic compounds (<1%) and wax content (<5%). Full assay results are available on the Emergency Response Intranet Page.

These oils can be categorised as heavy Group IV oils (AMSA, 2015). They are fluid at winter and summer sea temperatures and are relatively viscous with a persistent fraction of oil remaining during weathering. They have a high flash point that presents a low fire and explosion hazard when fresh.

Table A3: Summary of Van Gogh, Coniston and Novara crude oil properties

Hydrocarbon Type	Initial density (kg/m³) @ 15°C	Viscosity (cSt)	Component by Volume (%)	Non-Persistent		Persistent		Aromatic content (v/v %)
				Volatiles (%)	Semi-volatiles (%)	Low Volatility	Residual (%)	
			BP (ºC)	IBP–260	260–360	360–540	>540	
Van Gogh crude oil	951	@ 40 ºC: 145.7	% of total	5.8	29.5	44.4	20.3	0.3
Coniston crude oil	961	@ 70ºC: 40.56	% of total	6.9	32.5	40.9	19.8	0.3
Novara crude oil	970	@ 60ºC: 123.4	% of total	3.9	29.0	42.6	24.4	0.2
Van Gogh, Coniston and Novara crude oil blend	952	@ 70ºC: 31.21	% of total	5.9	27.8	43.7	22.6	0.5

Source: Intertek (2009, 2010, 2012, 2016, 2019)

<u>Weathering characteristics</u>

RPS Group (2015) conducted an assessment on Van Gogh field crude oil (Theo-3 well) for weathering properties and applicable spill response strategies, drawing on assay data and a laboratory weathering study (Leeder Consulting, 2007a, b). Weathering and dispersant efficacy studies have also been conducted on Coniston and Novara oils separately (Intertek Geotech, 2012) and a blend of oils (Van Gogh and Coniston comingled; Intertek 2018). Key results are summarised below.

Oil appearance on water

Van Gogh, Coniston and Novara crude oils have a dark brown colour and would appear as dark brown to black slicks which may sit low near the water surface due to the relatively high viscosity and high density.

Although sheens may be visible spreading from thicker slicks initially, indicating the spread of lower density components, sheens will likely be absent after the oil has weathered for 6-12 hours.

Evaporation/flammability

All oils have a high flash point (> 110°C) with low representation by highly volatile components (<10%), indicating low risk of flammable vapour concentrations being generated. Evaporate will occur slowly and only partially with a high proportion of low volatility/residual compounds (60-70%). Based on laboratory weathering studies losses from evaporation over a period of 3 days are expected to be less than 50% although there were some differences observed among oils (**Table A4**). Results indicate Coniston and Novara oils would be more resistant to weathering than Van Gogh crude or a blend including Van Gogh crude. Laboratory studies show loses of <10% for Coniston/Novara oils. Across all studies losses through evaporation levelled within or at approximately 3 days.

Table A4 – Laboratory weathering results (% volume loss) for Van Gogh, Coniston and Novara oils

Oil	% volume loss after 24 hours		% volume loss after 3 days	
	Winter conditions[1]	Summer conditions[1]	Winter conditions[1]	Summer conditions[1]
Theo-3 (Van Gogh) (Leeder Consulting 2007a)	15	36	26	52
Coniston (Intertek Geotech, 2012)	3.9	5.4	6.8	7.1
Novara (Intertek Geotech, 2012)	1.9	1.9	1.9	1.9
Coniston and Van Gogh blend (Intertek, 2018)	21	Not tested	24	Not tested

[1] Representative air and water temperatures for Summer and Winter at Ningaloo Vision site were used – refer to reports for specific details.

Viscosity, pour point and density

All oils have low initial pour points (-18 – 4 °C) which after 3 days of weathering, under summer and winter conditions, remain low and under the ambient temperatures at the spill site indicating that oils will remain liquid during initial weathering (**Table A4**). The viscosity of oils when fresh and after 3 days weathering indicate high viscosity and low spreading rates will occur due to gravity and surface tension. Viscosity and pour point increases during weathering (**Table A4**). For very weathered residues of these oils, assay derived pour point data indicates that highly weathered residues may be solid at ambient sea and air temperatures given residue pour points are typically above 50 °C.

Density also increases with weathering for these oils (Table A3), but fresh and weathered oil densities are <1 and therefore oils should remain buoyant in sea water. Measurements of density of Theo-3 (Van Gogh) crude with weathering indicate stabilisation at around 0.985 kg/l, suggesting that the oil density would remain below seawater density (i.e. <1.025 kg/l) for weeks to months.

The high viscosity and lower density than seawater will also resist physical break-up and entrainment into the water column (as oil droplets). Consequently, the oil will tend to remain afloat as slicks of liquid oil on the water surface even under rough sea conditions, most likely separating into patches under rough conditions.

Exception to this expectation might occur if the oil gets churned by wave action along a sandy shoreline and suspended sediment binds with the oil to raise the density of the sediment/oil mixture above that of seawater. This might result in sinking of the oil/sediment mixture near shorelines.

Table A5 – Viscosity, Pour Point and Density of Van Gogh, Coniston and Novara oils during weathering

Oil	Season[2]	Viscosity[1] (Cst)			Pour point (°C)			Density @ 15° (mg/L)		
		0 h	24 h	3 d	0 h	24 h	3 d	0 h	24 h	3 d
Theo-3 (Van Gogh) (Leeder	summer	48.5	248	885	-18	3	14	0.94	0.97	0.98
	winter	48.5	88.1	158	-18	-11	-4	0.94	0.97	0.98

Consulting 2007a)										
Coniston (Intertek Geotech, 2012)	summer	234	337	334	-9	-1	-1	0.96	NR	NR
	winter	234	455	493	9	-1	-1	NR	NR	NR
Novara (Intertek Geotech, 2012)	summer	518	617	689	4	7	9	0.97	NR	NR
	winter	NR	NR	NR	4	7	7	NR	NR	NR
Coniston and Van Gogh blend (Intertek, 2018)	winter	181	203	NR	-12	-9	NR	0.96	0.96	NR

[1] Viscosity measured at 60°C for Theo-3 oil and 40°C for Coniston, Novara and Coniston/Van Gogh blend

[2] Representative air and water temperatures for Summer and Winter at Ningaloo Vision site were used – refer to reports for specific details.

NR=No results

Emulsification potential

Emulsification testing has been conducted on Theo-3 (Van Gogh) crude and a blend of Coniston and Van Gogh oil while observations have been made on the emulsification potential of Coniston and Novara oils. Laboratory results vary across these oils; laboratory testing (tumbling of oil sample and sea water) indicated no significant take up of water for Theo-3 oil but the same testing for a blend of Van Gogh and Coniston oils revealed the formation of stable emulsions which fully separated over a period of 7 days under low energy (calm) conditions. While the emulsion resulted in an increase in volume, the viscosity, density and pour point of the blend remained relatively stable with slight increases over a 7-day weathering period. Visual observations from weathering testing of Coniston and Novara oils indicted that both oils form emulsions too however stability was considered to be on a scale of hours rather than days (Intertek Geotech, 2012).

Adhesion

The relatively high viscosity of Van Gogh, Coniston and Novara crude oils suggests that the oil will be cohesive and would adhere to surfaces such as sediment, infrastructure and the feathers of sea birds. The adhesion rate of the oil to a steel surface was observed to increase on weathering, consistent with the rise in viscosity. This indicates that the oil could be more problematic, in terms of physical impacts on biota, and for response (removal from surfaces, pumping etc.) as the oil weathers.

Dissolution of soluble, toxic, components

Van Gogh, Coniston and Novara crude oils contain only a low proportion of soluble hydrocarbons. Where BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) have been measured over weathering (Leeder, 2007a; Intertek, 2018), none of these compounds were detected above detection limits.

The high viscosity and tendency to remain as slicks instead of breaking up into droplets will also slow the rate of release of any soluble compounds that are present; by reducing the surface area available for exchange, indicating that soluble compounds that do leach from the oil would be widely spread, limiting concentrations that could occur.

Potential for oiled wildlife

The high viscosity of Van Gogh, Coniston and Novara crude oils indicate the potential for physical smothering of intertidal fauna and habitats. The high viscosity also indicates a high potential physical effect of the oil on seabirds that come into contact with the oil, physically restricting their flight and swimming movement and coating their feathers to cause matting of the feather structure and impairing the waterproofing and thermoregulation properties they provide. Preening by the birds in response would expose them to ingestion of oil.

Dispersant amenability

Dispersant amenability studies have been performed on Van Gogh (Theo-3) (Leeder, 2007b), Coniston and Novara oils (Intertek Geotech, 2012) and a blend of Van Gogh and Coniston oils (Intertek, 2018). Theo-3 oil was tested with Slickgone NS and Corexit 9527 dispersants. Coniston and Novara oils were tested with Slickgone NS and Corexit 9500. The blend of Van Gogh and Coniston oils was tested with Slickgone NS, Corexit 9500 and Finasol OSR 52. With the exception of Corexit 9527, these dispersants are currently available for Santos WA to use through its arrangements with AMOSC, OSRL and AMSA.

While the methodologies used were broadly consistent some variations were applied. The testing of Theo-3 oil involved six weathered states of the oil ranging from 4 hours to 10 days old. The testing of Coniston and Novara oils considered fresh and 24 hour weathered oil only while the study of the Van Gogh and Coniston blend considered fresh oil only. The Theo-3 oil testing looked at dispersant efficacy immediately and 15 minutes after dispersant was applied while the studies on Coniston, Novara and Van Gogh/Coniston blend looked at ongoing efficacy at six time-steps from 15 minutes to 24 hours following application of dispersant. Summer and winter conditions (sea and air temperature) indicative of the Ningaloo Vision location were used for dispersant tests of Theo-3 and Coniston and Novara oils while winter conditions only were used for the test of Van Gogh/Coniston blend.

Dispersant efficacy results from 15 minutes following dispersant application are summarised in **Table A6** below. More comprehensive results and description of methods are available in the testing reports available on the Santos WA Emergency Response Intranet Page.

Table A6: Dispersant efficacy results for Van Gogh, Coniston and Novara oils

Oil	Weathered state	Percentage of oil dispersed (%) by chemical dispersant at 15 mins			
		Corexit 9527	Corexit 9500	Slickgone NS	Finasol OSR 52
Theo-3 (Van Gogh) (Leeder Consulting 2007a)	Fresh	72 (s), 36 (w)	NR	45 (s), 28 (w)	NR
	24 h	38 (s), 25 (w)	NR	10 (s), 31 (w)	NR
Coniston (Intertek Geotech, 2012)	Fresh	NR	32 (s), 59 (w)	22 (s), 52 (w)	NR
	24 h	NR	67 (s), 47 (w)	34 (s), 39 (w)	NR
Novara (Intertek Geotech, 2012)	Fresh	NR	50 (s), 36 (w)	35 (s), 29 (w)	NR
	24 h	NR	40 (s), 23 (w)	25 (s), 47 (w)	NR

Coniston and Van Gogh blend (Intertek, 2018)	Fresh	NR	27 (w)	32 (w)	35 (w)

s= summer conditions, w=winter conditions. Refer to reports for details.
NR = No results

Dispersant efficacy results at 15 minutes after application ranged from 10% to 72% noting that the dispersant result of 72% dispersion of Theo-3 crude was with Corexit 9527 which is currently not available.

Efficacy of Theo-3 (Van Gogh crude oil) had the greatest range across testing (10 – 72%). For Corexit 9527 efficacy on Theo-3 crude ranged from 25 to 72% with greater efficacy in summer conditions and on fresh oil. For Slickgone NS, efficacy on Theo-3 crude ranged from 10 to 45% (**Table A6**) with better or equivalent efficacy on fresh oil than 24-hour weathered oil. Further testing on more weathered oils revealed that efficacy declined on oils weathered more than 24 hours under summer conditions; for oil weathered for 3 days efficacy had declined to 4-5% under these conditions (Leeder Consulting, 2007b). This effect was less noticeable under winter conditions; efficacy declined to 16 to 34% (Leeder Consulting, 2007b).

For Coniston oil, the efficacy of Corexit 9500 (32 to 67%) was generally higher than for Slickgone NS (22 to 52%). There was no clear trend in efficacy between fresh and 24 hour weathered oil. For Slickgone NS, efficacy was better under winter conditions.

For Novara oil, the efficacy of Corexit 9500 (23 to 50%) was similar to that of Slickgone NS (25 to 47%). Corexit 9500 was more effective on fresh oil and under summer conditions.

For Van Gogh/Coniston blend oil efficacy of the three dispersants after 15 minutes from application ranged from 27 to 35% (**Table A6**). The results indicate that for the Van Gogh crude oil, Finasol OSR 52 was the most effective with 35% of oil dispersed, followed by Slickgone NS with 32% oil dispersed, and Corexit 9500 was the least effective with 27.3% oil dispersed. Efficacy was highest within the first two hours of testing, followed by a decline across the following 48 hours. Finasol OSR 52 was the only dispersant to maintain a level of efficacy (24%) after 8 hours from application, whereas the efficacy of Corexit 9500 and Slickgone NS declined rapidly to 11% and 4.5% respectively after 8 hours.

This rapid decline in efficacy following application may be attributable to the dispersant behaviour, coalescence of oil droplets and gravitational separation over time, however this may be in part due to the experimental set-up. It is noted that in the open ocean the dilution of a dispersed oil can happen very quickly. However, this is highly dependent on environmental conditions such as wind and wave action. This dilution and transportation through the water column (both vertically and laterally) can have a significant effect on preventing re- coalescence and can offset the factors described above. The results discussed above do not factor in any dilution of the dispersed oil/emulsions and therefore should be treated accordingly.

<u>Ecotoxicity testing</u>

Santos WA commissioned Ecotox Services Australia (ESA) to undertake an ecotoxicity study using standard test species relevant to the tropical marine environment of the NWS (ESA, 2015). A full suite of toxicity testing (six tests – echinoderm, microalgae, fish, tiger prawn, copepod and bivalve mollusc) was performed. The dataset was used to generate species protection percentile curves using the BurrliOZ software to calculate trigger values (TV) for weathered Coniston and Novara crude oils, and the chemically-dispersed oils. Full ecotoxicity results are available on the Emergency Response Intranet Page.

The TVs were derived using the Total Recoverable Hydrocarbon (TRH) concentrations for the Coniston and Novara crude oils (weathered oil samples). Derived TVs for the 99% and 95% level of species protection for the weathered Coniston and Novara crude oils were similar (**Table A7**). These derived TVs provide an early warning indication that TRH concentrations are reaching a level of concern which will assist in directing response and further investigation in the unlikely event of an oil spill.

Ecotoxicity test termination criteria based on loading rates of oil were considered a more accurate representation of toxicity and TV derivation for the chemically-dispersed oils (weathered oil + dispersant samples). Expressing concentrations in terms of TRH (total of C6–C36) can only be done for those samples where TRH is the sole cause of toxicity i.e. crude oil only. As the dispersant contributes towards toxicity, and affects the amount of TPH, it is not recommended for reporting in terms of TRH. The TVs based on loading rates derived for the Coniston and Novara crude oils with or without the addition of dispersant were used to inform the NEBA as part of the OPEP.

These results demonstrate that the addition of dispersant to Coniston and Novara oils increases the level of toxicity (95% and 99% species protection levels) to test organisms (**Table A7**). However, the concentrations of oil with and without dispersants is relatively high (i.e. at 100s to 1000s ppm levels) (**Table A7**). These levels are orders of magnitude higher (less toxic) than high exposure levels for entrained (100 ppb) and dissolved (400 ppb) hydrocarbons cited in NOPSEMA's Environment Bulletin for Oil Spill Modelling (April, 2019) and used for risk assessment within the Ningaloo Vision Operations Environmentt Plan (TV-00-RI-00003.02). The exposure levels within NOPSEMA's Environment Bulletin for Oil Spill Modelling (April, 2019) can therefore be considered very conservative for Van Gogh, Coniston and Novara crude oils.

A key effect of dispersant to an oil's toxicity is considered to be due to the dispersant making the more water soluble oil compounds more bioavailable to organisms. However, Van Gogh, Coniston and Novara oils have inherently low proportions of soluble aromatics (e.g. BTEX) and therefore the toxicity of the dispersants alone may also therefore be a factor within these results.

This information should be considered during a Net Environmental Benefit Analysis (NEBA) for dispersant use together with an understanding of the likely or observed exposure of sensitive receptors to oil as predicted through spill trajectory modelling or monitored through water quality sampling. It should be noted that natural dispersive forces in the marine environment will act to reduce the concentration and exposure to receptors of chemically dispersed oil; which cannot be replicated through laboratory testing.

Table A7: Trigger values based on loading rates derived for Coniston and Novara crude oils with or without addition of dispersant

Hydrocarbon type	Dispersant application	Level of species protection	Trigger value (mg/L)
Coniston Crude (weathered 24 hrs)	None	**99%**	**1,566**
		95%	4,233
	Corexit 9500 (1:25)	**99%**	**408**
		95%	961
	Slickgone NS (1:25)	**99%**	**118**
		95%	648
Novara Crude (weathered 24 hrs)	None	**99%**	**1,479**
		95%	3,939
	Corexit 9500 (1:25)	**99%**	**193**

		95%	**588**
	Slickgone NS (1:25)	**99%**	**161**
		95%	769

Appendix B: POLREP

Department of
Transport

Marine Pollution Report (POLREP)

BEFORE completing this form please contact the MEER duty officer on (08) 9480 9924 (24hrs). Immediate reporting will enable a rapid response.

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

Appendix C: SITREP

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 D: 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

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Timeline of observations:

Time	Description

Appendix E: Aerial Surveillance Observer Log

Santos

Aerial Surveillance Observer Log – Oil Spill

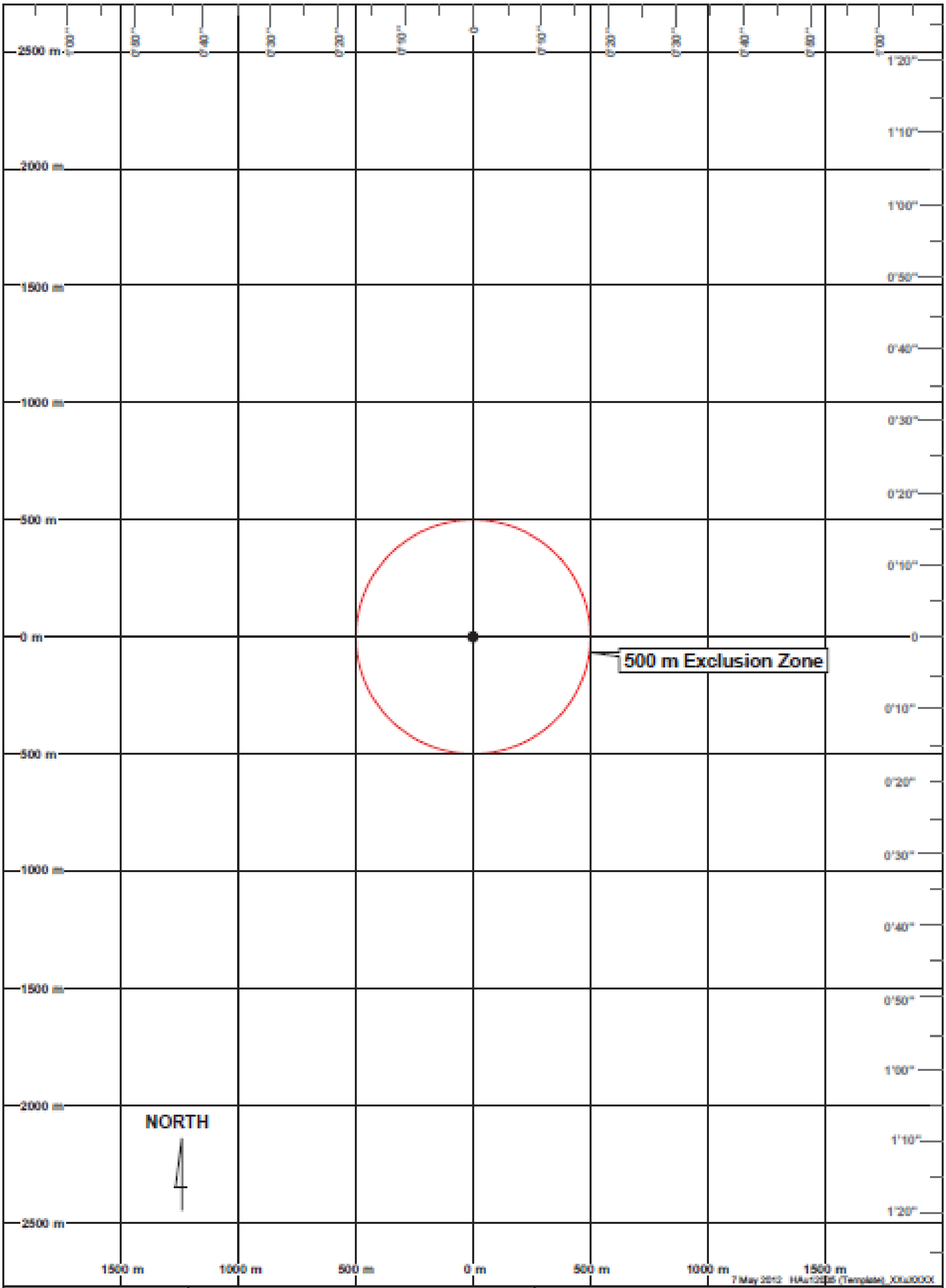
<table>
<tr><th colspan="5">Survey Details</th></tr>
<tr><td>Date:</td><td>Start time:</td><td>End Time:</td><td colspan="2">Observer/s:</td></tr>
<tr><td colspan="3">Incident:</td><td colspan="2">Area of Survey:</td></tr>
<tr><td>Aircraft type:</td><td colspan="2">Call sign:</td><td>Average Altitude:</td><td>Remote sensing used:</td></tr>
<tr><th colspan="5">Weather Conditions</th></tr>
<tr><td colspan="2">Wind speed (knots)</td><td colspan="3">Wind direction</td></tr>
<tr><td colspan="2">Cloud base (feet)</td><td colspan="3">Visibility</td></tr>
<tr><td colspan="2">Time high water</td><td colspan="3">Current direction</td></tr>
<tr><td colspan="2">Time low water</td><td colspan="3">Current speed (nM)</td></tr>
</table>

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 F: Aerial Surveillance Surface Slick Monitoring Template

AERIAL SURVEILLANCE SURFACE SLICK MONITORING TEMPLATE



	NAME:	VESSEL / AIRCRAFT:
	DATE / HOUR:	OTHER REFERENCE:

Appendix G: 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					

Santos

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 H: Aerial Surveillance Shoreline Observation Log

Santos

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 I: 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

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 J: 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.	-

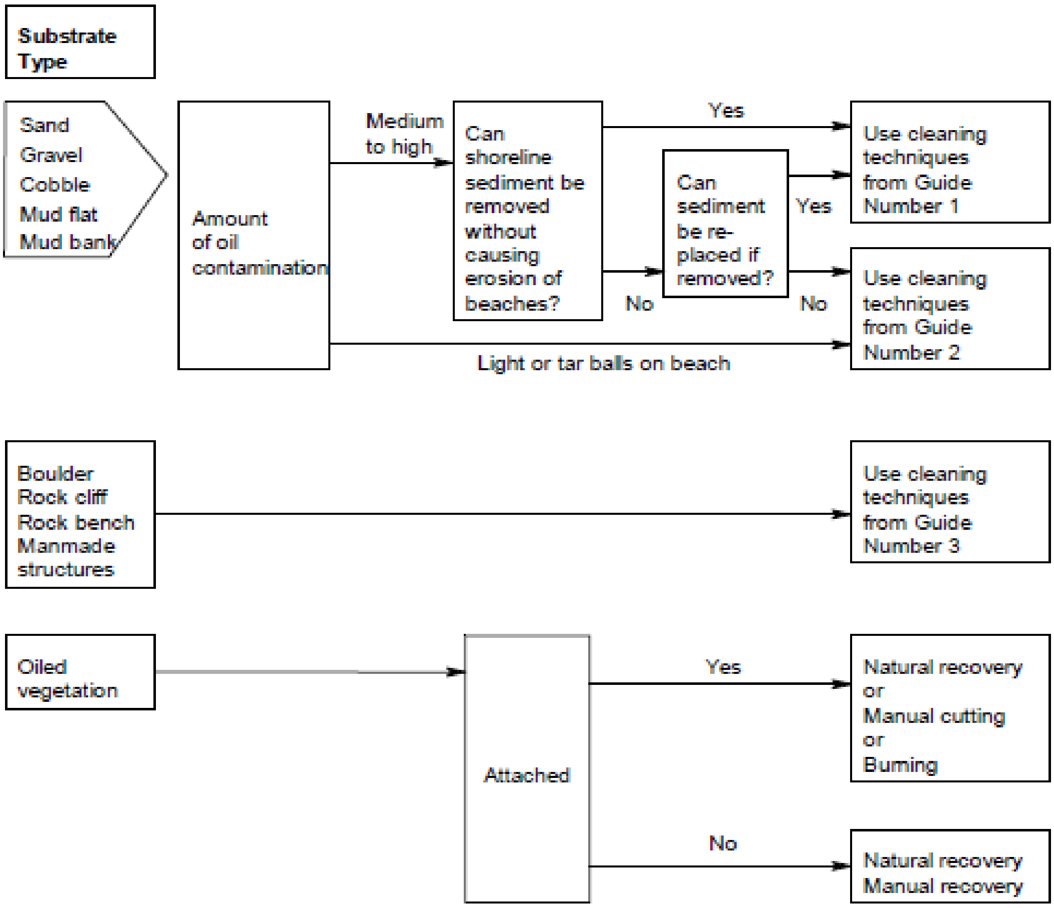

Figure 1: Shoreline Clean-up Master Decision Guide

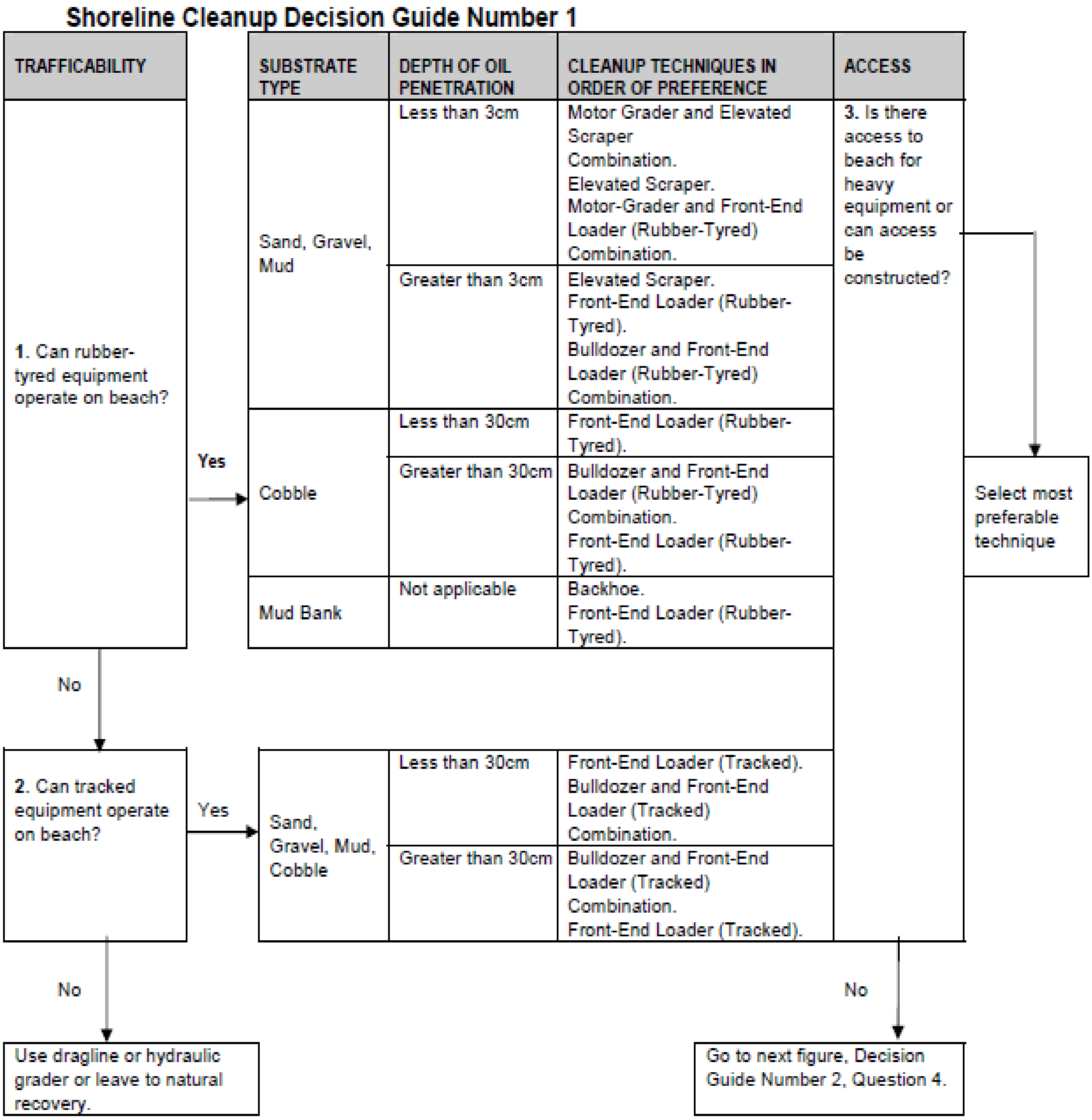

Figure 2: Shoreline Clean-Up Decision Guide 1

Shoreline Cleanup Decision Guide Number 2

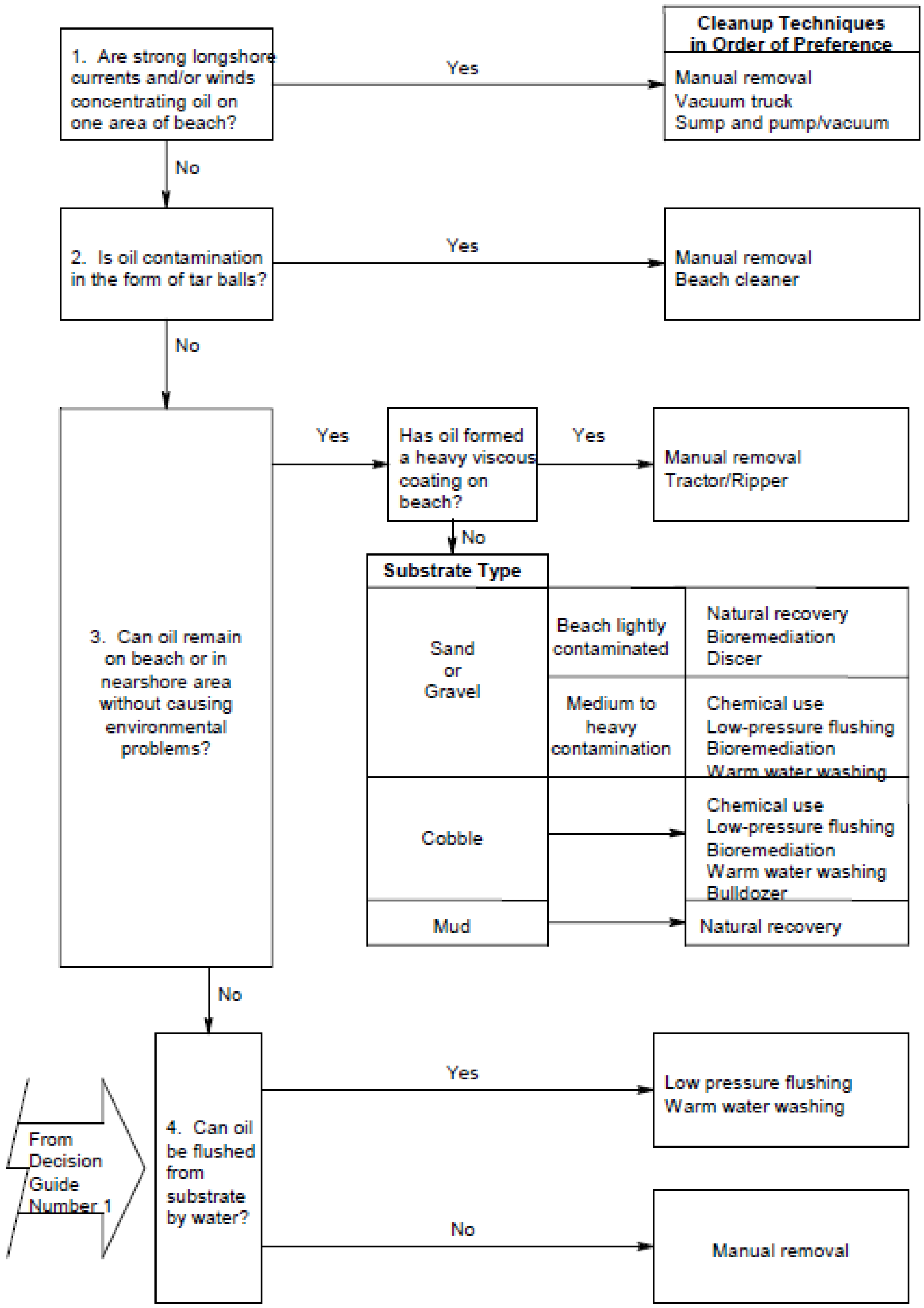

Figure 3: Shoreline Clean-Up Decision Guide 2

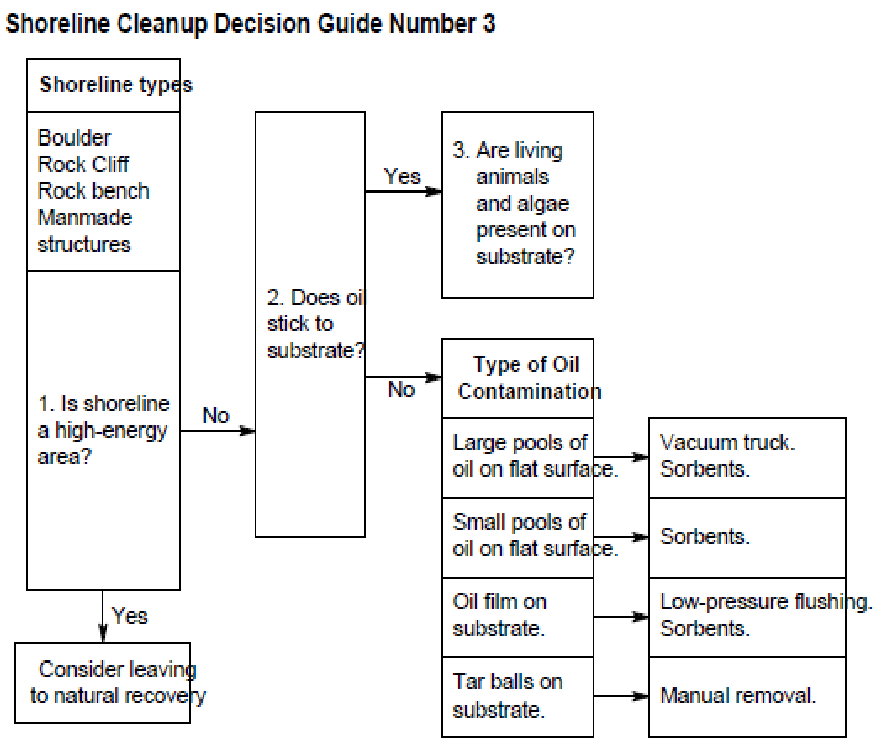

Figure 4: Shoreline Clean-Up decision Guide 3

Appendix K: 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 ✓ Barrier tape and stakes ✓ Signposting equipment	✓ Bins, barrels, skips, tanks ✓ Hot and cold beverages Welfare) ✓ 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:
  - Staging areas
  - Pits if necessary
  - Platform within earth berms
  - 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 L: 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 – 20 Trained in OWR management by Massey University through AMOSC		20
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*

Perth Zoo – Duty Veterinarian	Wildlife care and rehabilitation advice, expertise and management	Personnel potentially available to petroleum industry (currently there is no formal arrangement)	
	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 28 Feb 2019

** 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	AMOSC Duty Officer	Fremantle
1 x AMOSC owned OWR container 1 x AMOSC owned box 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
1 x NatPlan/DBCA Box/trailer kit		Fremantle
WA DBCA OWR Equipment*	**Activated through**	**Location**
1 x DBCA OWR container	DoT Duty Officer	Kensington
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		Fort Lauderdale, USA

* As per AMOSC Capacity Statement 28 Feb 2019

** As per OSRL Mobilisation Fact File. NB: 50% of equipment available to members.

Appendix M: 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 1). 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: 1. Environmental covariates are considered in sampling design recorded and incorporated statistically. 2. A hierarchical or stratified sampling design is used to address variation at multiple scales 3. Design is standardized, by sampling equivalent strata (e.g., level of exposure, depth etc.).	English et al. (1997), Snedecor and Cochran (1989)
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)

Principle	Explanation	Key guiding references
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)

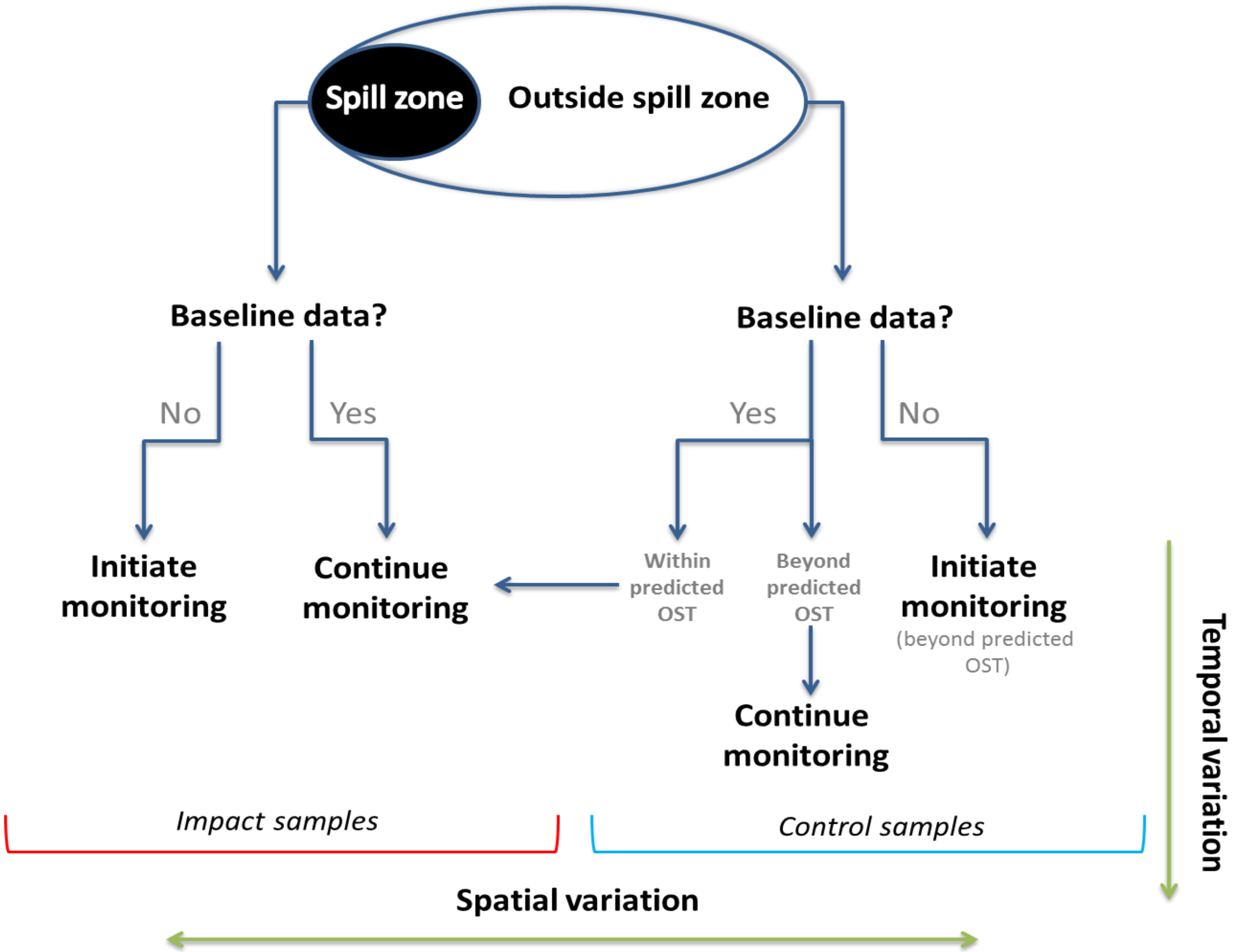

Figure 1: Structured decision making process based on Gregory et al. (2012) in reference to monitoring programs, the availability of baseline data, and oil spill trajectory. In an ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

1.2 Data Analysis

The most important approaches to statistical analysis and related sampling design are summarised in Table 2 (below).

Table 2: Summary of data analysis techniques.

Analysis type		Description	Strengths	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.
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

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 Monitor and Evaluate, 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	Refer Baseline Data Review (QE-00-BI-20001) In addition, the Industry-Government Environmental Metadatabase (IGEM) (Santos is subscribed to) 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.

<table>
<tr><th colspan="2">SMP1 – Marine Water Quality</th></tr>
<tr><td>Methodological approach</td><td>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):
4. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied;
5. 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;
6. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied.

See 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.

<u>Water profiles</u>

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).

<u>Water quality</u>

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 depend on holding times required (<8 hours ideal) and may involve filtering and freezing of each sample (Grochowsi and Stat 2017).</td></tr>
<tr><td>Scope of works</td><td>Prepared by monitoring provider for issue within 24 hours of SMP having been activated.</td></tr>
</table>

SMP1 – Marine Water Quality	
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. To monitor marine benthic infauna assemblages as an indicator of sediment quality, in relation to an oil spill and associated response activities.
Baseline	Refer Baseline Data Review (QE-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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.

SMP2 - Sediment Quality	
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 • Introduction of marine pests • Shading from marine infrastructure • Climate change

<table>
<tr><th colspan="2">SMP2 - Sediment Quality</th></tr>
<tr><td>Methodological approach</td><td>
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):
<ol start="7">
If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied;
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;
Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied.

See 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
<u>Sediment quality</u>
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 extend 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.

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.
<u>Infauna samples</u>
A subset of the sediment sample shall be sieved in the field (if time permits) with collected infauna preserved (buffered formalin, formaldehyde or 70% ethanol) 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.
</td></tr>
</table>

SMP2 - Sediment Quality	
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
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 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	Refer Baseline Data Review (QE-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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.

SMP3 - Sandy Beaches and Rocky Shores	
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 • Nutrification • Climate change.

SMP3 - Sandy Beaches and Rocky Shores	
Methodological approach	Monitoring will be designed as follows: • Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. • Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. • 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 (buffered formalin, formaldehyde or 70% ethanol) 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.
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.

SMP3 - Sandy Beaches and Rocky Shores	
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 – Mangroves	
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	On-ground monitoring is ongoing at several locations , refer Baseline Data Review (QE-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 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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.
Termination criteria	Mangrove extent and health are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly 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.

<table>
<tr><th colspan="2">SMP4 - Shorelines and Coastal Habitats – Mangroves</th></tr>
<tr><td>Receptor impact</td><td>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.</td></tr>
<tr><td>Methodological approach</td><td>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 onground monitoring should be carried out to complement any analysis of remote sensing. Analysis of long-term onground monitoring data will be as follows:
• Where long-term baseline data sites (only) are contacted a control chart (time-series) design will be applied.
• Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.
• Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See Figure 1).

On-ground monitoring of mangroves will aim to detect change in mangrove health, including canopy cover and plant/leaf health indices.

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.</td></tr>
<tr><td>Scope of works</td><td>Prepared by monitoring provider for issue within 24 hours of SMP being activated.</td></tr>
<tr><td>Implementation</td><td>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.</td></tr>
<tr><td>Analysis and reporting</td><td>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.</td></tr>
</table>

2.5 SMP5 Intertidal Mudflats

<table>
<tr><th colspan="2">SMP5 - Shorelines and Coastal Habitats – Intertidal Mudflats</th></tr>
<tr><td>Rationale</td><td>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.</td></tr>
<tr><td>Aim</td><td>To monitor changes in intertidal mudflat communities associated with an oil spill and associated activities.</td></tr>
<tr><td>Baseline</td><td>Refer Baseline Data Review (QE-00-BI-20001)

. In addition, the IGEM shall be reviewed for applicable intertidal mudflat infauna baseline data.</td></tr>
<tr><td>Initiation criteria</td><td>Operational Monitoring, SMP1 or SMP2 indicates that mudflat habitats are contacted or predicted to be contacted by a hydrocarbon spill.
Contact is defined as hydrocarbon exceeding one of the following thresholds:
• 1 g/m^2 Floating oil
• 10 ppb Dissolved Aromatic Hydrocarbons
• 10 ppb Entrained hydrocarbons.</td></tr>
<tr><td>Termination criteria</td><td>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.</td></tr>
<tr><td>Receptor impact</td><td>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.</td></tr>
</table>

SMP5 - Shorelines and Coastal Habitats – Intertidal Mudflats	
Methodological approach	Monitoring will be designed as follows: • Where long-term baseline data sites (e.g., Roebuck Bay) are contacted, a control chart (time-series) design will be applied. • Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. • Where no baseline data sites are involved a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied (See 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. 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, formaldehyde or 70% ethanol) 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.
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) • 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. Non-coral benthic filter feeders, which include sponges, molluscs, sea whips and gorgonians, are considered indicators of disturbance due to their immobility and long living. 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	Refer Baseline Data Review (QE-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	<u>Benthic habitat cover and composition</u> Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill. <u>Coral health and reproduction</u> Operational Monitoring, SMP1 or SMP2 indicates that coral habitat is contacted or is predicted to be contacted by a hydrocarbon spill. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.

<table>
<tr><th colspan="2">SMP6 - Benthic Habitats</th></tr>
<tr><td>Termination criteria</td><td><u>Benthic habitat cover and composition</u>

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.

<u>Coral health and reproduction</u>

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.</td></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>
</table>

SMP6 - Benthic Habitats	
Methodological approach	Monitoring design will be as follows: • Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. • Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. • Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. <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 fixed 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 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, ecotox 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.
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.

SMP6 - Benthic Habitats	
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. 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 ecotox laboratory in addition to standard suite of ecotox 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	Refer Baseline Data Review (QE-00-BI-20001) The Oil Spill Response Atlas (Department of Transport (DoT)) and National Conservation Values Atlas (Department of the Environment and Energy - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) 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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.
Termination 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 DoEE).

SMP7 - Seabirds and Shorebirds	
Receptor impact	Impact to sea and shore birds 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: • Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. • 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. • Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied. 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.
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.

SMP7 - Seabirds and Shorebirds	
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.

2.8 SMP8 Marine Megafauna

SMP8 - Marine Megafauna	
Rationale	Thirty-eight species of marine mammals are known to occur within the region. These include cetaceans (whales and dolphin) and sirenians (dugong). The whale shark (*Rhincodon typus*) is also included within this plan. 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 and whale sharks that may have resulted from the hydrocarbon spill and associated response.
Baseline	Refer Baseline Data Review (QE-00-BI-20001)
Initiation criteria	Operational monitoring indicates that marine megafauna are contacted or predicted to be contacted by a hydrocarbon spill. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.

SMP8 - Marine Megafauna	
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 megafauna with detectable levels of hydrocarbons attributable to the hydrocarbon spill; AND Monitoring is terminated in consultation with the relevant environmental authority (DBCA and/or DoEE).
Receptor impact	Impact to marine mammals and whale sharks 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) • Marine surveys will follow the protocols of Watson et al. (2009) 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.
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.

SMP8 - Marine Megafauna	
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	Refer Baseline Data Review (QE-00-BI-20001) The Oil Spill Response Atlas (Department of Transport (DoT)) and National Conservation Values Atlas (Department of the Environment and Energy - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) should also be consulted.

SMP9 - Marine Reptiles	
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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.
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 DoEE).
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) • 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.

SMP9 - Marine Reptiles	
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: • Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. • Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. • Where no baseline data sites are involved, and timing allows, a post spill pre-impact approach will be attempted • 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.
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.

SMP9 - Marine Reptiles	
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	Refer Baseline Data Review (QE-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.
Initiation criteria	Operational monitoring and results from SMP1 predicts or observes contact of oil to target species for consumption. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.

SMP10 - Seafood Quality	
Termination criteria	Hydrocarbon concentrations in the tissues of seafood are not above levels considered a human health risk from consumption; 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), 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.
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	Refer Baseline Data Review (QE-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. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.
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).

<table>
<tr><th colspan="2">SMP11- Fish, Fisheries and Aquaculture</th></tr>
<tr><td>Receptor impact</td><td>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.

Other pressures to these states are:
• Accidental chemical spillage
• Over fishing
• Introduction of marine pests
• Habitat disturbance
• Climate change.</td></tr>
<tr><td>Methodological approach</td><td>Fish assemblages will be assessed using the stereo-baited remote underwater videos (BRUVs) following Shortis et al. (2009). 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:
• Where long-term baseline data sites are contacted a control chart (time-series) design will be applied.
• Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.
• If baseline data is not available, a gradient approach to quantifying impacts will be applied (See 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.</td></tr>
<tr><td>Scope of works</td><td>Prepared by monitoring provider for issue within 24 hours of this SMP being activated.</td></tr>
<tr><td>Implementation</td><td>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.</td></tr>
</table>

SMP11- Fish, Fisheries and Aquaculture	
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 Shark

SMP12- Whale Shark	
Rationale	Whale sharks inhabit most of the Western Australian coast and seasonally aggregate at Ningaloo Reef in the austral autumn and winter, coinciding with a pulse of productivity following mass coral spawning in early autumn, with the population during this period dominated by juveniles (Bradley et al. 2016). In addition to the monitoring that will be undertaken as part of SMP8 Marine Megafauna, additional scientific monitoring of whale sharks along the Ningaloo Coast will be undertaken (SMP12). Santos has historically and currently supported research on the behaviour, demography and migration patterns of whale sharks at Ningaloo Reef. 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.
Aim	To quantify impacts of an oil spill on whale sharks at the Ningaloo Coast

Baseline	Baseline monitoring information of whale sharks includes: 1) Aerial survey. Monthly surveys funded by Woodside Energy were completed from 2000 to 2002. DEC 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 DEC 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 (DEC pers. comm.). Note that while aerial survey techniques have shortfalls for determining abundance patterns, they are still useful for identifying aggregation sites of whale sharks in the Exmouth sub-basin. 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) 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

SMP12- Whale Shark	
	chance, although they do indicate the presence of these animals around oil and gas facilities offshore and in deep water on the shelf. 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 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 by Wilson et al. (2001; 2003). Preliminary work on the food chains leading to the prey of whale sharks is underway (Marcus et al., 2016, 2019). 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 Ningaloo Coast whale shark aggregations are contacted or predicted to be contacted by oil. Contact is defined as hydrocarbon exceeding one of the following thresholds: • 1 g/m^2 Floating oil • 10 ppb Dissolved Aromatic Hydrocarbons • 10 ppb Entrained hydrocarbons.
Termination criteria	The termination criteria for this monitoring program are: • 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.
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 within 24 hours of this SMP being activated
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been approved
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 N: 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 O: Scientific Monitoring Capability

Scientific Monitoring Assurance and Capability Assessment

Assurance arrangements

Astron Environmental Services (Astron) is currently Santos WA's primary Monitoring Service Provider for the implementation of SMPs 1-11. 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 1-11.

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 WA has also recently undertaken a Tier 2 audit of Astron (December 2018) 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 WA 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 (OSMP) project, governed through an APPEA-Industry Steering Committee. This project, being progressed throughout 2020, 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 WA is currently 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 WA 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. 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:

- IMCRA
- 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 were 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 (ie., 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 (ie., 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) 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. These experimental design approaches are described within the Oil Spill Scientific Monitoring Plan (EA-00-RI-10099).

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
Water Quality (SMP1)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Sediment Quality (SMP2)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Sandy Beaches/Rocky Shorelines (SMP3)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Mangroves (SMP4)	Survey	Survey	Survey	Survey	Not applicable	Survey
Intertidal Mudflats (SMP5)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Benthic Habitats (SMP6)	Priority survey	Survey	Priority survey	Survey	Survey	Priority survey
Seabirds/ shorebirds (SMP7)	Priority survey	Survey	Survey	Survey	Survey	Priority survey
Marine megafauna (SMP8)	Survey	Survey	Priority survey	Survey	Survey	Survey
Marine reptiles (SMP9)	Priority survey	Survey	Survey	Survey	Survey	Survey
Seafood Quality (SMP10)	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
Whale sharks (SMP12)	Not applicable	Not applicable	Not applicable	Survey	Not applicable	Not applicable

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 three broad regions: 1) Barrow/ Montebello/ Lowendal Islands; 2) Ningaloo Coast/ Muiron Islands or; 3) Dampier Archipelago would potentially require priority baseline monitoring within the 7 day time period.

Table 2 outlines the required scientific monitoring capability for rapid response in Scenario 2 (Ningaloo Coast/Muiron Islands), 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) 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 2: Scenario 2 capability assessment for rapid sampling of Ningaloo Coast and Muiron Islands area within seven days.

Receptors	Priority Protection Areas		Required capability for rapid response (per Priority Protection Area)	Actual Team Capability
	Ningaloo	Muiron Islands		
Water Quality (SMP1)	Priority survey	Priority survey	1 teams of 2 personnel • at least one member in each team to have experience in water sampling • at least one member in each team to have experience in deep sea sediment sampling	3 teams of 2 personnel
Sediment Quality (SMP2)	Priority survey	Priority survey		
Sandy Beaches/Rocky Shorelines (SMP3)	Priority survey	Priority survey	1 teams of 2 personnel • at least one team member with experience in shoreline macrofauna/infauna assessment	3 teams of 2 personnel
Intertidal Mudflats (SMP5)	Priority survey	Priority survey		
Mangroves (SMP4)	Survey	Survey	Not required[2]	Not required
Benthic Habitats (SMP6)	Survey	Survey	Rapid priority response not required	2 teams of 2 personnel • at least one team member with experience in benthic habitat assessment • ROV operator or divers
Seabirds/ shorebirds (SMP7)	Survey	Survey	Rapid priority response not required	4 teams of 2 personnel • at least one member of each team is an experienced ornithologist)

Receptors	Priority Protection Areas		Required capability for rapid response (per Priority Protection Area)	Actual Team Capability
	Ningaloo	Muiron Islands		
Marine megafauna (SMP8)	Survey	Survey	Rapid priority response not required	2 teams of 2 personnel (aerial)[1] • both experienced wildlife observers 2 teams of 2 personnel (vessel)[1] • both experienced wildlife observers
Marine reptiles (SMP9)	Survey	Survey	Rapid priority response not required	2 teams of 2 personnel (aerial)[3] • both experienced wildlife observers 3 teams of 2 available (vessel)[3] • both experienced wildlife observers 3 teams of 2 personnel (ground-based)[4] • at least one member with experience in turtle survey techniques
Seafood Quality (SMP10)	Priority survey	Priority survey		

Receptors	Priority Protection Areas		Required capability for rapid response (per Priority Protection Area)	Actual Team Capability
	Ningaloo	Muiron Islands		
Fish, Fisheries & Aquaculture (SMP11)	Priority survey	Priority survey	1 teams of 3 personnel • at least one member to have experience in fish identification and necropsy • at least one member to have BRUV experience	3 teams of 3 personnel
Whale sharks (SMP12)	Survey	Not applicable	Not required due to ongoing research along the Ningaloo coast	Not required due to ongoing research along the Ningaloo coast

[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.

[3]Two of these teams are those also assigned to SMP8

[4]One of these teams is also assigned to vessel-based surveys for the same SMP. They can be moved according to priority for either vessel-based or ground survey

Appendix P: Forward Operations Guidance

Forward Operating Base (FOB)

For a Ningaloo Vision operation spill response Santos WA will establish a FOB at Harold E Holt (HEH) Military Base through the HEH Facilities Manager or Exmouth SES Incident Command Centre for a local FOB through the Exmouth Shire CEO.

For an ongoing response, a FOB may also be set-up in Santos WA 's Dampier facilities leased from Toll. These facilities are located in Toll '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 IMT will develop a communication strategy to support the FOB/s and forward staging areas.

Local facilities with operational value for response uses are listed **Table 1**.

Table 1: Exmouth facilities with operational value 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. Dispersant operations base
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

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 Exmouth, Carnarvon 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 waste water will be decanted into suitable transportable medium provided by Santos WA 's 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 WA's WSP can provide disposal as required of wastewater from ablutions.

Security

To ensure that Staging Areas are secure, Santos WA can provide temporary fencing to contain operations / equipment during the clean-up; suppliers of temporary fencing are available in Karratha, or larger quantities may need to be sourced from Perth. If required the specialist services of security providers will be engaged.

Messing

Messing and catering facilities can be provided through one of Santos WA 's 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 WA 's 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 WA 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

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 WA 's 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 WA 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 WA 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 WA's 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.

PPE

Santos WA 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 WA 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 WA 's WSP.

PPE requirements for spill responders is detailed in the Santos WA Oil Spill Recovery Safety Management Plan (QE-91-RF-10016).

Radio communications

Through AMOSC Mutual Aid arrangements, Santos WA 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.

Santos WA could additionally 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.