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Varanus Island Hub Operations Oil Pollution Emergency Plan

PROJECT / FACILITY	Varanus Island
REVIEW INTERVAL (MONTHS)	30 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	**Owner**	**Reviewer/s** *Managerial/Technical/Site*	**Approver**
	Senior Advisor – Oil Spill Response	**Team Lead – Security & Emergency Response**	**Manager - HSE**
9			

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Rev	Rev Date	Amendment
9	03/04/2020	Revised following NOPSEMA opportunity to modify and resubmit
8	17/12/2019	Revised to incorporate NOPSEMA Request for Further Written Information
7	31/07/2019	5-year revision to NOPSEMA
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4	03/09/2014	Revised to incorporate NOPSEMA Request for Further Written Information (refer MOC-63) and DMIRS comments
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1	20/02/2014	Submitted to DMIRS (10/07/2014)
0	05/09/2013	Revised to incorporate DMIRS comments and changed Commonwealth water spill scenarios.

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How to use this OPEP in the event of a spill

Sections 1 to 4 contain background information only:

- **Activity description and location,**
- **OPEP requirements,**
- **Oil Spill Response Framework**
    - **Spill Response Levels**
    - **Jurisdiction Authorities and Control Agencies**
    - **Santos WA Incident Management Structure (Roles and responsibilities; Training and exercises)**
    - **Integration with other Organisations**
- **Spill Modelling and Protection Priorities**
- **Response Options and NEBA**

Sections 5 to 19 contain directions on how to respond to the spill:

- **Initial Response (First Strike Activation)**
- **Notifications and Reporting**
- **IAP Planning**
- **Spill Response Plans:**
    - **Source Control Plan**
    - **Monitor and Evaluate Plan**
    - **Mechanical Dispersion Plan**
    - **Containment and Recovery Plan**
    - **Shoreline Protection Plan**
    - **Shoreline Clean-up Plan**
    - **Onshore Response Plan**
    - **Oiled Wildlife Response Plan**
    - **Waste Management Plan**
    - **Scientific Monitoring Plan**
    - **Forward Operations Plan**
    - **Spill Response Termination**

Sections 20 to 21 contain information on:

- **Document Review and Revision**
- **OPEP Custodian**
- **References**

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1 Oil Pollution Emergency Plan Overview

This document is the accompanying Oil Pollution Emergency Plan (OPEP) to the Varanus Island Hub Operations Environment Plan (EP) for Commonwealth Waters (EA-66-RI-10003) required by Regulation 14(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), and to the Varanus Island Hub Operations EP (State Waters) (EA-60-RI-00186), and Generic Well Suspension and Well Abandonment EP (EA-00-RI-10027) (State waters) required by the Petroleum (Submerged Lands) (Environment) Regulations 2012.

1.1 Description of Varanus Island Hub Operations

Varanus Island (VI) is the central gathering and processing hub for Santos WA's offshore oil and gas production facilities in the area. The VI facilities and installations are referred to as the VI Hub.

The following types of activities take place at the VI Hub facilities:

+ Routine operations and maintenance;
+ Marine operations;
+ Diving / remotely operated vehicle (ROV) activities;
+ Wireline intervention of wells for workover / re-perforation / suspension; and
+ Well abandonment operations.

Figure 1-1 shows a schematic layout of the VI Hub facilities and **Figure 1-2** shows their locations. The offshore facilities (platforms and subsea developments) that are either directly or indirectly linked to VI and their current production status are listed in **Table 1-1**.

VI currently receives produced hydrocarbons from the following offshore facilities:

+ Harriet Bravo platform;
+ Linda platform
+ Halyard subsea installation;
+ Spar-2 subsea installation; and
+ John Brookes platform.

Gas/condensate and crude oil is processed on Varanus Island. Dry gas is exported to the mainland via the sales gas pipeline for domestic use. Liquid hydrocarbons (Varanus Blend) are stored in tanks on the island and are periodically off-loaded to offtake tankers via a tanker load-out line leading to the Marine Terminal.

The John Brookes platform, Halyard and Spar-2 subsea installations are located in Commonwealth waters and produce to Varanus Island via the John Brookes pipeline and Halyard flowline/ East Spar pipeline, respectively.

Airlie Island (AI) is no longer a hydrocarbon producing facility. AI is under a care and maintenance regime with hydrocarbon containing infrastructure removed. The Chervil platform which previously produced to AI has been removed but subsea infrastructure remains.

The Varanus Island Hub Operations Environment Plan (State Waters) (EA-60-RI-000186) and Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003) provides further detail on the operational activities at VI Hub and further detail on the onshore and offshore facilities.

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Table 1-1: Offshore Facilities that Connect to the VI Hub

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[1]	Field/s	Reservoir	Produced hydrocarbon
State waters							
Harriet Alpha platform	Not producing/ suspended	N	Nth Alkimos-2H Harriet A-11 Gudrun-2 Harriet A-1 Harriet A-3 Harriet A-5 ST1 Harriet A-8H1 Harriet A-9H	N	Gudrun Harriet Alkimos	Flag Sandstone	N
Gipsy subsea	Plugged and abandoned	N	N	Gipsy-2H Gipsy-4	Gipsy	Nth Rankin Mungaroo	N
Harriet Charlie platform	Plugged and abandoned	N	N	Harriet C-1 Harriet C-2 Harriet C-3 Harriet C-4	Harriet	Flag Sandstone	N
Harriet Bravo platform	Oil Production	Bambra-7H Bambra-8H	Bambra East-3 Harriet Bravo-1 Harriet Bravo-5H	N	Bambra Harriet	Flag Sandstone	Bambra crude
Agincourt platform	Not producing	N	Agincourt-4H Artreus-1 Zephyrus-1 Jane-1 ST2	N	Agincourt Artreus Zephyrus	Double Island Sandstone	N

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[1]	Field/s	Reservoir	Produced hydrocarbon
Wonnich platform	Not producing	N	Wonnich-1 Wonnich Deep-1H	N	Wonnich	Flag Sandstone	N
Sinbad monopod	Plugged and abandoned	N	N	Sinbad-1 Sinbad-2 Endymion-1 Selene-1	Sinbad Endymion	Flag Sandstone	N
Campbell monopod	Plugged and abandoned	N	N	Campbell-2 Campbell-3 Campbell-4 ST1 Campbell-5 Campbell-6	Campbell	Flag Sandstone	N
Simpson Alpha mini-platform	Not producing	N	Simpson-7 Tanami-4 Tanami-5 West Simpson-1	N	Simpson	Flag Sandstone	N
Simpson Bravo mini-platform	Not producing	N	Simpson-9 Simpson-10 Monet-2 Simpson-4	N	Simpson	Flag Sandstone	N
Gibson South Plato platform	Not producing	N	South Plato-1 South Plato-3H	Plato-2 South Gibson-1	South Plato	Flag Sandstone	N
Victoria platform	Not producing	N	Albert-1 Little Sandy-1 Mohave-1H	N	Albert Little Sandy Mohave	Flag Sandstone	N

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[1]	Field/s	Reservoir	Produced hydrocarbon
			Perdika-1 ST1 Victoria-1 ST1 West Cycad-2		Perdika Victoria West Cycad		
Double Island monopod	Not producing	N	Double Island-1H ST2	N	Double Island	Double Island Sandstone	N
Bambra Sea Pole	Not producing	N	Bambra-3	N	Bambra	Flag Sandstone	N
Twickenham platform	Pig launching facility only	N	N	N	N	N	N
Linda platform	Gas/condensate production	Lee-3 Lee-4 Linda-3 Rose-4	Doric-2 Linda North-1	N	Lee Linda Doric Rose	Flag Sandstone	Lee gas/ condensate Linda gas/ condensate
VI	Water injectors / not producing	Alkimos-1 (Active Water Injector – Not Producing) Tanami-1 (Active Water Injector – Not Producing)	Tanami-3 Rosette-1	N	VI		N
Open Water	Temporarily abandoned		Bambra-2 Koombana-1	Agincourt-1 Marley-1	Bambra Agincourt	Flag	N

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[1]	Field/s	Reservoir	Produced hydrocarbon
Commonwealth waters							
John Brookes platform	Gas/condensate Production	John Brookes-2 John Brookes-3 ST1 John Brookes-5 John Brookes-6 ST1	N	N	John Brookes	Top Barrow 'A' and Upper Barrow Sandstone	John Brookes gas/ condensate
Open Water	Exploration – Temporarily abandoned	N	Rosella-1	N	John Brookes		N
Halyard subsea	Gas/condensate Production	Halyard-1	N	N	Halyard	Upper Barrow Sandstone	Halyard condensate
East Spar subsea	Not producing	N	East Spar-3 ST1 East Spar-4A ST1 East Spar-6 ST1 East Spar-7 East Spar-9	N	East Spar	Flacourt Formation Upper Barrow Sandstone	N
Spar subsea	Gas/ condensate production	Spar-2	N	N	Spar	Upper Barrow Sandstone	Spar gas/ condensate

[1]Plugged and abandoned wells pose no credible spill risk and no longer require a Well Operations Management Plan (WOMP) (Commonwealth water wells) or a Well Management Plan (WMP) (State waters wells). Plugged and abandoned wells are therefore not included in the Environment Plans associated with this OPEP. Only plugged and abandoned wells associated with existing infrastructure (i.e. platforms) have been included in Table 1.1.

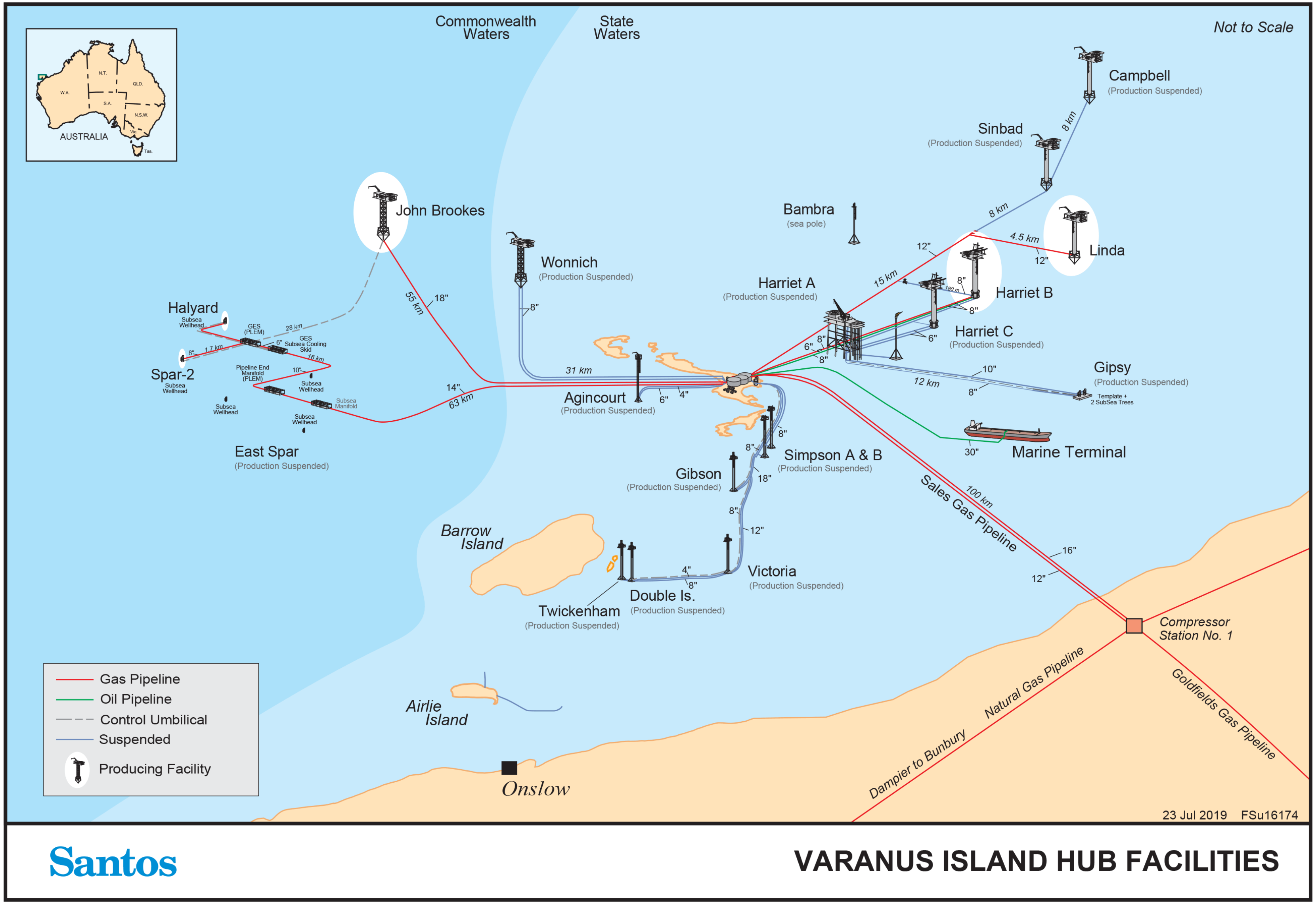

Figure 1-1: Schematic of the Varanus Island Hub facilities

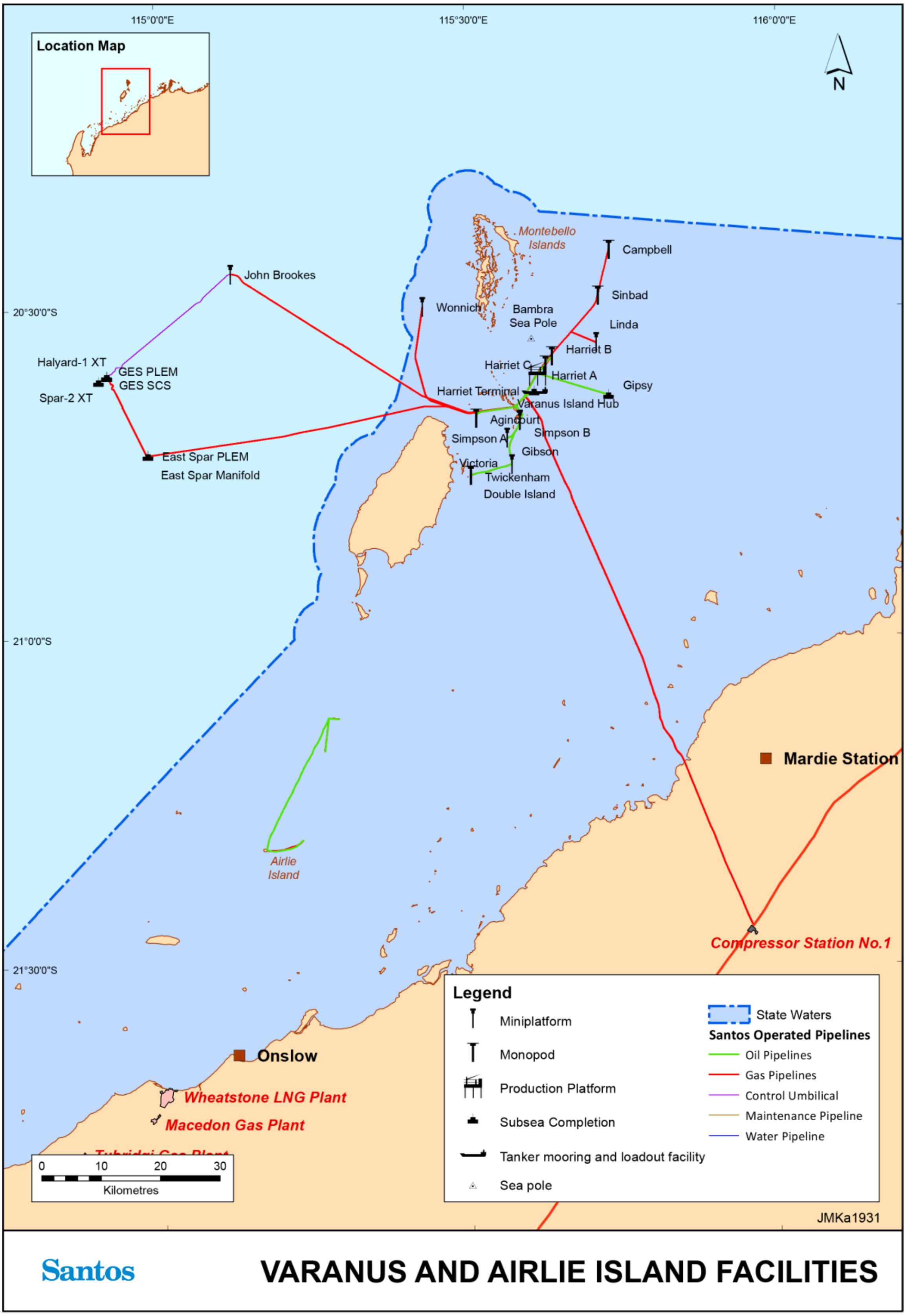

Figure 1-2: Location of the VI Hub facilities covered by this OPEP

1.2 Purpose and Scope of OPEP

The purpose of this OPEP is to describe Santos WA's response to a hydrocarbon spill in State or Commonwealth waters or onshore, associated with operational activities at VI Hub facilities and care and maintenance activities on Airlie Island.

This OPEP covers all infrastructure and operational activities on VI and AI, the associated offshore platforms/monopods and subsea tie-backs, the subsea pipelines, flowlines and umbilicals (within State waters and Commonwealth waters) between VI and the offshore facilities and the pipeline from VI to the marine load-out terminal.

This OPEP covers well intervention activities, including those to temporary or permanently plug wells on existing infrastructure.

For well interventions within State waters, a Bridging Document to the Generic Well Suspension and Well Abandonment EP (EA-00-RI-10027) will be submitted to the Department of Mines, Industry Regulation and Safety (DMIRS), for approval, assessing the suitability of this OPEP for the well intervention campaign and outlining any revisions to credible spill scenarios and additional control measures as required.

This OPEP has been developed to meet all relevant requirements of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), the State Petroleum (Submerged Lands)(Environment) Regulations 2012 (P(SL)(E) Regulations), and the State Petroleum Pipeline (Environment) Regulations 2012 (PP(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: Maritime Environmental Emergencies (MEE).

1.3 High Level Objectives of OPEP

The overall aim of this OPEP is to prevent 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 as low as reasonably practicable (ALARP).

The objectives of this OPEP are to:

+ Provide guidance to the IMT in relation to spill response implementation; and
+ To demonstrate the capability requirements for response activities.

2 Oil Spill Response Framework

2.1 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 2-1** below for hydrocarbon spills.

Table 2-1: 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>Spill 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>

2.2 Jurisdictional Authorities and Control Agencies

During a spill response there will be both a Jurisdictional Authority and a Control Agency assigned to the oil spill incident for all Spill Response Levels. The Jurisdictional Authority is the relevant Statutory Authority that has responsibilities for oil pollution in that jurisdiction. The Control Agency is the agency or company assigned by legislation, administrative arrangements or within the relevant contingency plan to control response activities to an oil pollution emergency. With respect to a hydrocarbon spill from Varanus Island Hub operations, the relevant Jurisdictional Authority and Control Agency varies dependent upon the location of the spill (Commonwealth or State waters or onshore), the nature of the incident (vessel based or petroleum activity based) and the Spill Response Level (refer **Table 2-2**).

Table 2-2: Jurisdictional Authorities and Control Agencies for Varanus Island Hub oil spill response

Role	Spill Level	State Waters		Commonwealth waters		Onshore
		Facility [1]	Vessel [2]	Facility	Vessel	
Control Agency	1	Petroleum Titleholder (Santos WA)	DoT	Petroleum Titleholder (Santos WA)	AMSA	Petroleum Titleholder (Santos WA)
	2/3	DoT	DoT	Petroleum Titleholder (Santos WA)	AMSA	Petroleum Titleholder (Santos WA)
Jurisdictional Authority	1/2/3	DoT	DoT	NOPSEMA	AMSA	DFES/ DER

2.2.1 Petroleum Activity Spill in Commonwealth Waters

For an offshore petroleum activity oil spill incident 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.

2.2.2 Petroleum Activity Spill in State Waters

For WA State waters, the DoT Marine Safety General Manager is prescribed as the Hazard Management Agency (HMA) for marine oil pollution as per the WA *Emergency Management Act 2005* and *Emergency Management Regulations 2006*. The DoT as the HMA has developed the State Hazard Plan: Maritime Environmental Emergencies (DoT, 2018) (replacing the WestPlan-MOP). These arrangements effectively

[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.

nominate DoT as the equivalent Jurisdictional Authority for Petroleum Activity spills in State waters, whose responsibility is to ensure there is an adequate response to marine pollution in State Waters.

Under the State Hazard: MEE, the Control Agency for Level 1 Petroleum Activity spills in State waters is the Petroleum Titleholder (Santos WA) with the Control Agency for Level 2/3 spills nominated as DoT.

While Santos WA is not the Control Agency for Level 2/3 Petroleum Activity spills in State waters, Santos WA is required to have adequate plans and resources available to respond to a worst case spill originating in State waters under the following State petroleum legislation administered by DMIRS:

+ *Petroleum (Submerged Lands) Act 1982* and *Petroleum (Submerged Lands) (Environment) Regulations 2012*
+ *Petroleum Pipelines Act 1969* and *Petroleum Pipelines (Environment) Regulations 2012*

Where DoT has assumed the role of Control Agency, Santos WA will provide all necessary resources to assist DoT. The framework under which Santos WA will provide support to DoT for an oil response within State waters is detailed in **Section 2.4.3**.

2.2.3 Cross-jurisdiction Petroleum Activity Spills

For a Level 2/3 Petroleum Activity spill, there is the possibility of the spill crossing jurisdictions between Commonwealth and State waters. In these instances, the Jurisdictional Authority remains true to the source of the spill (i.e. NOPSEMA for Commonwealth waters and DoT for State waters). Where a Level 2/3 spill originating in Commonwealth waters moves into State waters two Control Agencies will exist: DoT and the Petroleum Titleholder (Santos 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 2.4.3.**

2.2.4 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.

As with petroleum activity spills, Santos WA is required to have adequate preparedness arrangements for spills from vessels undertaking Petroleum Activities within Commonwealth waters under *OPGGS Act 2006* and *OPGGS (E) Regulations*.

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 Control Agency, at which time Santos WA would provide all necessary resources as a Supporting Agency.

2.2.5 Vessel Spills in State Waters

For a vessel incident originating in State Waters the Jurisdictional Authority/ Hazard Management Agency is DoT. DoT is also the Control Agency for Level 2/3 vessel spills in State waters under the State Hazard Plan arrangements.

As with petroleum activity spills, Santos WA is required to have adequate preparedness arrangements for spills from vessels undertaking Petroleum Activities within State Petroleum legislation administered by DMIRS.

Santos WA will be responsible for coordinating a first-strike response to all vessel based spill until such time as DoT takes over the role as Control Agency, in the event of a Level 2/3 spill, at which time Santos WA would provide all necessary resources (including personnel and equipment) as a Supporting Agency.

2.2.6 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). Control Agency responsibilities will be determined by DoT and AMSA with Santos WA providing all necessary resources (including personnel and equipment) as a Supporting Agency.

2.2.7 Onshore Spills

In the event of an onshore spill of hazardous liquids (including hydrocarbons), the Jurisdictional Authority and Hazard Management Agency (HMA) for incident response is the Department of Fire and Emergency Services (DFES). The DFES is the prescribed HMA for response under the *Emergency Management Regulations 2006* for all emergencies in which there is 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”.

Under the State Hazard Plan: Hazardous Materials Emergencies (HAZMAT), DFES are the Control Agency for State waters petroleum pipeline spills, however this excludes spills at certain island facilities, including Varanus Island. Therefore, Santos WA will be the Control Agency for onshore spills at Varanus Island.

As stated in the State Hazard Plan: Hazardous Materials Emergencies (HAZMAT), on-site recovery and clean-up of hazardous materials is the responsibility of the owner and as such, Santos WA will ensure clean-up and remediation of any onshore spill is completed to the satisfaction of the Department of Environment Regulation (DER) as the relevant Jurisdictional Authority for the clean-up of onshore oil spill pollution and management of contaminated sites.

2.3 Santos WA Incident Management Structure

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 Control 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 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 VI incident includes:

+ Varanus Island-based Incident Response Team (IRT);
+ Incident Management Team (IMT) – Perth based to coordinate and execute responses to an oil spill incident;
+ Crisis Support Team (CST) and 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;
+ Other field-based 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 2-1**.**

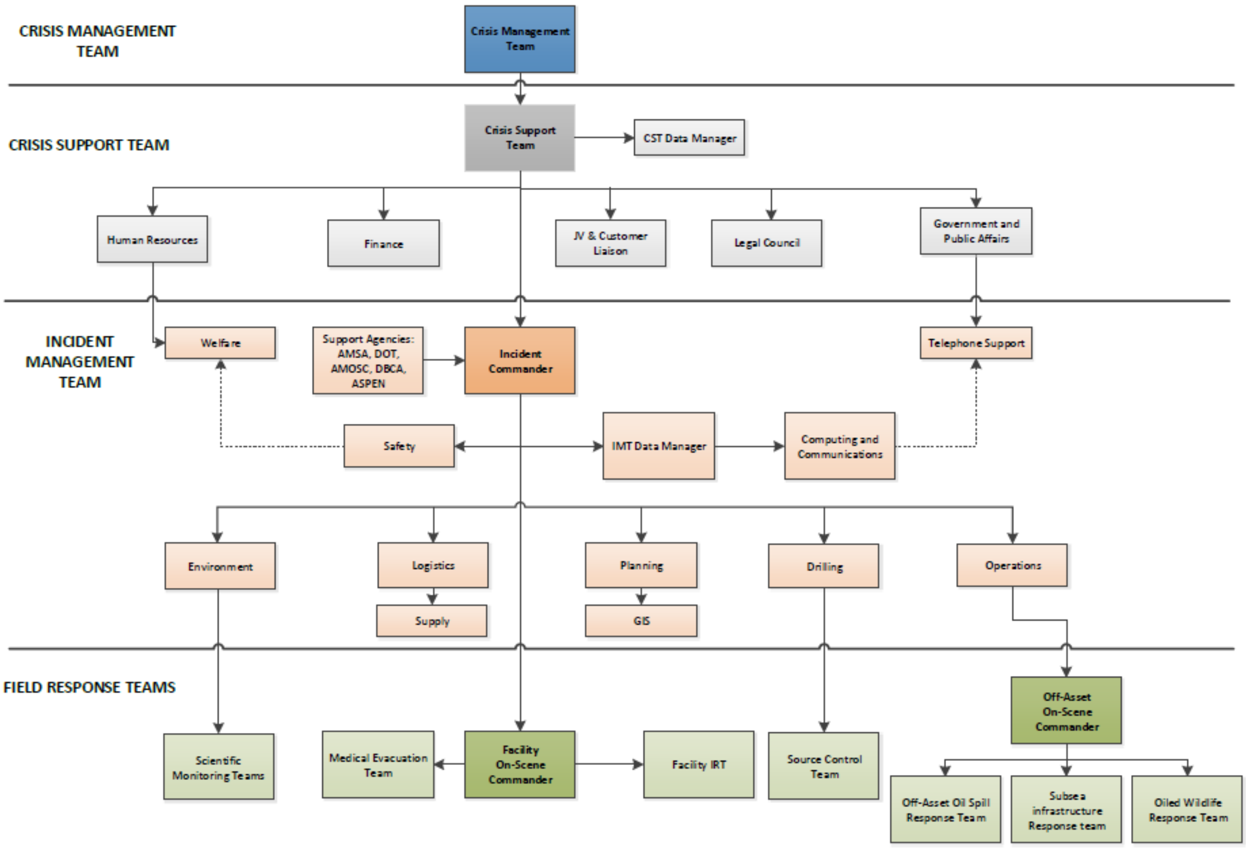

Figure 2-1: Santos WA Incident Response Organisational Structure

Note: For a Level 2/3 Petroleum Activity spill whereby DoT is involved as a Control Agency, either within a single jurisdiction (State water only spills) or cross-jurisdictional (spills from Commonwealth to State waters), Santos WA will work in partnership with the DoT in providing spill response capability. Santos WA's expanded organisational structure for these situations is detailed in **Section 2.4.3**.

2.3.1 Roles and Responsibilities

The tables below (**Table 2-3** to **Table 2-7**) provide an overview of the responsibilities of the Santos WA CST, IMT, and field-based response team members in responding to an incident, the Emergency & Oil Spill Coordinator in preparing for and responding to an incident, and the Chief Executive Officer in supporting an incident response.

Also provided are the roles and responsibilities of Santos WA personnel or contractors required to work within DoT's organisational structure, 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 (January 2017).

DoT will provide two roles to the Santos WA CST/IMT in a coordinated response. These are also outlined for reference.

Table 2-3: Roles and Responsibilities in the Crisis Support Team (CST)

CST Member	Main Responsibilities
CST Leader	Notify Santos 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 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 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 2-4: Roles and Responsibilities in the Incident Management Team (IMT)

IMT Member	Main Responsibilities
Incident Commander	Coordinate all 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/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 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

IMT Member	Main Responsibilities
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
Computing and Communications Leader	Set up computing and communications in the IMT and CST Centres Establish video monitoring between IMT and CST Set up the incident response telephone room upon request
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 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 2-5: Key Field Based Roles and Responsibilities

Field-Based Position	Main Responsibilities
Varanus Island On-Scene Commander	Commands the onsite response to Varanus Island Hub 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
Varanus Island Incident Response Team (IRT)	Respond to incidents under the instruction of an Incident Response Team Leader in accordance with actions developed by the VI 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
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 2-6: Santos WA Personnel Roles Embedded within the State Maritime Environmental Emergency Coordination Centre (MEECC) / Department of Transport (DoT) IMT

Santos Personnel Roles embedded within the State MEECC / DoT IMT	Main Responsibilities
CST Liaison Officer	Provide a direct liaison between the Santos CST and the State Maritime Environmental Emergency Coordination Centre (MEECC) Facilitate effective communications and coordination between the Santos 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 DoT 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 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 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 OPEP and planning processes)

Santos Personnel Roles embedded within the State MEECC / DoT IMT	Main Responsibilities
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 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 Facilitate the acquisition of appropriate services and supplies through Santos WA's existing private contract arrangements related to waste management Collects Request Forms from DoT to action via the Santos WA IMT
Deputy Finance Officer	As part of the Logistics Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Santos' existing OSRL, AMOSC and private contract arrangements. Facilitate the communication of financial monitoring information to Santos WA to allow them to track the overall cost of the response.

Santos Personnel Roles embedded within the State MEECC / DoT IMT	Main Responsibilities
	Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Santos
Deputy On Scene Commander (FOB)	Provide a direct liaison between the Santos WA Forward Operations Base/s (FOB/s) and the DoT FOB Facilitate effective communications and coordination between the Santos WA FOB Operations Commander and the DoT FOB Operations Commander Offer advice to the DoT FOB Operations Commander on matters pertaining to the Santos WA incident response policies and procedures Assist the Senior Safety Officer deployed in the FOB in the performance of their duties, particularly as they relate to Santos WA employees or contractors Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to the Santos WA safety policies and procedures

Table 2-7: 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' 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 WA Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures

2.3.2 Incident Response Authority

During the course of incident, team members may be required to make technical and financial decisions that exceed those levels set for normal operations.

The IMT Leader has full technical authority to request all Santos WA and contracted resources deemed necessary to manage the incident, and to call in additional resources if required.

The IMT Leader is to request the CST Leader to obtain authority from the CMT for financial commitments to respond to the incident consistent with the level of authorisation required for normal operations.

2.3.3 Training and Exercises

2.3.3.1 CST/IMT Training and Exercises

Santos WA sets training and exercise requirements for IMT/CST personnel to ensure skills and competency requirements are achieved and maintained. Competency is maintained through participation in regular response exercises and workshops. Training and exercise requirements for Santos WA are summarised in **Table 2-8**.

Table 2-8: 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

2.3.3.2 Oil Spill Responders

Santos has an internal capability of trained oil spill responders that can be deployed in the field in a spill response and has access to external trained spill responder resources (Refer **Table 2-9)**.

Table 2-9: 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. For providing incident management (IMT) and operations (field response) assistance.	AMOSC Core Group Workshop (refresher training undertaken every 2 years). AMOSC – IMO1 Oil Spill Operators Course and/or IMO2 Oil Spill Management Course	As defined in Core Group Member Reports Min.84 Max. 140 (incl. Santos).

Responder	Role	Training	Available Number
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 L**.		
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 **Table 2-9**, 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 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
+ The State Hazard: MEE: State Response Team (SRT) and NW 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: MEE requirements.

In the event of a spill the trained spill responders outlined in **Table 2-9** 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.

2.3.4 Response Testing

Following acceptance of an OPEP, notification arrangements of the plan are tested through a communications test to all external agencies and companies with roles defined within the plan. The Communications Tests are repeated annually for activities that extend longer than 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 a IMT/CST desktop and activation exercises using emergency scenarios across its main operating facilities on the NWS or a drilling activity. An oil spill incident scenario is used for the activation exercise once per year. Both safety and oil spill incidents tests 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 are done as part of larger exercises or as standalone tests where the capability and availability of resources through the response provider is 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.

2.3.5 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 are entered into the Santos 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.

2.3.6 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 annual Assurance Schedule (QE-91-HA-20002). Audits will assist in identifying and addressing any deficiencies in systems and procedures. At the conclusion of the audit any opportunities for improvement and /or 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 is 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 of AMOSC's ability to respond to an oil spill incident as per the methods and responsibilities defined in Oil Pollution Emergency Plans and AMOSC's Service Level Statement.

The deployment readiness and capability of OSRL's oil spill response equipment and personnel in Singapore is audited every two years. The intent of this audit is to provide assurances to Santos WA's of OSRLs ability to respond to an oil spill incident as per the methods and responsibilities defined in Santos WA's Oil Pollution Emergency Plans and OSRL's Service Level Agreement.

The objectives and frequency of oil spill response testing and auditing relevant to VI Hub oil spill response are summarised in **Table 2-10**.

Table 2-10: 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	<u>Desktop Exercise</u> To familiarise IMT with functions and process in response to a simulated oil spill scenario <u>Activation Exercise</u> 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 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) The following Santos-owned equipment is inspected and/or tested Tracker buoys Offshore boom/ nearshore boom Power packs Vessel dispersant spray systems	Reports are generated for exercises and recorded in Santos WA's Learning Management System. Key recommendations are recorded are tracked in Santos WA's Action Tracking System. Tracker Buoy tests are recorded.

Exercise	Objective	Frequency	Recording and review
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 the Santos WA or in coordination/ consultation with other member company. Recommendations provided to OSRL for action and close-out.

2.3.7 Incident Management Environmental Performance

Table 2-11 indicates the environmental performance outcomes, controls and performance standards for the Santos WA incident management framework.

Table 2-11 Environmental performance outcomes, controls and performance standards for incident management

Environmental Performance Outcome	Manage incident via a systematic planning process		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Incident Management	**Response Preparedness**		
	Competent and sufficient Incident Management Team (IMT) and oil spill responder personnel	Maintaining numbers of responder personnel trained as per Santos WA standards and procedures	Training and exercise records
	Incident management facilities	Maintain IMT/CST facilities as per Santos WA standards and procedures	Inspection reports
	Response Implementation		
	Net Environmental Benefit Analysis (NEBA)	NEBA undertaken to inform response strategy selection or rejection	Incident Log Incident Action Plan

		NEBA undertaken each operational period to determine if response strategy is continuing to have a net environmental benefit. NEBA included in development of following period Incident Action Plan	Incident Log Incident Action Plan
	Incident Action Plan (IAP)	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

2.4 Integration with other Organisations

2.4.1 Australian Marine Oil Spill Centre (AMOSC)

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

Response equipment and personnel are allocated on a first-come-first-served basis, with the intent, under best efforts, to address any short-fall through AMOSC's affiliation with UK-based oil spill response company, Oil Spill Response Limited (OSRL), of which Santos WA is a direct subscriber. Further support can be gained through OSRL to the Global Response Network (GRN).

AMOSC has contracts with all its member companies to enable the release of Core Group personnel to be made available for any Santos WA requirements as soon as possible, 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, BHP and Woodside have signed a Memorandum of Understanding (MOU) that defines the group's mutual aid arrangements. Under this MoU, Santos WA, BHP and Woodside have agreed to use their reasonable endeavours to assist in the provision of emergency response services, personnel, consumables and equipment.

2.4.2 Australian Maritime Safety Authority (AMSA)

The Australian Maritime Safety Authority (AMSA) is the designated Combat 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.

2.4.3 WA Department of Transport (DoT)

In the event that a Level 2/3 spill arises within, 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).

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) (). The coordinated response may occur within a single jurisdiction (spill within State waters) or cross-jurisdiction (spill crossing from Commonwealth to State waters).

2.4.3.1 Single Jurisdiction Arrangements

For Level 2/3 spills originating within State waters, DoT will assume control as the Control Agency with the exception of source control activities (for example well intervention and relief well drilling) which will remain under the control of Santos WA's IMT.

The initial first strike response will be undertaken by Santos WA; formal protocols for the transfer of Control Agency responsibility fCrom Santos WA to DoT are outlined within Section 6.4.2 of DoT's MOP: Response and Consultation Arrangements.

At the request of the SMEEC, Santos WA will be required to provide all necessary resources, including personnel and equipment, to assist the DoT's IMT in performing duties as the Control Agency for State waters response This includes providing an initial 9x personnel to work within the DoT IMT located at Marine House, Fremantle, no later than 8 am following the day of the request. It also includes providing 1x personnel to serve in DoT's Forward Operating Base no later than 24 hours following formal request by the SMEEC.

Two DoT personnel will be provided from DoT's command structure into Santos WA's CST/IMT as CST / Media Liaison Officers.

The roles and responsibilities of Santos WA activated personnel working within DoT's command structure and DoT personnel working within Santos WA's command structure are provided in **Section 2.3.1**.

In addition to these incident management roles, Santos WA, at the request of the SMEEC, will be required to provide an appropriate number of operational field personnel to assist with field response activities, such as shoreline protection and clean-up and oiled wildlife response, with the required number determined based on the nature and scale of the spill and response requirements. DoT may also stand-up field response capability through the State Response Team and request National Response Team support.

Any matters of contention between Santos WA and DoT, with respect to the partitioning of resources and responsibilities between IMTs will be referred to the SMEEC for resolution.

2.4.3.2 Cross Jurisdictional Arrangements

For Level 2/3 spills that crosses from Commonwealth waters to State waters, both DoT and Santos WA will be Control Agencies. 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 MOP: 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 jurisdiction 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 2.3.1) and operational personnel to assist with those response strategies where DoT is the Lead IMT. **Figure 2-2** shows Santos WA's organisational structure for a Petroleum Activity spill within (single jurisdiction) or entering (cross-jurisdiction) State waters. In both instances, the Santos WA IMT and DoT IMT will provide a coordinated response. While Santos WA will stand up its IMT structure in both single and cross jurisdiction incidents, the scale of operations will likely be lesser for a single jurisdiction response (State waters only) where Santos WA will primarily be controlling Source Control activities.

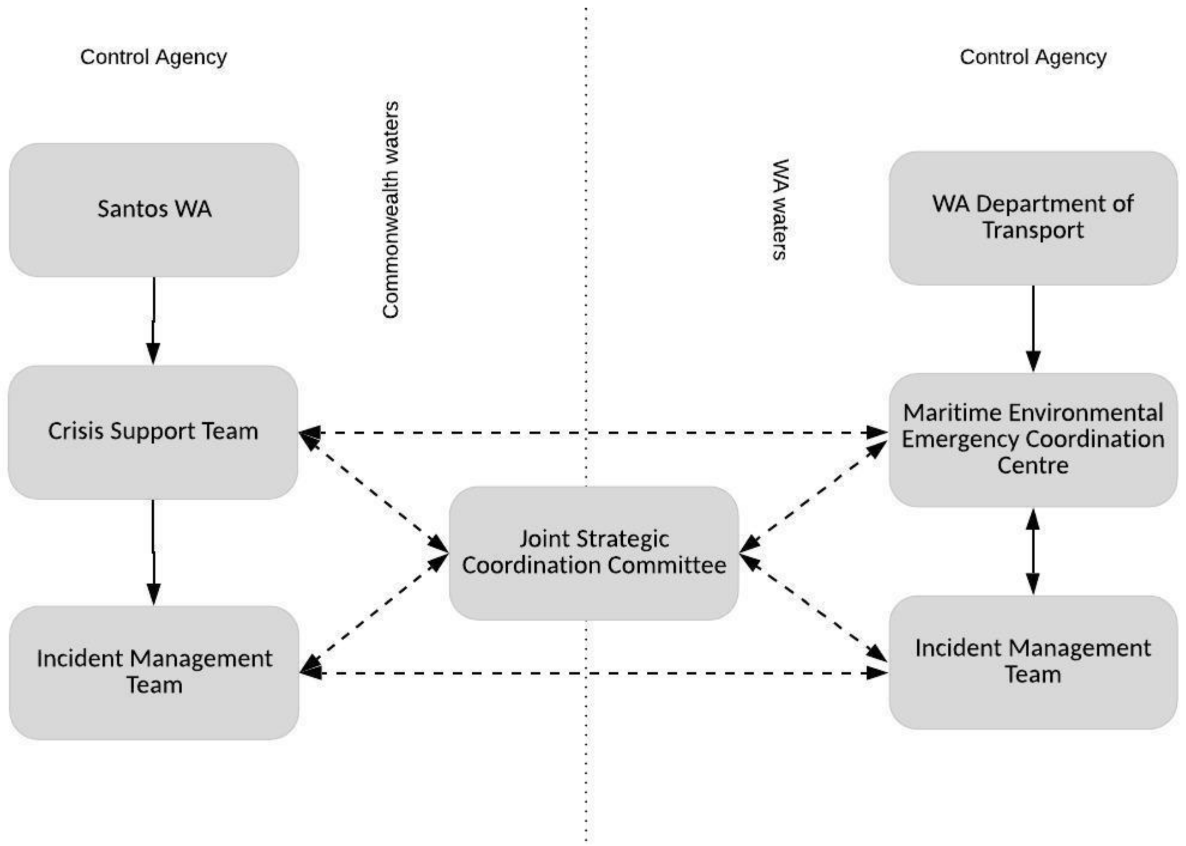

Figure 2-2: Santos WA incident management structure for Level 2/3 marine oil pollution incident within or entering State waters

2.4.4 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) through an Oiled Wildlife Advisor (OWA). 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.

2.4.5 WA Department of Fire and Emergency Services (DFES)

Under the *Emergency Management Regulations 2006*, the FES Commissioner (DFES) is the Hazard Management Agency for 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. However, DFES will not be the Control Agency for onshore spills on VI given that the island is excluded from arrangements under State Hazard Plan: Hazardous Materials Emergencies (HAZMAT).

Santos WA will notify DFES of Level 2/3 onshore hydrocarbon spills but will assume role as the Control Agency under such scenarios.

2.4.6 Department of Water and Environmental Regulation (DWER)

For an onshore spill, the direct on-site recovery and clean-up of the hydrocarbon pollution is the responsibility of the owner of the hazardous material (Santos WA). DWER have responsibilities under the *Environmental Protection Act 1986* to ensure that the pollution is cleaned up by the owner. DWER administers the *Contaminated Sites Act 2003* and may declare and supervise the clean-up of, a Contaminated Site, as a result of oil pollution.

For noting, VI and AI are currently classified as Contaminated Sites and have ongoing monitoring and/or response activities in place as per their Remedial Action Plans (RAPs) and in consultation with a Contaminated Sites Auditor.

2.4.7 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).

2.5 Interface with 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.

+ Western Australia State Hazard Plan: Maritime Environmental Emergencies

Details the management arrangements for preparation and response to a marine oil 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 worst case spills from Varanus Island Hub operations.

+ Western Australia State Hazard Plan: Hazardous Materials Emergencies (HAZMAT)

Details the emergency management arrangements for hazardous materials emergencies throughout the State of Western Australia

+ 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.

2.6 Interface with Internal Documents

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

+ Values and Sensitivities of the Marine and Coastal Environment (EA-00-RI-10062);
+ Incident Command & Management Manual (QE-00-ZF-00025);
+ Santos Energy Incident and Crisis Management Bridging Procedure;
+ Varanus Island Hub Operations EP (EA-60-RI-00186) (State waters);
+ Generic Well Suspension and Well Abandonment EP (EA-00-RI-10027) (State waters);
+ Varanus Island Hub Operations EP for Commonwealth Waters (EA-66-RI-10003);
+ Varanus Hub Incident Response Plan (QE-00-ZF-00044);
+ Incident Response Telephone Directory (QE-00-ZF-00025.020);
+ Environment Incident Notification Guidelines and Matrices (QE-91-HF-10003);

+ Incident Reporting Guideline Environmental Approvals Supporting Information (QE-91-ZF-10003);
+ Environmental Management Standards for Operations Support Vessels (EA-91-ZI-10002);
+ Refuelling and Chemical Management Standard (QE-91-IQ-00098);
+ Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200)
+ Varanus Island Fire and Petroleum Spillage Management Plan (QE-91-RI-10001);
+ Source Control Emergency Response Plan (SCERP) (DR-00-ZF-10001);
+ Santos Drilling & Completions Management Process;
+ Reindeer Schlumberger Report 1-1BAORA3;
+ Schlumberger SIS Report No. 1-1KBOVKT;
+ Berthing Handbook Tanker Loading Facilities Port of Varanus Island (LT-10-ZG-00001);
+ Procedure for VI Tanker Loading, Crude Sampling and Quality and Quantity Determination (QE-91-IG-00007)
+ Start up and Shutdown of Suck Back Pump (VI-91-IP-10197);
+ NWA Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053);
+ Oil Spill Response HSE Management Manual (QE-91-RF-10016);
+ Detailed Site Investigation Varanus Island (EA-60-RI-10062);
+ Varanus Island Remedial Action Plan (VI-10-RG-10023);
+ Oil Spill Scientific Monitoring Plan (EA-00-RI-10099);
+ Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162);
+ Baseline Data Review document (QE-00-BI-20001);
+ Incident and Crisis Management Exercise and Training Plan (QE-92-HG-10001); and
+ Santos WA Environmental Monitoring Program (EA-00-RI-10058).

2.7 Cost Recovery

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

3 Spill Risk and Protection Priorities

3.1 Spill risk scenarios

All credible oil spill scenarios, including presentation of detailed modelling results, for Varanus Island Hub operations (offshore and onshore) are detailed in the accepted Varanus Island Hub Operations Environment Plan (EA-60-RI-186); the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003); and the Generic Well Suspension and Well Abandonment Environment Plan (EA-00-RI-10027).

This OPEP outlines strategies, actions and supporting arrangements applicable for all credible oil spill events associated with Varanus Island Hub operations. Of the credible spill scenarios identified in the EPs, 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 VI Hub 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;
+ Proximity to sensitive receptors, shorelines, State/Commonwealth boundaries etc.

The worst case credible spill risks that occur in Commonwealth waters (three scenarios), State waters (3 scenarios) and onshore (8 scenarios) selected to inform this OPEP are presented in **Table 3-1**, **Table 3-2** and **Table 3-3** respectively. For a description of all characteristics and behaviour associated with hydrocarbons that may unintentionally be released refer to **Appendix A**.

For spills of crude oil or HFO from offtake tanker storage tanks, spill modelling was undertaken at the Marine Terminal location, since this is representative of the tanker location during berthing and cargo loading activities.

For marine diesel spills from support/supply vessels undertaking Varanus Island Hub operations, one spill modelling location in State waters and one spill modelling location in Commonwealth waters was used. In State waters a marine diesel spill location at Wonnich platform represents a spill from a vessel operating near Varanus Island. For Commonwealth waters a vessel spill was modelled at John Brookes platform, being a representative location for vessel activities in Commonwealth waters. Platform locations are considered higher risk locations for vessel tank ruptures given the increased potential for collision.

Table 3-1: VI Hub Commonwealth Waters Worst Case Spill Scenario Summary

Worst case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)	EMBA for surface hydrocarbon
Surface spill – Release of marine diesel from support/ supply vessel fuel tank (due to vessel collision/dropped object)	Marine Diesel (Group III)	329 m^3 surface release over a 1 hour period	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is up to approximately 101 km from the release site.
Loss of well control/damage to infrastructure causing condensate with gas release from John Brookes wellheads at surface	John Brookes Condensate (Group I)	39,011 m^3 from wellheads at surface released over 100 days	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is up to approximately 26.5 km from the release site.
Pipeline leak of condensate from the John Brooke Pipeline at the State waters boundary	John Brookes Condensate (Group I)	210 m^3 from subsea pipeline released over 5.2 hours	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is up to approximately 23 km from the release site.

Table 3-2: VI Hub State Waters Worst Case Spill Scenario Summary

Worst case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)	EMBA for surface hydrocarbon
Surface spill – release from support/ supply vessel fuel tank (due to vessel collision or lifting operations) at the Wonnich Platform	Marine Diesel (Group III)	329 m^3 surface release over a 0 to 24-hour period	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is approximately 38 km north west from the release site.
Surface spill –release from offtake tanker due to vessel collision / vessel grounding	HFO (Group IV)	1,900 m^3 surface release over a 0 to 30-hour period	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is approximately 396 km north east from the release site.

Worst case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)	EMBA for surface hydrocarbon
Surface spill – release from offtake tanker due to vessel collision / vessel grounding	Varanus Island Crude Blend (Group 1)	8,629 m^3 surface release over a 0 to 30-hour period	At the surface concentration response threshold of 10 g/m^2, the potential extent of floating surface oil is approximately 56 km west from the release site.

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Table 3-3: VI Hub Onshore Worst Case Spill Scenario Summary

Worst case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)
Release of Marine Diesel Fuel from bunker transfer	Marine Diesel (Group III)	15 m^3 surface release over a 15-minute period
Loss of containment from one of the First Stage Liquid Production Vessels	Varanus Island Crude Blend (Group 1)	115m^3 in less than 1 hour
Loss of integrity / Impact damage causing condensate with gas release from the East Spar 14” Pipeline	Halyard-1 Condensate (Group I)	161 m^3 over a 24 hour period
Dropped object causing condensate with gas release from the John Brookes 18” Pipeline near the VI shoreline.	John Brookes Condensate (Group I)	220 m^3 over a 24 hour period
Loss of integrity / Impact damage causing crude oil release from the Harriet Bravo to VI 8” Pipeline	Harriet Crude (Group 2)	13 m^3 over a 24 hour period
Loss of integrity / Impact damage causing crude oil release from the Agincourt 6” Pipeline	Agincourt-1 Crude (Group 1)	10 m^3 over a 24 hour period
Crude oil release from storage at VI onshore from Loss of integrity / Impact damage	Varanus Island Crude Blend (Group 1)	39,750 m^3 in less than 1 hour
Loss of integrity / Impact damage causing crude oil release from export 30” pipeline	Varanus Island Crude Blend (Group 1)	2,742 m^3 over a 0 to 24 hour period

3.2 Hydrocarbon Characteristics and Behaviour

The hydrocarbon characteristics, including weathering and behaviour is further described in **Appendix A: Hydrocarbon Characteristics and Behaviour**. Additionally, Laboratory assays of some of the hydrocarbons can be accessed at:

http://auperweb019.energylimited.com/drawings/default.asp?grp=Assays

3.3 Offshore spills (State and Commonwealth waters)

3.3.1 Stochastic Modelling

This section presents the spill modelling results for selected worst-case scenarios only. All scenarios were modelled using a stochastic approach running multiple simulations across all seasons using a number of unique environmental conditions sampled from historical metocean data.

Environmental impact assessment thresholds are addressed in **Section 7.5.3** of the EPs. 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 3-4.**

Table 3-4: Surface Hydrocarbon Thresholds for Response Planning

Hydrocarbon (g/m^2)	Description
>1	Estimated minimum threshold for commencing some scientific monitoring components (refer to **Appendix N: SMP Activation Process**)
50	Estimated minimum floating hydrocarbon threshold for containment and recovery
100	Estimated floating hydrocarbon threshold for effective containment and recovery Estimated minimum shoreline accumulation threshold for shoreline clean-up

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

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, and therefore these are the results presented in this OPEP.

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.[1]

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 the Accidental Release of

[1] Santos WA 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.

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Hydrocarbons in **Section 7.5** of the Commonwealth (AE-66-RI-10003) and State (EA-60-RI-00186) for further description on selection of impact exposure values.

3.3.2 Deterministic modelling

Following the stochastic modelling, deterministic modelling was conducted to interrogate the stochastic modelling results determining the worst-case outcomes for the region and identifying the deterministic replicate simulations associated with such outcomes. The deterministic criteria are:

+ Replicate simulation with the maximum oil volume accumulation on shorelines
+ Replicate simulation with the maximum length of shoreline oiled,
+ Replicate simulation with the shortest time before floating oil at or above 10 g/m^2 contacted an onshore feature, and
+ Replicate simulation with the shortest time before floating oil at or above 10 g/ m^2 contact an offshore feature.

3.3.3 Modelling results

Sections below present the spill modelling results of the worst-case scenarios only. The geographical extent or 'scale' of the area potentially affected by the spill scenarios is described using the maximum extent of the spill impact thresholds known as the Environment that May Be Affected (EMBA). Receptor locations used for assessment in the modelling and the EMBA are in provided in Sections 3.1 and 7.5 in the EPs (Commonwealth EA-66-RI-10003; State EA-00-RI-10027).

The modelling information required to inform a hydrocarbon spill response for the worst case credible scenarios is presented below, with further detail of modelling results found in **Table 3-5, Table 3-6, Table 3-7, Table 3-8,** and **Table 3-9.**

These results focus on Protection Priority areas that have been identified as those areas having a high environmental value and greatest exposure to floating oil that could be responded to using spill response measures.

Table 3-5: Predicted shoreline contact for a surface release of John Brookes condensate (39,011 m^3) from a loss of well control at the John Brookes Platform in Commonwealth Waters

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations >10 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations >10 g/m^2 (hours)	Probability (%) of shoreline accumulation at concentrations >100 g/m^2	Minimum time for shoreline accumulation at concentrations >100 g/m^2 (hours)	Maximum accumulated volumes for shoreline accumulation (m^3) at concentrations >100 g/m^2
Montebello Islands	<1	No contact predicted at this threshold	13	171	29
Barrow Island	<1	No contact predicted at this threshold	8	105	14
Barrow-Montebello surrounds[1]	<1	No contact predicted at this threshold	8	104	7
Offshore Ningaloo	8	1,396	N/A	N/A	N/A

[1]This receptor is only emergent at lowest astronomical tide therefore accumulation is considered temporary only under these tidal conditions.

Table 3-6: Predicted shoreline contact for a short-term (5.4 hours) pipeline leak of condensate (210 m^3) from the John Brooke Pipeline at the State waters boundary (summer)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations >10 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations >10 g/m^2 (hours)	Probability (%) of shoreline accumulation at concentrations >100 g/m^2	Minimum time for shoreline accumulation at concentrations >100 g/m^2 (hours)	Maximum accumulated volumes for shoreline accumulation (m^3) at concentrations >100 g/m^2
Lowendal Islands	1	7	7	21	5
Montebello Islands	<1	No contact predicted at this threshold	7	16	8
Barrow-Montebello surrounds[1]	48	1	N/A	N/A	N/A
Montebello Marine Park	81	1	N/A	N/A	N/A

[1]This receptor is only emergent at lowest astronomical tide therefore accumulation is considered temporary only under these tidal conditions.

Table 3-7: Predicted shoreline contact for a marine diesel spill (329 m^3) from Wonnich Platform in State waters

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations >10 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations >10 g/m^2 (hours)	Probability (%) of shoreline contact at concentrations >100 g/m^2	Minimum time for shoreline accumulation at concentrations >100 g/m^2 (hours)	Maximum accumulated volumes for shoreline accumulation (m^3) at concentrations >100 g/m^2
Montebello Islands	19.5	3	28.5	5	165
Barrow-Montebello Surrounds[1]	100	1	21.5	3	115
Montebello Marine Park	21.5	2	N/A	N/A	N/A

[1]This receptor is only emergent at lowest astronomical tide therefore accumulation is considered temporary only under these tidal conditions.

Table 3-8: Predicted shoreline contact for an HFO spill (1,900 m^3) from the Varanus Island off-take tanker in State waters

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations >10 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations >10 g/m^2 (hours)	Probability (%) of shoreline contact at concentrations >100 g/m^2	Minimum time for shoreline accumulation at concentrations >100 g/m^2 (hours)	Maximum accumulated volumes for shoreline accumulation (m^3) at concentrations >100 g/m^2
Barrow Island	25.5	6	19.5	11	1,183
Lowendal Islands	98	1	49.5	2	1,324
Montebello Islands	17.5	11	30	12	1,480
Barrow-Montebello Surrounds[1]	33	3	35	13	468
Montebello Marine Park	17.5	11	N/A	N/A	N/A

[1]This receptor is only emergent at lowest astronomical tide therefore accumulation is considered temporary only under these tidal conditions.

Table 3-9: Predicted shoreline contact for a release of Varanus Island Crude Blend (8,629 m^3) from the Varanus Island off-take tanker in State waters

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations >10 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations >10 g/m^2 (hours)	Probability (%) of shoreline contact at concentrations >100 g/m^2	Minimum time for shoreline accumulation at concentrations >100 g/m^2 (hours)	Maximum accumulated volumes for shoreline accumulation (m^3) at concentrations >100 g/m^2
Barrow Island	22	6	21.5	11	613
Lowendal Islands	98.5	1	51.5	2	521
Montebello Islands	7	8	23	10	636
Barrow-Montebello Surrounds	29	3	29	4	177
Montebello Marine Park	13	9	N/A	N/A	N/A

3.4 Onshore spills

As described in **Table 3-3**, Level 2 and Level 3 onshore spills could occur from the following infrastructure:

- Crude oil storage tanks
- Production vessels in the process area (represented as first stage liquid production vessels)
- Hydrocarbon supply pipelines (to VI)
- Offtake Tanker loading line (export pipeline and hose)
- Diesel storage/transfer system.

Figure 3-1 shows the location of onshore sources and adjacent sensitive receptor locations on VI.

The largest potential release was identified to be 39,750m^3 of VI Blend hydrocarbon due to storage tank failure. The hydrocarbon storage tanks on VI are contained within a HDPE lined earthen bund designed to contain a catastrophic release (full tank contents) thus preventing hydrocarbon contact to the terrestrial or marine environment outside of the Lease area or to the groundwater system. Similarly, a worst case spill from process equipment will be contained within secondary containment around the process equipment designed to contain spills and direct contaminated runoff to sumps and humeceptors. Further detail on the secondary containment system around VI process equipment and crude oil storage tanks is provided within the accepted Varanus Island Hub Operations Environment Plan (EA-60-RI-186); the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003).

Marine diesel spills from storage tanks or the distribution network is in most instances surrounded by secondary containment, although some sections of the diesel pipework may potentially impact the natural terrestrial and/or marine environment if a spill was to occur.

For the live production pipelines connecting offshore infrastructure to VI processing facilities (i.e. the John Brookes, East Spar, Agincourt and Harriet to VI pipelines) and the cargo export pipeline leading from crude storage tanks to the VI terminal (offtake tanker terminal), there are sections of pipeline that do not have secondary containment to contain a spill or prevent impact to the terrestrial, subterranean or marine environment.

Figure 3-1: Potential onshore spill sources, facility and surrounding sensitivities

3.4.1 ZPI – surface extent

The onshore pipelines are a mix of above ground and buried sections. Onshore pipelines Agincourt 6”, East Spar 14” and John Brookes 18” located east of the VI facility have buried sections (approximately 50m) from the shoreline and are subsequently raised above ground towards the facility process area. The Harriet Bravo 8” and Tanker Load Out 30” pipelines north east of the facility are mainly buried except for short a section (about 50 m) raised above ground.

The surface extent of the ZPIs for these pipelines has been estimated as a distance of 50 m from either side of the pipelines, as shown in **Figure 3-2** to **Figure 3-4**, with arrows showing potential direction of surface flow down contour gradients. The distance was conservatively estimated based on an empirical equation (Mackay & Mohtadi, 1975) to estimate the spread of an oil spill on permeable porous flat surface. The 50 m extent covers all onshore pipeline spills except that from the Tanker Load Out pipeline. This line, which is running towards the beach/dune area, is not expected to extend significantly in a radial manner, instead any spill is expected to run down the slope reducing the radial spill footprint significantly. Based on the topography of the site, generally most spills from the above ground section of the pipelines will likely to flow towards to the coastline however there is expected to be considerable infiltrated into the porous sandy soils at the beach/fore dune areas that would greatly reduce the volume entering the marine environment. This is especially true for condensates which have lowest viscosity and therefore highest propensity for infiltration (as well as greatest evaporation to the atmosphere).

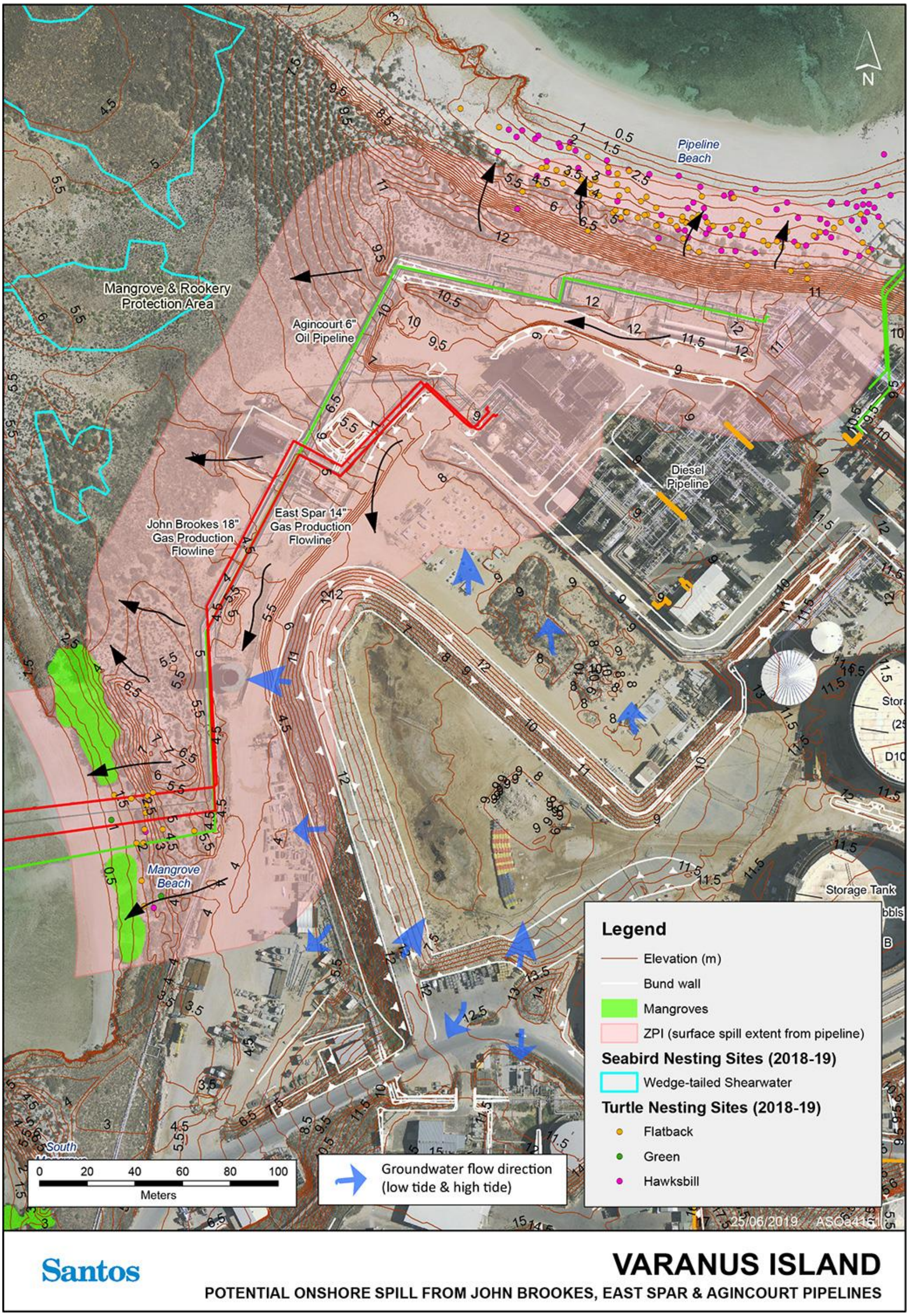

Figure 3-2: Onshore pipelines (John Brookes, East Spar, Agincourt) spill ZPI - surface

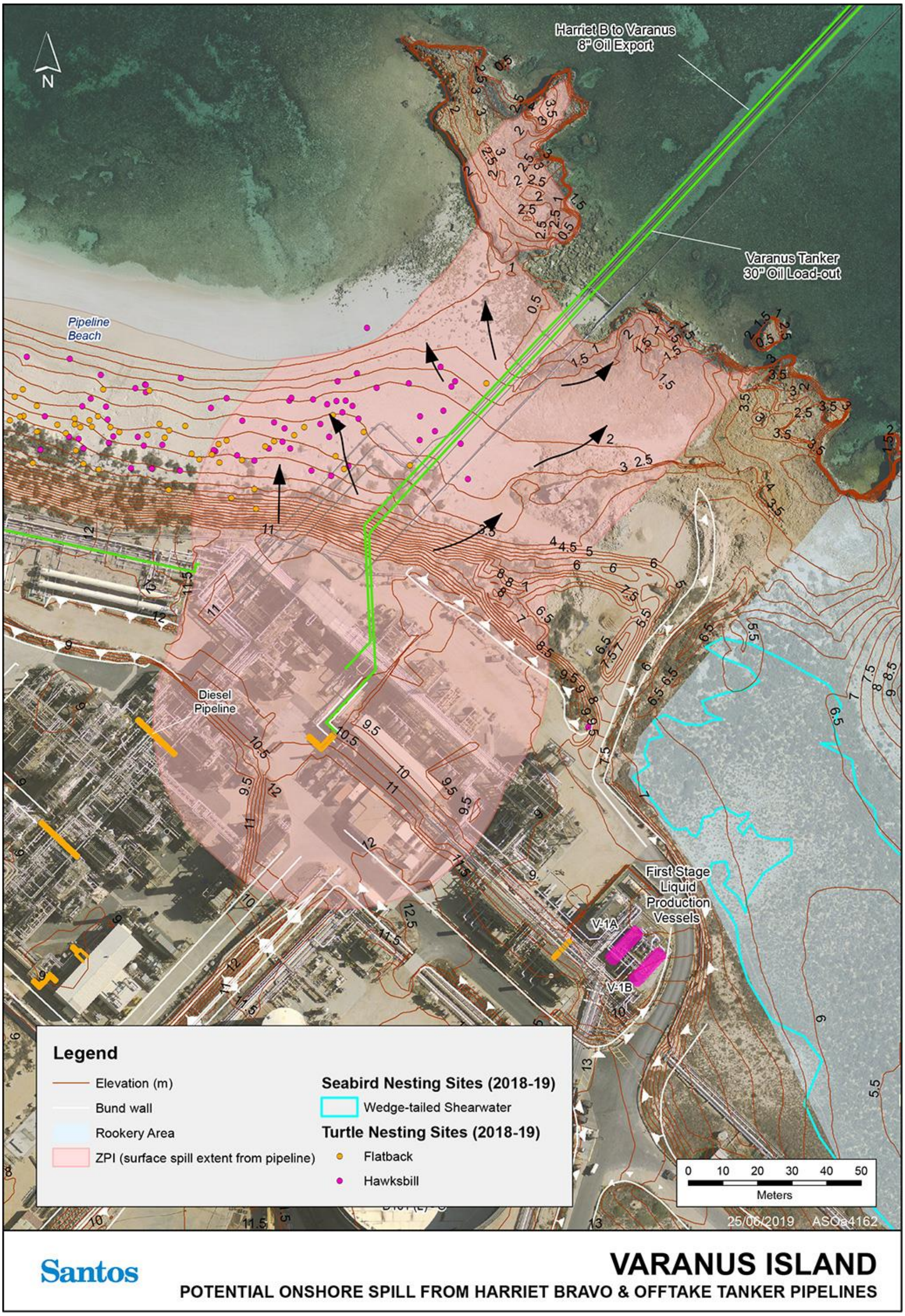

Figure 3-3: Onshore pipelines (Harriet Bravo, Tanker Load-out) spill ZPI - surface

Figure 3-4: Onshore pipelines (Diesel) spill ZPI - surface

3.4.2 ZPI - subsurface extent

The ZPI of subsurface contamination in the event of a spill from onshore pipelines has been conservatively estimated as the entire area of the Lease and beyond as shown in **Figure 3-1**. The subsurface contamination zone delineated includes the potential extent of light non-aqueous phase liquid (LNAPL) and dissolved phase hydrocarbon. The ZPI was estimated based on the monitoring data of the past contamination at the site (JBS&G, 2016). Whilst the volume and rate of leaks leading to existing contamination at the Lease area has not been measured the indicative hydrocarbon leakage volume is comparable to the maximum credible spill of onshore pipelines identified (JBS&G, 2016).

The groundwater flow directions marked on **Figure 3-1** are indicative. The inferred flow direction is highly complex and dynamic due to the predominantly Karstic geology of the site, the highly heterogeneous nature of the aquifer and the strong tidal influence on the groundwater hydrogeology.

It is likely for some releases to rapidly drain to the water table and be diluted and dispersed by rapid turbulent flow along preferential pathways in response to tide induced water table fluctuations and others may be captured by adsorption within finer matrix materials and within the capillary fringe above the water table (Emerge, 2015).

Contaminant storage may occur in the rock matrix and epikarst, but contaminant transport occurs mostly along preferential pathways that are typically inaccessible locations (creates complex networks of preferential flow pathways that are difficult to locate), which makes modelling of karst systems challenging (Ghasemizadeh et.al., 2012).

Based on the understanding developed from the numerous past studies on land contamination conducted on VI (JBS&G, 2016), the spatial extent of the contaminated zone has been maintained largely due to the tidal factors.

Figure 3-5: Onshore pipelines spill subsurface ZPI

3.5 -Identify Priority Protection Areas

3.5.1 Offshore spill

Protection priority areas, based on trajectory spill modelling, together with key sensitivities are included in **Table 3-10**. For further information on how these were defined refer to **Section 7.5** of the VI Hub Operations EP (State Waters) (EA-60-RI-00186) and of the VI Hub Operations Environment Plan (EP) for Commonwealth Waters (EA-66-RI-10003).

Table 3-10: Protection Priority Areas and Key Sensitivities

Protection Priority	Values	Relevant key periods
Lowendal Islands	Habitats Shallow lagoons with seagrass meadows Mangroves Macro algal reefs Reefs Turtles Loggerhead, green and hawksbill nesting turtles. Significant flatback rookery Seabirds 14 species of migratory and threatened seabirds Whales Humpback whale migration	Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov-to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan Birds: Sept-Feb Humpback whale migration: May-Dec
Montebello Islands	Habitats Reefs Algae (40%) Mangroves (globally unique as offshore) Fish habitat Intertidal sand flat communities Turtles Loggerhead and green (significant rookery), hawksbill, flatback turtles. Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green) Seabirds 14 species of migratory and threatened seabirds Significant nesting, foraging and resting areas Whales Pygmy blue whale northern migration Humpback whale migration	Coral spawning: Mar & Oct Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov-to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan Birds: Sept-Feb Pygmy blue whale migration: Apr-Aug

Protection Priority	Values	Relevant key periods
	Socio-Economic Pearling (inactive/pearling zones) Very significant for recreational fishing and charter boat tourism Social amenities and other tourism Nominated place (National heritage)	Humpback whale migration: May-Dec
Barrow Island	Habitats Bandicoot Bay - conservation area Fisheries Act (benthic fauna/seabird protection), mudflats, rock platforms, mangroves, clay pans Mangroves are in Bandicoot Bay (considered globally unique) Coral reefs (eastern side) - Biggada Reef Biggada Creek Turtles Regionally and nationally significant green turtle (western side) and flatback turtle (eastern side) nesting beaches Turtle Bay north beach North and west coasts- John Wayne Beach also loggerhead and hawksbill turtles. Seabirds Migratory birds (important bird area) 10th of top 147 bird sites. Highest population of migratory birds in BI Nature reserve (south-south east island). Double island important bird nesting (shearwaters, sea eagles). Whales Pygmy blue whale northern migration Socio-Economic Significant for recreational fishing and charter boat tourism Nominated place (National heritage)	Coral spawning: Mar & Oct Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan Loggerhead turtle nesting: Dec-Jan Birds: Sept-Feb Humpback whale migration: May-Dec Blue whale migration: Apr-Aug
Barrow-Montebello shallows	The values and relevant key sensitive timings are as described above for Barrow Island and the Montebello Islands.	

3.5.2 Onshore spill

The existing sensitivities adjacent to onshore spill ZPIs are shown in **Figure 3-1** to **Figure 3-5.** A general description of the onshore environmental setting is provided **Table 3-11**.

In the event of a spill, onshore priorities for protection will be confirmed based on the nature (location/volume/hydrocarbon type) of the incident. However, with respect to identifying potential receptors for spill response planning purposes, the following onshore sensitivities have been considered (**Table 3-12**) based on contact with hydrocarbons.

Table 3-11: Onshore environment features

Key Feature	Description of the feature
Landforms/Topography	Topography of the general area is flat to undulating low dunes with elevation ranges from sea level to a maximum of 18 m AHD
Surface water	There are no surface water features. Stormwater runoff quickly infiltrates into the subsurface geology.
Geology	Much of the lease area and the surroundings is made of outcrop of very finely grained massive limestone with an abundance of solution cavities. Dominant aquifer lithologies are karstic calcarenite and karstic limestone.
Hydrogeology	Groundwater flow directions substantially influenced by tidal effect and groundwater quality is consistent with sea water. Groundwater flow directions are variable throughout the duration of the tidal cycle with a range of potential directions. Highly variable values are likely attributable to the dominant limestone geology of the site that contains many large cavities and channels allowing preferential groundwater flow through these features. Consequently Varanus Island has high to very high hydraulic conductivity and high spatial variability. Under these conditions local groundwater flow is not in accordance with Darcy's Law and is largely unpredictable. The depth to groundwater across the site is substantially influenced by tidal processes and significant variation in water levels of the typical tidal range reported in open marine water can occur.

Table 3-12 Onshore environmental sensitivities and priorities for protection

Protection Priority	Values	Relevant Key Periods
Seabird rookery protection areas to the east and west of the lease boundary	Wedge-tailed shearwaters, crested terns and bridled terns	Wedge-tailed shearwater: adults excavate burrows from Jul – Oct; eggs laid in Nov; chicks hatch in Jan; chicks fledge in Apr. Crested terns: Oct to Dec. Bridled terns: Eggs laid Oct to Jan; chicks hatch Dec to Mar.
Pipeline Beach	Turtles (flatback, hawksbill and green)	Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan
Mangrove beach	Mangroves	All year
Beyond the northern and eastern and western lease boundary	Near shore habitats (intertidal zones)	All year

4 Response Option Selection

The response strategies outlined in this OPEP have been developed by Santos WA utilising risk assessments to identify credible worst-case 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 spill dispersion extent that is used to identify potential sensitive receptors and response strategies required to reduce the consequences of a spill to ALARP.

The process implemented throughout the response to assess the appropriate response strategies and implement these in a controlled manner to ensure the health and safety of operational personnel and effectiveness in response is the Incident Action Planning (IAP) process.

Incident action planning is the responsibility of the spill Control Agency. It is the responsibility of the Control Agency IMT to evaluate the response strategies provided in this OPEP based on actual and real circumstances. Where Santos WA is not the Control Agency, Santos WA will provide support to the incident action process adopted by the Control Agency through provision of situational awareness information and available resources. Where there is more than one Control Agency (i.e. a cross-jurisdictional response in coordination with DoT), Santos WA will undertake the IAP process as Lead IMT for those spill response activities it is responsible for and provide information and personnel to support DoT's planning function for those activities which DoT assumes control as Lead IMT.

4.1 Evaluation of Applicable Response Strategies

Based on the nature and scale of the credible spill scenarios outlined in **Section 3.1**, the following spill response strategies have been assessed as potentially applicable for combatting a spill (**Table 4-1**). These response strategies have been identified as either primary or secondary options depending on which may result in a net environmental benefit based on the worst-case spill scenarios identified in **Section 3.1**. Primary response strategies are those considered to have net environmental benefit of managing the spill. Secondary response strategies are those that may be used to either supplement primary response options or may be appropriate under specific circumstances.

In the event of an emergency situation where human safety is at significant risk, tasks included in this OPEP may not be implemented, and the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence.

Note: The information contained in **Table 4-1** 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 all necessary resources and planning assistance.

Table 4-1: Applicable Response Strategy Operational Considerations

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
Source Control	Spill kits	✓ 1	✓ 1	✓ 1	✓ 1	Relevant for containing spills that may arise on board a vessel, offshore platform or onshore.
	Secondary containment	✓ 1	X	✓ 1	✓ 1	Relevant for spills that may arise due to stored hydrocarbons, and from spills arising from machinery and equipment on board a vessel, offshore platform or onshore. Bunded areas will contain hydrocarbons reducing the potential for a spill escaping to the surrounding environment and allowing collection of hydrocarbon and contaminated run-off through contaminated drainage systems as applicable.
	Shipboard Oil Pollution Emergency Plan (SOPEP)	✓ 1	X	✓ 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/MODU's 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.
	Pipeline isolation (Emergency Shutdown (ESD))	X	✓ 1	X	✓ 1	All pipelines and wells covered under this OPEP have ESD available (manual and/or automatic) to isolate hydrocarbon inventories and limit the volume of a spill.
	Well Emergency Shutdown (ESD)	X	✓ 1	X	✓ 1	
	Pumping procedures	✓ 1	X	X	✓ 1	Provides guidance for supervision and actions required in the event of a hydrocarbon spill during pumping operations for marine diesel and crude oil transfers.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	Suck Back Pump	X	X	X	✔ 1	Specifically used for sucking inventory (VI Crude) out of the Tanker Loading Line in the event of a release from the Loading Line or Loading Hose during offtake tanker cargo loading.
	Surface well kill	X	✔ 1	X	✔ 1	Considered during relief well planning but may not be possible depending upon technical and safety constraints. Surface well kill is only considered when the estimated leak rate is small enough not to generate an explosive gas cloud and access to the platform is still preserved. This methodology would not be considered should safe access to the platform or ability to operate a vessel alongside the platform not be achievable.
	Capping Stack	X	X	X	X	Capping Stacks cannot be landed and connected to subsea wellheads under the credible loss of well control scenarios outlined in the EP and this strategy is therefore not considered applicable.
	Relief well drilling	X	✔ 1	X	✔ 1	Relevant for a loss of well control. 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	X	Not applicable for 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 Plan (Operational Monitoring)	Vessel surveillance	✔ 1	✔ 1	✔ 1	✔ 1	Provides real-time information on spill trajectory and behaviour (e.g. weathering). Informs implementation of other response strategies. Vessel personnel may not be trained observers. Vessel observers on leaking vessel may not have capacity to observe oil during emergency response procedure implementation. Constrained to daylight. Limited to visual range from the vessel.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						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. 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

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	Operational Water Quality Monitoring					Fluorometry surveys are used to determine the location and distribution of the entrained oil and dissolved aromatic hydrocarbon components of the 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. Considerable health & safety considerations. Requires trained observers. Constrained to daylight. Delayed response time.
Chemical dispersion	Vessel Application	X	X	X	X	Marine spills of a size where chemical dispersion could potentially be applied are a loss of well control (gas/condensate) or vessel tank rupture of HFO or VI Blend crude oil. *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 marine diesel as it has a low additional benefit of increasing the dispersal rate of the spill while introducing the potential for increased impacts. *Condensate:* Condensates produced are not considered a persistent hydrocarbon, and has a very high natural evaporation and dispersion rates in the marine environment reducing the volume of hydrocarbon remaining at the sea surface. Spill modelling indicates that these natural weathering processes will result in minimal contact of surface condensate at shoreline locations.
	Aerial Application	X	X	X	X	
	Subsea Application	X	X	X	X	

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						On the basis of the above, chemical dispersant application is not recommended as an applicable strategy, the benefit of applying condensate from an environmental perspective is considered minimal. From a subsea application perspective there are also considerable safety risks and technical challenges in applying dispersant at the source to shallow subsea wells with gas/condensate release. Capping Stack application is not considered applicable for the credible loss of well control scenarios covered in this EP and therefore there is no benefit in subsea dispersant application for the purpose of facilitating this strategy. *Crude oil and HFO:* Crude oil or HFO could be released in significant quantities from offtake tanker tank rupture, however the Marine Terminal is in shallow water in State waters close to sensitive receptors. Application in shallow waters can result in organisms being exposed to higher concentrations of naturally dispersed oil and water soluble compounds for a longer duration than if the product was applied in deeper water. In addition dispersant efficacy testing on a crude blend showed results of less than 1% efficacy. On the basis of the above, chemical dispersant application is not recommended as an applicable strategy for the credible spill scenarios covered under this OPEP.
Offshore Containment and Recovery	Use of offshore booms/ skimmers or other collection techniques deployed from vessel/s to contain and collect oil.	X	X	✔ 1	✔ 2	Offshore containment and recovery may be suitable for Heavy Fuel Oils (HFO) and Crudes which are heavy residual fuels with a high viscosity and which may exist on the sea surface at a sufficient thickness to make containment and recovery effective. Marine diesel is a low viscosity oils that spread quickly resulting in thin surface expressions, making recovery via booms and skimmers difficult and ineffective. For these oils offshore containment and recovery is not considered an applicable strategy. Similarly, the properties of the crude oils and condensates that could be spilt from VI infrastructure (i.e. Group 1 or 2

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						light, thin oils) indicate that these hydrocarbons would also express at low thickness on the sea surface and would be difficult to contain and collect. Properties of oils change during weathering, and for VI hydrocarbons, this would be monitored to assess the potential effectiveness of containment and recovery.
Mechanical Dispersion	Vessel prop-washing	✔ 2	✔ 2	X	✔ 2	Safety is a key factor and slicks with potential for high VOC emission are not suitable. Recommended for the removal of sheens. 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 coat 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. Better to keep HFO on the sea surface and collect than to disperse. Marine diesel, condensate and crude oils are light oils 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. The potential disadvantage of mechanical dispersion is that it could temporarily increase the concentration of entrained and dissolved oil in the vicinity of submerged shallow water receptors (e.g. corals, seagrass ad macroalgae). This is most likely in shallow water of a few metres deep. The suitability of mechanical dispersion as a response measure would consider the prevailing environmental conditions (it mimics the action of wave induced entrained so is most beneficial in calm conditions) and the type, proximity and depth (as applicable) of sensitivities in the area. Mechanical dispersion will be considered for petroleum activity sourced spills at the discretion of the On-Scene Commander/IMT or by the relevant Control Agency.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
Protection and Deflection	Booming in nearshore waters and at shorelines	✔ 2	✔ 2	✔ 1	✔ 1	Use of anchored boom or other barriers (e.g. sand bags, earthworks) to contain/divert oil and/or to protect sensitive receptors in the nearshore environment. Considered for Level 2/3 spills if operational monitoring shows or predicts spill is predicted to contact sensitive shorelines. Both marine diesel and condensate have high volatility and low persistence with low potential for shoreline loading. Flushing and bioremediation may provide a greater net benefit than booming operations. Booming is likely to be more effective for HFO.
Shoreline clean-up	Activities include physical removal, surf washing, flushing, bioremediation, natural dispersion	✔ 2	✔ 2	✔ 1	✔ 1	Various strategies to clean shorelines of oil including: + Mechanical/ manual collection + Low pressure flushing + Sorbent materials + Surf washing + Sand tilling + Bioremediation. Considered if operational monitoring shows or predicts contact to sensitive shorelines. Shoreline clean-up may be more effective for HFO. Intrusive activities such as physical removal of waste using manual labour or mechanical aids requires careful site-specific planning in order to reduce secondary impacts of habitat disturbance, erosion and spreading oil beyond shorelines. The majority of the affected coastline is offshore islands, mangroves and tidal flats, most of which has no access by land. Flushing may be considered if the oil enters high priority/slow recovery habitats such as mangroves.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						Marine diesel and condensate have low to no persistence in the environment and therefore prolonged loading of shorelines is not expected. Natural remediation and flushing may be preferred to more intrusive clean-up methods given the nature and low persistence of these hydrocarbons.
Onshore response	Protection, onshore clean up and monitoring	✔ 1	✔ 1	N/A	✔ 1	Sorbent booms to control contaminated surface water if present Soil and groundwater monitoring and remediation as defined under Contaminated Sites legislation Shoreline response options as per above (protection/deflection booming and shoreline clean-up) if spill reaches shoreline/marine environment. Onshore pipelines may result in surface contamination (predicted 50 m wide ZPI) or soil/groundwater contamination (rapid infiltration and complex movement within aquifer due to complex/heterogeneous karst geology). Sorbents can be used onshore to isolate surface flow from receptors (mangroves/nesting sites for birds and turtles) although natural infiltration is expected to be considerable. If surface contamination reaches beaches/ marine waters the process applied to marine spill shoreline/coastal response applies. Site remediation of soil and groundwater will be under direction of DWER and will be detailed in a remediation action plan under Contaminated Site legislation. VI is an existing contaminated site with ongoing monitoring and remediation as specified within a Remedial Action Plan. Any further contamination would build on site knowledge and techniques already developed through this process.
Oiled wildlife Response	Activities include hazing, pre-emptive capture, oiled wildlife capture,	✔ 2	✔ 2	✔ 1	✔ 2	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. Potential for onshore releases to impact nesting areas.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	cleaning and rehabilitation.					Surveillance can be carried out as a part of the fauna specific operational monitoring Wildlife may become de-sensitised 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	✔ 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 filter feeders) + Seabirds and shorebirds + Marine megafauna (incl. whale sharks and mammals) + Marine reptiles (incl. turtles) + Seafood quality + Fish, fisheries and aquaculture The type and extent of scientific monitoring will depend upon the nature and scale of oil contact to sensitive receptor locations as determined through operational monitoring. Pre-defined initiation criteria exist for scientific monitoring plans associated with marine and coastal sensitivities.

4.2 Resource Arrangements and Demonstration of ALARP

A detailed ALARP assessment on the adequacy of resourcing available to support spill response strategies and control measures is presented in **Table 4-2**.

Table 4-2 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-event data, mobilising the workforce and conducting a	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
		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.			
Direct surface intervention	Local personnel supplemented by additional personnel, as required, through arrangements with Wild Well Control, as outlined within the Source Control Emergency Response Plan (SCERP) (DR-00-ZF-10001 Pumping equipment (e.g. cement units/ triplex pumps, high pressure treating iron pipe-work and flexible high pressure hoses) are readily available within the region.	Direct surface intervention (i.e. deployment onto the jack-up rig) using specialised well control personnel is a strategy that could be adopted however limited to very specific incidents where the technical and safety factors are not a constraint. Santos has successfully planned and executed well-kill/ bull-heading/ flushing operations during routine non-leak well suspension activities in numerous platforms using this type of equipment and local personnel.	Additional resources are not considered required or limiting. The limiting factor is the meeting of technical and safety aspects of the LOWC event which could only be assessed at the time of a spill event.	Not considered required.	Given the uncertainty for the response strategy feasibility, in combination with the potential safety hazards surrounding the well, the current preparedness measures for well intervention is considered ALARP
Monitor and Evaluate- Aerial Surveillance	Helicopter services available through Santos WA's primary contracted supplier based out of Karratha.	Given location of spill sites, mobilisation of helicopters from Karratha (via VI if required) is considered adequate for surveillance. Endurance is not considered a limiting factor at	Resource not considered limiting. Primary supplier on contract with additional providers available to provide desired	No additional costs as helicopters are currently contracted for day-to-day operations to and from Santos WA facilities.	There is no value in increasing dedicated overpasses; therefore, the arrangements are considered ALARP. However, opportunistic

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	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).	these locations. Mobilisation and refuelling from Exmouth is possible depending on trajectory of spill. 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.	overpass frequency. Santos WA trained observers can be provided on rotation from Day 2.	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.	aerial surveillance can be provided through the shared use of aircraft deployed for other purposes.
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 Dampier. Santos WA has access to automatic identification system	On-contract vessels performing duties at VI and Ningaloo Vision will be available, as well as vessels of opportunity from other petroleum operators. The activity area is central on the North West Shelf and offshore from the major marine base of Dampier. Additional available vessels out of Dampier can be put on hire through Santos WA's contracted vessel providers; mobilisation times to site can provide additional contracted vessels relatively quickly.	Based on the close proximity of the activity to VI and the central location of the activity relative to the main marine base of Dampier, dedicated additional vessels for the purpose of oil spill surveillance is not considered to be required, given the need is met through vessel sharing. Surveillance will also be conducted through	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.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	live-vessel tracking portal to establish vessel availability. Vessel surveillance will be activated within 90 minutes for available on-site (at VI) vessels.	Additional mobilisation from Exmouth 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).	a number of complementary strategies (aerial surveillance, oil spill trajectory modelling, tracker buoys).		
Monitor and Evaluate- Oil Spill fate Modelling	24/7 standby Oil Spill Trajectory Modelling (OSTM) service provider. OSTM provider will be contacted immediately (within 2 hours) upon notification of a Level 2 or 3 spill (as per Section 2.1 of the VI HUB 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	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 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.	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 no environmental benefit from dedicating additional modelling capability.	Santos WA pays for the provision of the 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 and can provide 24/7 coverage.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	4 hours for OILMAP operation for near-shore.				
Monitor and Evaluate- Tracker Buoys	Up to 12 Santos WA tracker buoys (at different Santos WA facilities); 4 are immediately available on VI, and deployment can be at a staggered rate determined by the need to track oil 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.	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. Four are available on VI. 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).	Additional buoys are available through secondary suppliers (e.g., AMOSC, OSRL and AMSA – more than 20 buoys available) if required. These can be registered on the Santos WA/Joubeh satellite tracking system within hours. Dedicated vessels are not required given that the need is met through vessel sharing.	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 AMSA, AMOSC, OSRL within days. There is no additional upfront cost for accessing these secondary buoys.	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. Therefore, no additional requirements and the response is considered ALARP.
Monitor and Evaluate-	Contract in place with third party provider to enable access and	Suitable imagery can be accessed through existing contracts with AMOSC and OSRL. The most appropriate	Satellite imagery is considered a supplementary source of information that can	Not considered required.	The current satellite imagery arrangements are considered

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
Satellite Imagery	analysis of satellite imagery	images for purchase will depend on the extent and location of the spill. Frequency of reporting is subject to satellite overflight schedule.	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 provider there is no requirement for additional resources.		adequate to provide the required function.
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.	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 with OSRL – located in Singapore. 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	There are locally available subsea gliders and access to towed fluorometers. Water sampling equipment and CTD meters are also available locally. 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.	Santos WA can access subsea gliders with fluorometers and towed fluorometers through OSRL. 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	The existing arrangements are considered sufficient to provide targeted 'first strike' 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
	Glider Field Engineer for deployment and recovery. Dedicated vessels for towed fluorometers, CTD meter deployment, water sampling. Vessels of opportunity (vessel sharing) for subsea glider deployment. Oil sample collected using a vessel of opportunity and analysed on VI or in Perth.	rapid activation, planning and deployment of operational water quality monitoring personnel. Subsea gliders and towed fluorometers can cover approximately 1 km/hr. One glider could cover 24 km/day. CTD meters provide discrete 'single point' readings over a depth profile. Water quality sampling at discrete locations. For subsea gliders and towed fluorometers, the deployment philosophy is not to 'blindly' patrol the entire spill area. Deployments will be targeted to ground truth spill modelling predictions. That is, the predicted front or fronts of entrained oil will be traversed by gliders to verify entrained oil presence. This will be prioritised where fronts are predicted to reach sensitive receptor areas. Similarly, discrete water sampling will target sites	Deployment personnel will initially be provided through Santos WA's contracted monitoring provider and subsea glider deployment personnel.	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.	

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		positioned to validate modelling predictions.			
Monitor and Evaluate – Shoreline and Coastal Habitat Assessment	Spill response teams (Santos WA and 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 information on shoreline character can be obtained from Santos WA's GIS, including habitat/fauna distribution layers and aerial imagery. The HFO spill (State waters) from the VI off-take tanker could result in the quickest shoreline contact (above 100 g/m^2) at the Lowendal Islands (2 hrs), Barrow Island (11 hrs) and Montebello Islands (12 hrs). A John Brooke Pipeline condensate leak at the State	Personnel and equipment for shoreline and coastal habitat assessment is not considered limiting. However, the time for deployment may exceed predicted times to minimum shoreline contact, particularly at the Lowendal Islands. The pre-positioning of personnel and/or pre-assessment of shorelines prior to a spill is considered of limited benefit since: • Shoreline and Coastal Habitat Assessments do not need to occur prior to oiling since they are designed to record information about level of oiling and applicable response techniques.	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
		waters boundary could also result in a short timeframe in shoreline contact (above 100 g/m^2) at the Montebello Islands and (16 hrs) and Lowendal Islands (21 hrs). First-strike deployment arrangements would come from personnel and equipment based at VI. This includes Santos WA AMOSC Core Group personnel, and IRT members. Santos WA maintain the capability to implement a first strike shoreline and coastal habitat assessment within the first 24 hours of a spill notification.	• Shoreline characteristics change over time and thus pre-assessments may not be accurate or relevant at the time of a spill.		
Monitor and Evaluate – Wildlife Reconnaissance (aerial/ vessel surveillance. Shoreline and coastal habitat assessment)	Spill response teams (Santos WA and AMOSC core group, State Response Team) Santos WA and AMOSC Core Group Aerial Observers. Santos WA contracted helicopters, vessels and vehicles available as required.	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 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	Having experienced fauna observers and dedicated helicopters and vessels on standby for targeted fauna surveys from the very start of the spill could result in improving the quality of data initially received.	The cost of personnel, helicopters and vessels on standby for this purpose would cost in the order of tens of thousands of dollars per day.	The current arrangements, in terms of using monitor and evaluate surveillance to provide the initial wildlife reconnaissance, followed by targeted fauna surveys with experienced fauna observers as part of the scientific monitoring program, are considered adequate.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Third party Scientific Monitoring Wildlife aerial observers	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			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 performing other duties. Dedicated vessels are therefore not considered to be required.	Given there will be on-hire vessels supporting the activities and the central location of activity relative to the main marine base of Dampier, dedicated additional vessels specifically for the purpose of mechanical dispersion are not considered to be required, particularly given this strategy can be tasked through vessel sharing.	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 limited value they would provide.	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.
Containment and Recovery	Booms plus ancillary equipment (Santos WA – VI; AMOSC – Exmouth, Fremantle and Geelong; AMSA – Fremantle and Dampier).	First-strike deployment of containment and recovery equipment for an offtake tanker release of HFO (State waters only) is to be from VI using vessels, offshore boom and oil skimmer available onsite. Personnel to be provided	Containment and recovery equipment and personnel is not considered limiting. However, the time for deployment may exceed predicted times to shoreline contact,	The operational cost of booms, skimmers, vessels and personnel on standby is in the order of tens of thousands of dollars per day.	The cost of having dedicated personnel and equipment on standby on operational vessels is considered grossly disproportionate to the

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Boom tow-vessels. Spill response teams (Santos WA and AMOSC core group, State Response Team).	through the VI IRT and onsite vessel crew. Secondary deployment of offshore boom would most likely be from Dampier, using Santos WA and AMSA offshore booms and skimming equipment stockpiled in Dampier. Santos WA contracted vessel provider will be used preferentially for vessel deployments out of Dampier. Offshore boom and skimming equipment can be loaded and ready for deployment within 4 hours from activation. Santos WA maintain the capability to implement first strike containment and recovery strategies within the first 24 hours of a spill notification. Further deployments as required, would be provided from Dampier and Exmouth using Santos WA, AMOSC and AMSA equipment, Santos WA contracted vessel providers and personnel from Santos WA IRTs, AMOSC Core Group and State/National Response Teams.	particularly at the Lowendal Islands (contact within 2 hrs). Containment and recovery equipment and personnel could be positioned permanently on VI support vessels which would eliminate vessel loading time, however this is likely to reduce the response time by only an hour and would restrict vessels and personnel undertaking other operational activities given that: • To be beneficial the vessels with a deployment team would have to be on standby near the marine terminal, thereby restricting ability of vessels and personnel to undertake other duties. • Containment and recovery		environmental benefit gained.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		As a backup to AMOSC stockpiles, significant quantities of offshore boom are available through OSRL out of Singapore. For some scenarios, given the proximity of the spill to the shoreline or due to weather conditions, it will not be possible to implement strategies prior to the minimum modelled contact times. For such instances, containment and recovery could still have environmental benefit once implemented.	equipment would take up significant deck space reducing the ability for vessels to undertake operational activities		
Protection and deflection	Shoreline and nearshore booms plus ancillary equipment (Santos WA – VI; AMOSC – Exmouth, Fremantle and Geelong; AMSA – Fremantle and Dampier). Boom tow-vessels. Spill response teams (Santos WA and AMOSC core group, State Response Team).	Shoreline and nearshore booms provided by Santos WA or through AMOSC or AMSA are available from Exmouth, VI and Dampier within close proximity to shorelines 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 (e.g., Chevron	Boom equipment is not considered limiting. However, the time for deployment may exceed predicted times to shoreline contact, particularly at the Lowendal Islands (contact within 2 hrs). In addition, boom deployment locations cannot be confirmed until oil spill fate modelling and/or aerial/vessel	Having either pre-positioned boom and response personnel or boom/ personnel on standby vessels would involve costs in the order of thousands of dollars per day.	The cost of having dedicated personnel and equipment prepositioned or on standby vessels is considered grossly disproportionate to the environmental benefit gained. Pre-positioning boom would also create potential environmental impacts which would likely outweigh any potential benefits in the event of a spill.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	Tactical response plans in place for the deployment of booms at offshore island locations (e.g., Montebello Islands).	equipment based at Barrow Island). For the scenarios with predicted short-time frames to shoreline contact (HFO spill from the off-take tanker in State waters and the John Brooke Pipeline condensate leak at the State waters boundary), 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. Regular deployment exercises conducted by VI AMOSC Core Group and IRT personnel of spill response equipment have demonstrated the ability of loading of VI field support vessels within relatively short timeframes (<4 hours). Santos WA maintain the capability to implement first strike protection and deflection strategies within the first 24 hours of a spill notification, taking into consideration the need for oil spill modelling, surveillance and	surveillance data has been assessed. Prepositioning equipment closer to or at sensitive receptor locations or having personnel and equipment on standby vessels would potentially reduce deployment time. However, pre-deploying boom at sensitive locations creates potential for impacts which weighed against the uncertainty of an oil spill reaching the location are deemed to be unacceptable.		Given personnel and equipment for deployment of boom are already available on VI and within close proximity to shorelines with the greatest potential, and quickest timeframes, for impact, the existing arrangements are considered to reduce risk to ALARP.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		an operation NEBA to guide such a response. For some scenarios, given the proximity of the spill to the shoreline or due to weather conditions, it will not be possible to implement strategies prior to the minimum modelled contact times. For such instances, protection and deflection could still have environmental benefit once implemented.			
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). Vessels for transport (Santos WA contracted vessel providers).	Shoreline clean up strategies will be implemented under the direction of DoT as the HMA. The greatest predicted shoreline loading is from the HFO tanker spill (State waters only) with 1,468 m^3 (>100 g/m^2) accumulating at the Montebello Islands within 12 hrs. Existing Santos WA equipment and that available through AMOSC/AMSA arrangements is considered to be sufficient given stockpile locations at Dampier, Exmouth and VI. Further equipment can be provided through additional Australian stockpile locations.	The main limitation of undertaking a shoreline clean-up response is based around access for plant and personnel to remote offshore island locations. VI can accommodate a maximum of 160 personnel outside of cyclone season. Barrow Island also has resident personnel associated with Chevron's operations. Provision of additional clean-up resources such as spill kits, sorbents, brooms,	During a spill event, the cost of additional resources is not considered the limiting factor; the limiting factor is considered to be access and support services for plant and personnel to remote offshore island locations.	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 to offshore islands – 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
	Equipment is prepositioned on VI so readily available.	First strike deployment arrangements would come from personnel and equipment based at VI. Santos WA maintain the capability (onsite oil spill responders and equipment) to implement first strike shoreline cleanup strategies within the first 24 hrs of a spill notification. Transport of personnel and equipment to Montebello Islands could potentially occur prior to the worst-case loading timeframe. Santos WA has developed Tactical Response Plans to guide nearshore and shoreline operations at Montebello Islands. A sustained clean-up would involve 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. Maximum shoreline loading from the LOWC at John	shovels, buckets etc are not considered to provide an environmental benefit unless additional personnel can be mobilised.		

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		Brookes is predicted to be 29 m3 (>100 g/m^2) accumulating at the Montebello Islands within 7 days. For the John Brookes pipeline leak scenario at the State water boundary, the maximum predicted shoreline loading is 8 m^3 (>100 g/m^2) accumulating at the Montebello Islands within 16 hrs. Given the light/volatile nature of condensate and the relatively low volumes predicted to arrive at shorelines under worst case conditions, intrusive and labour intensive methods are unlikely to be favoured or required.			
Waste management	Assorted waste receptacles and trucks. Waste personnel – project manager, local responsible personnel and operations personnel. Vessels for waste transport from offshore islands. Dedicated spill equipment container available on VI with	Santos WA's waste service provider is contracted to provide first-strike and ongoing waste storage, transport and disposal requirements commensurate with a worst-case spill across Santos WA's operations. These resources are over and above those required for the worst case scenarios described in this OPEP.	Waste contractor has access to sufficient resources for the worst-case waste requirements associated with the activity; there is no benefit to acquiring additional resources specifically for the activity. Additional equipment to manage shoreline clean-up waste on	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
	equipment to establish waste storage areas during shoreline clean-up (e.g., collapsible bunds, absorbent rolls, drain covers, temporary fencing).		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 WA Oiled Wildlife Response Plan (AMOSC, AMOSC-activated Oiled Wildlife Response contractors, Industry Mutual Aid, DBCA, OSRL-activated Oiled Wildlife Response contractors, “Sea Alarm”). VI HSE Advisors with fauna handling training	In Commonwealth waters, Santos WA is the control agency for an OWR in consultation with DBCA. If a spill occurs in or 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 effectiveness and ensure the response effort itself does not cause more harm. In the HFO tanker spill scenario in State waters the spatial extent of floating oil above the impact threshold of 10 g/m^2 may extend up to 396 km from the release location. Additionally, the minimum modelled contact times above 100 g/m^2 is 2 hrs at the Lowendal Islands. For this	Prehire and/or prepositioning of staging areas and responders may enhance response times and hence the overall success of an OWR. Particularly for the HFO spill scenario, the number of wildlife oiled is likely to 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	The cost of personnel (Level 1 responders) on standby is $1,500 per person per day as per existing arrangements through recruiting agencies. 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 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	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, OSRL/Sea Alarm and through Santos WA Workforce hire are considered adequate. Santos WA is committed to improving their first strike OWR capability through the development of a Varanus Island Oiled Wildlife First Strike Plan prior to the end of 2020.

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
	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.	scenario widespread physical oiling to wildlife could result in a level 5 OWR over time(Table 15-3). 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 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. The minimum modelled contact time for a condensate spill above 100 g/m^2 is 16 hrs at the Montebello Islands from the John Brookes pipeline spill scenario at the State boundary. The minimum modelled contact	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. The first strike capability of Santos WA, prior to the arrival of OWR/wildlife specialists, would be enhanced through the development of a VI Oiled Wildlife First Strike Plan, which would include training requirements.	DoEE) which is expected to be more of a limiting factor with regards to time than mobilising additional resources.	

Strategy	Resourcing	Justification	Environmental Benefit of Additional Resources	Cost of Additional Resources	ALARP Assessment
		time for the LOWC above 100 g/m² is 4 days at Barrow Island. Given the propensity of condensate to evaporate and the relatively small volumes predicted ashore, the OWR is unlikely to exceed a level 3 (Table 15-3). 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. Preceding this, at Varanus Island, a first strike response may be undertaken by the VI HSE Advisors whom have undertaken fauna handling training and are listed on the DBCA licences (Regulation 25 and 28) which allow them to handle, and if necessary euthanise wildlife. Prior to any first strike actions, approval and instruction would be sort from DBCA.			

4.3 Net Environmental Benefit Analysis (NEBA)

The Control Agency IMT use the NEBA process to inform the development and refinement of incident response strategies and tactics, so the most effective response strategies and tactics with the least detrimental environmental impacts can be identified, documented and executed.

Within Santos WA's IMT, the Environmental Team Lead is responsible for reviewing the priority receptors identified within the EP and this OPEP and coordinating the Operational NEBA to identify which response options 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, the Operational 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 to prioritise for response across the Control Agencies.

Strategic NEBAs have been developed for all response strategies identified as applicable to credible worst-case spills identified in this OPEP, with the benefit or potential impact to each sensitivity identified within the Environment that May Be Affected (EMBA). Based on the similarities between the hydrocarbon types, i.e., condensate, marine diesel, and crude, and overlap of the shorelines contacted, a single Strategic NEBA was developed for all of the worst-case spill scenarios identified in **Section 3.3** apart from the HFO spill in State waters, and is represented in

Table 4-3**,** A separate strategic NEBA was developed for the HFO spill scenario from the VI off-take tanker in State waters and is represented in **Table 4-4**. Although not all spill response activities included in the strategic NEBA would be under the control of Santos WA during a spill incident, they have however been included to assist in planning conducted by DoT.

In the event of a spill, NEBA is applied with supporting information from situational awareness and information collected as part of the Monitor and Evaluate Plan (**Section 9**) 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 ranking; 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/SIMA is applied to the current situation, or operationalised. To complete the NEBA/SIMA:

+ All ecological and socioeconomic sensitivities identified within the spill trajectory area are inserted; and
+ Potential effects of response strategies on each sensitivity are assessed and assigned a positive, negative or no change rating.

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

Table 4-3: Impact of spill response strategies on the environmental values of the protection priorities following worst-case spill of John Brookes condensate/marine diesel/VI crude blend in Commonwealth or State

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Montebello Islands									
Turtle nesting – Northwest and Eastern Trimouille Islands (hawksbills), Western Reef and Southern Bay and Northwest Island (green)	Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan								
Mangroves – particularly Stephenson Channel								N/A	
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct					N/A	N/A	N/A	
Seabird nesting	Sept-Feb								
Migratory shorebirds	Sept-Feb								

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Humpback/ Pygmy blue whale migration	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec					N/A	N/A		
Fishing/ charter boat tourism									
Barrow Island									
Turtle nesting – particularly flatback (western side) and green turtles (eastern side)	Green turtle nesting: Nov-to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan Loggerhead turtle nesting: Dec-Jan								
Mangroves and mudflats (shorebird foraging) – Bandicoot Bay								N/A	
Coral and other subsea benthic primary producers – incl. Biggada Reef	Coral spawning: Mar & Oct					N/A	N/A	N/A	

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Seabird nesting - incl. Double Island	Sept-Feb								
Migratory shorebirds - particularly Bandicoot Bay	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec								
Aboriginal listed sites incl. pearling camps	Sept-Feb							N/A	N/A
Lowendal Islands									
Turtles nesting- Important hawksbill (Beacon, Parakeelya, Kaia and Pipeline), Loggerhead and green turtle nesting (minor) Varanus pipeline, Harriet and Andersons),	Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan								
Mangroves- mangrove stands on Varanus Island on the west coast in discrete patches at South Mangrove Beach also on Bridled Island								N/A	

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct					N/A	N/A	N/A	
Seabird nesting	Sept-Feb								
Migratory shorebirds	Sept-Feb								
Dugongs- Seagrass beds around the Lowendal islands thought to provide valuable food source						N/A	N/A		
Humpback whale migration	May-Dec					N/A	N/A		
Aboriginal listed sites incl. pearling camps								N/A	N/A

Table 4-4: Impact of spill response strategies on the environmental values of the protection priorities following surface release of HFO from offtake tanker in State Waters

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Montebello Islands										
Turtle nesting – Northwest and Eastern Trimouille Islands (hawksbills), Western Reef and Southern Bay and Northwest Island (green)	Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan									
Mangroves – particularly Stephenson Channel									N/A	
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct						N/A	N/A	N/A	

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Seabird nesting	Sept-Feb									
Migratory shorebirds	Sept-Feb									
Humpback/ Pygmy blue whale migration	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec						N/A	N/A		
Fishing/ charter boat tourism										
Barrow Island										
Turtle nesting – particularly flatback (western side) and green turtles (eastern side)	Green turtle nesting: Nov-to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan									

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
	Loggerhead turtle nesting: Dec-Jan									
Mangroves and mudflats (shorebird foraging) – Bandicoot Bay									N/A	
Coral and other subsea benthic primary producers – incl. Biggada Reef	Coral spawning: Mar & Oct						N/A	N/A	N/A	
Seabird nesting - incl. Double Island	Sept-Feb									
Migratory shorebirds - particularly Bandicoot Bay	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec									
Aboriginal listed sites incl. pearling camps	Sept-Feb								N/A	N/A

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Lowendal Islands										
Turtles nesting- Important hawksbill (Beacon, Parakeelya, Kaia and Pipeline), Loggerhead and green turtle nesting (minor) Varanus pipeline, Harriet and Andersons),	Loggerhead turtle nesting: Dec-Jan Green turtle nesting: Nov- to Apr. Peak period from Jan-Feb Hawksbill turtle nesting: Oct-Jan Flatback turtle nesting: Dec-Jan									
Mangroves- mangrove stands on Varanus Island on the west coast in discrete patches at South Mangrove Beach also on Bridled Island									N/A	
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct						N/A	N/A	N/A	

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Seabird nesting	Sept-Feb									
Migratory shorebirds	Sept-Feb									
Dugongs- Seagrass beds around the Lowendal islands thought to provide valuable food source							N/A	N/A		
Humpback whale migration	May-Dec						N/A	N/A		
Aboriginal listed sites incl. pearling camps									N/A	N/A

Legend	
	Beneficial impact
	Possible beneficial impact dependent upon the situation (e.g. Timeframes and metocean conditions to dilute entrained oil)
	Negative impact
N/A	Not applicable for the environmental value

5 Initial Response (First Strike Activations)

The initial response actions to major incidents at VI Hub facilities are outlined within the Varanus Hub Incident Response Plan (QE-00-ZF-00044). This includes site- and role-specific information relevant to the initial stages of an incident response including notifying the Central Control Room (CCR), raising the alarm, mustering of personnel and ESD of facility infrastructure. The Varanus Hub Incident Response Plan (QE-00-ZF-00044) should be consulted as an overall guide to incident response at VI Hub Facilities, which includes all major incidents additional to oil spills.

For hydrocarbon spills to the environment the Varanus Island On-scene Commander (Field Superintendent) is to contact the Incident Commander (Incident Commander) in Perth via the on-call Duty Manager (as per below).

Position	Type of communication	Timeframe	To Whom
On-Scene Commander	Verbal	Within 30 minutes of incident having been identified or as soon as additional resources are required	Incident Commander via Duty Manager

First strike activations required for the credible oil spill incidents identified in this plan are outlined in **Sections 5.1** to **5.4** below.

5.1 Level 1 offshore spills

Level 1 activations are based on spills which will not have an adverse effect on the public or the environment and can be controlled by the use of resources available onsite, without the need to mobilise additional resources for combatting the spill. First strike actions for level 1 offshore spills are detailed below (**Table 5-1**).

Low flow well leak incidents identified from subsea inspection activities of plugged and abandoned wells are included in **Table 5-1**, given worst case credible releases are relatively low in volume and not considered not to require a typical Level 2/3 spill response. Nevertheless, these releases would need operational monitoring to assess the potential environmental consequence (refer **Section 9.8**) and following evaluation of operational monitoring information may be reassessed as a Level 2 spill requiring scientific monitoring to be initiated.

Table 5-1: First Strike Activations for Level 1 Offshore Spills

When	Actions	Who
Immediate	Manage the safety of personnel on platform or vessel	Offshore Platform Designated Person / Vessel Master
Immediate	Control the source using available onsite resources Refer: Source Control Plan – go to Section 7	Offshore Platform Designated Person / Vessel Master
Immediate	Report incident to Varanus Island Central Control Room (CCR)	Offshore Platform Designated Person / Vessel Master
30 minutes	Report incidents where spill has reached marine environment to Santos Offshore Duty Manager	On-Scene Commander (Field Superintendent)

When	Actions	Who
60 minutes	If spill has reached marine surface waters gain further situational awareness by undertaking surveillance of the spill from vessel or platform (refer Section 8.1)	Offshore Platform Designated Person / Vessel Master On-Scene Commander (Field Superintendent)
60 minutes	Initiate regulatory notifications as per Notifications Plan (refer Section 6.1)	Offshore Platform Designated Person / Vessel Master On-Scene Commander (Field Superintendent) IMT Safety Team Leader IMT Environment Team Leader
Ongoing	Consider undertaking mechanical dispersion using available vessels – go to **Section 10**. Continue to monitor spill behaviour	Offshore Platform Designated Person / Vessel Master On-Scene Commander (Field Superintendent)
Ongoing	In the instance of a low flow subsea well leak identified from subsea inspection refer to **Section 9.8** for operational monitoring requirements.	Santos Offshore Operations (Gas Assets)

5.2 Level 2/3 offshore petroleum activity spills (platforms, monopods, pipelines and subsea installations)

For Level 2/3 spills from offshore petroleum facilities (petroleum activity spills) the Control Agency is Santos WA (Commonwealth waters), DoT (State waters) or both Santos WA and DoT (spill crossing between Commonwealth and State waters). Santos WA will provide first strike response and then work in coordination with DoT if DoT is required to assume Control Agency responsibilities. First strike activations for a level 2/3 offshore petroleum spill are found below (**Table 5-2**)

Table 5-2: First Strike Activations for Level 2/3 Offshore Petroleum Activity Spills

When	Actions	Who
Site Actions		
Immediate	Manage the safety of personnel on platform or vessel + Activate evacuation plans if required	Offshore Platform Designated Person/ Observer
Immediate	Report incident to On-scene Commander (Field Superintendent) via Central Control Room (CCR) +	Offshore Platform Designated Person
Immediate	Control the source using available onsite (platform and remote) resources. Refer to the Source Control Plan – go to **Section 7**	Offshore Platform Designated Person

When	Actions	Who
30 minutes	Assess the situation and undertake response as per Varanus Hub Incident Response Plan	On-Scene Commander (Field Superintendent)
30 minutes	Notify IMT	Duty Manager Incident Commander
IMT Actions (0-48 hours)		
Within 90 minutes	Gain situational awareness by initiating Operational Monitoring. Refer to the Monitor and Evaluate Plan (**Section 9**).	IMT Operations Team Leader IMT Logistics Team Leader IMT Environment Team Leader
Refer timeframes (Section 6)	Initiate notifications to relevant Control Agency (DoT if spill within or entering State waters), other regulatory agencies and oil spill service providers as per Notifications Plan (**Section 6**)	IMT Incident Commander (or delegate) IMT Safety Team Leader IMT Environment Team Leader
Day 1	Prepare for use of offsite source control resources as applicable. Refer to the Source Control Plan – go to **Section 8**	IMT Operations Team Leader IMT Drilling Team Leader IMT Logistics Team Leader IMT Supply Team Leader
If/when initiated	Prepare for use of Offshore Containment and Recovery- go to **Section 11**	IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Use mechanical dispersion (vessel) as applicable. Refer to Mechanical Dispersion Plan – go to **Section 10**	IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Prepare for use of Shoreline Protection and Deflection – go to **Section 12**	IMT Environment Team Leader IMT Operations Team Leader IMT Logistics Team Leader IMT Supply Team Leader
If/when initiated	Prepare for Oiled Wildlife Response – go to **Section 15**	IMT Environment Team Leader IMT Logistics Team Leader IMT Supply Team Leader
If/when initiated	Prepare for scientific monitoring as per Scientific Monitoring Plans where applicable – go to **Section 17**	IMT Environment Team Leader IMT Logistics Team Leader IMT Supply Team Leader
If/when initiated	Prepare for initiation of Shoreline Clean-up Plan – go to **Section 13**	IMT Operations Team Leader IMT Logistics Team Leader IMT Supply Team Leader
Day 1	Prepare for proactive phase by completing the first Operational NEBA and beginning Incident Action Planning for those activities where Santos WA has command responsibilities as the single Control Agency or Lead IMT (for where Santos WA and DoT are Control Agencies): + Develop IAPs (including Operational NEBA) for subsequent operational periods.	Planning Team Leader Human Resources Team Leader Computing and Tele-Communications Leader Logistics Team Leader IMT Assistant

When	Actions	Who
	+ Arrange personnel roster to extend the IMT coverage + Begin set-up and mobilisation of personnel to forward operations base (FOB) as required + Undertake arrangements for supplying IMT personnel to DoT as applicable	
1 day	Initiate the development of a Safety Management Plan/s for activities under the command of Santos WA. Refer Oil Spill Recovery Safety Management Plan (QE-91-RF-10016)	Safety Team Leader
Ongoing	For spills that originate in State waters (single-jurisdiction) or that cross from Commonwealth to State waters (cross-jurisdiction), DoT will assume the role as a Control Agency and Santos WA will provide the following support as requested: *State water spills* For State water spills, DoT will assume control of all spill response activities with the exception of facility source control activities (well and pipeline source control). Santos WA will provide available response equipment and personnel (operational and IMT support) as outlined within the following plans: + Monitor and Evaluate Plan (refer **Section9**) + Mechanical Dispersion Plan (refer **Section 10**) + Offshore Containment and Recovery (**Section 11**) + Protection and Deflection (refer **Section12**) + Shoreline Clean-up (refer **Section 13**) + Oiled Wildlife Response (refer **Section 15**) + Waste Management Plan (refer **Section 16**) + Scientific Monitoring Plans (**Section 17**) *Commonwealth to State water spills* For spills crossing from Commonwealth to State waters (cross-jurisdiction), both Santos WA and DoT will be Control Agencies. DoT will assume control of primarily State water activities as Lead IMT. For these activities Santos WA will provide available response equipment and personnel (operational and IMT support) as outlined within the following plans: + Protection and Deflection (refer **Section 12**) + Shoreline Clean-up (refer **Section 13**) + Oiled Wildlife Response (refer **Section 15**) + Waste Management Plan (refer **Section 16**) + Scientific Monitoring Plans (**Section 17**)	Santos WA to provide the following roles to DoT MEECC/ IMT: CMT Liaison Officer IMT Liaison Officer Intelligence Support Officer Deputy Planning Officer Environmental Support Officer Public Information Support & Media Liaison Officer Deputy Logistics Officer Facilities Support Officer Deputy Finance Officer Deputy On Scene Commander (FOB)

5.3 Level 2 offshore vessel-based Spills

Level 2 activations are based on spills that cannot be controlled by the use of facility (or on-scene vessel) resources alone or spills that may be able to be controlled using on-site resources, but which will have an adverse effect on the public or the environment.

For Level 2 spills from vessels, AMSA is the Control Agency for Commonwealth water spills and DoT the Control Agency for State waters spills. Santos WA will provide first strike response and then support DoT or AMSA in their role as Control Agencies through provision of resources.

Table 5-3: First Strike Activations for Level 2 Vessel Spills

When	Actions	Who
Immediate	Manage the safety of personnel on the vessel Implement first-strike source control where possible as per vessel SOPEP	Vessel Master
Within 30 minutes	Notify VI On Scene Commander/ Incident Commander	Company Site Rep
As soon as practical	Make initial notifications Activate the Notifications Plan - go to **Section 4.2** Including notifications to relevant Control Agency (DoT or AMSA)	Vessel Master/ Company Site Rep
Immediate	Continue source control as required Activate the suitable Source Control Plan - go to **Section 7** Control the source using available vessel resources. Refer to the Source Control Plan - go to **Section 7**	Vessel Master
As soon as practical	Prepare a POLREP/SITREP (go to Appendices E and F) and provide as much information to the IMT and Control Agency as soon as possible	IMT Incident Commander IMT Safety Team Leader IMT Environment Team Leader
IMT Actions (0-48 hrs)		
Within 90 minutes of notification	Gain situational awareness by initiating Operational Monitoring and initiate mobilisation of tracking buoy/s Activate the Monitor and Evaluate Plan – go to **Section 9**	IMT Operations Team Leader IMT Logistics Team Leader IMT Environment Team Leader
Day 1	Prepare for use of offsite source control resources as applicable. Refer to the Source Control Plan - go to **Section 7**	IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Prepare for use of Offshore Containment and Recovery – go to **Section 11**	IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Use mechanical dispersion (vessel) as applicable. Refer to Mechanical Dispersion Plan – go to **Section 10**	IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Prepare for initiation of Shoreline Protection and Deflection - go to **Section 12**	IMT Environment Team Leader IMT Operations Team Leader IMT Logistics Team Leader
If/when initiated	Prepare for initiation Oiled Wildlife Response as applicable – go to **Section 15**	IMT Environment Team Leader

When	Actions	Who
		IMT Logistics Team Leader IMT Supply Team Leader
If/when initiated	Prepare for initiation of scientific monitoring as per Scientific Monitoring Plans where applicable – go to **Section 17**	IMT Environment Team Leader
If/when initiated	Prepare for initiation Shoreline Clean-up Plan - go to **Section 13.2**	IMT Operations Team Leader IMT Logistics Team Leader IMT Supply Team Leader
Day 1	Initiate the development of a Safety Management Plan/s Refer Oil Spill Recovery Safety Management Plan (QE-91-RF-10016)	IMT Safety Team Leader
Ongoing	Following notification of a Level 2/3 spill, AMSA or DoT, as the legislated Control Agency, will assume control of the spill response and provide direction to those activities already commenced by Santos WA. Santos WA will provide resources as a Support Agency as outlined within the following plans: + Source Control Plan (refer **Section 7**) + Monitor and Evaluate Plan (refer **Section9**) + Mechanical Dispersion Plan (refer **Section 10**) + Offshore Containment and Recovery (**Section 11**) + Protection and Deflection (refer **Section 12**) + Shoreline Clean-up (refer **Section 13**) + Oiled Wildlife Response (refer **Section 15**) + Waste Management Plan (refer **Section 16**) + Scientific Monitoring Plans (**Section 17**)	

5.4 Onshore spills

For response to a hydrocarbon leak from the onshore pipelines, tanks and process equipment at Varanus Island Santos WA is the Control Agency for the response to the incident as well as being responsible for the clean-up, monitoring and remediation of the spill site.

First strike activations are outlined in **Table 5-4**.

Table 5-4: First Strike Activations for Onshore Pipeline Spill

When	Activation	Who
Immediate	Manage the safety of any personnel onsite.	Onsite personnel
Immediate	If personnel onsite, report incident to the On-scene Commander (Field Superintendent) via Central Control Room (CCR).	Onsite personnel
Immediate	Control the source. Refer to the Source Control Plan - go to **Section 7**	On-scene Commander (Field Superintendent)

As soon as practical	Report incident to the Perth based Incident Commander (IMT Leader)	On-scene Commander (Field Superintendent)
As soon as practical	Initiate notifications to regulatory agencies, service providers and stakeholders – go to **Section 6**	IMT Incident Commander IMT Safety Team Leader IMT Environment Team Leader
2 hours	Prepare for initiating Onshore Response as per Onshore Response Plan - go to **Section 14**	On-scene Commander IMT Incident Commander IMT Operations Team Leader IMT Logistics Team Leader
Ongoing	Coordination of monitoring and remediation as required under Contaminated Sites legislation as directed by DWER	Designated Santos WA personnel and subcontractors

6 Notification and Reporting Plan

The Varanus Island Incident Response Plan (QE-00-ZF-00044) identifies the initial incident notifications and actions to be conducted by onsite personnel, including notifying the incident to the Central Control Room (CCR) and On-scene Commander (Field Superintendent).

For oil spill incidents the On-scene Commander will notify the Perth-based IMT for delegation of further notifications to relevant Regulatory Authorities and for further spill response assistance for Level 2/3 spills.

6.1 Regulatory notification and reporting

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

Contact details for the Regulatory agencies outlined in **Table 6-1** and **Table 6-2** are provided within the Incident Response Telephone Directory (QE-00-ZF-00025.020)

Table 6-1 and **Table 6-2** outline 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 6-1 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).

Santos

Table 6-1: 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 the Varanus Island Hub 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	Guidance Note on Environmental Non-compliance and Incident Reporting	A spill incident associated with the Varanus Island Hub Operations in State waters that has the potential to cause an environmental impact that	Notification by IMT Environmental Team Leader (or delegate)	Environmental and Reportable Incident/ Non-compliance Reporting Form

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
	• Follow up written notification within 3 days		is categorised as moderate or more serious than moderate[1]		http://www.dmp.wa.gov.au/Environment/Environment-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					

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
Commonwealth Department of the Environment and Energy (DoEE) (Director of monitoring and audit section)	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
Department of Biodiversity Conservation and Attractions (Pilbara Regional Officer)	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

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
					(including name of marine park likely to be affected) Proposed response arrangements as per the OPEP Details of the relevant contact person in the IMT
Department of Primary Industry and Regional Development (DPIRD) - Fisheries	Verbal phone call notification within 24 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.

Table 6-2: External Notification and Reporting Requirements for Onshore Spills

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
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 the Varanus Island Hub Operations in State waters that has the potential to cause an environmental impact that is categorised as moderate or more serious than moderate[1]	Notification by IMT Environmental Team Leader (or delegate)	Environmental and Reportable Incident/ Non-compliance Reporting Form http://www.dmp.wa.gov.au/Environment/Environment-reports-and-6133.aspx
WA Department of Water and Environmental Regulation	• Verbal phone call within 2 hours of incident being identified • Follow up written notification as soon as reasonably practicable	Section 72 of the Environmental Protection Act 1986	All actual spills likely to cause pollution or environmental harm[1]	Notification by IMT Environmental Team Leader (or delegate)	S 72(1) Waste Discharge Notification Form https://www.der.wa.gov.au/images/documents/your-environment/pollution/Notification_of_waste_discharges.pdf
Department of Biodiversity Conservation and Attractions (State Duty Officer)	Verbal notification within 2 hours	Western Australian Oiled Wildlife Response Plan	Notify if spill has the potential to impact or has impacted wildlife (to activate the Oiled Wildlife Advisor)	Notification by IMT Environmental Team Leader (or delegate)	Not applicable

6.2 Level 2/3 spill response support notifications

Table 6-3 outlines notifications that should be made to supporting agencies to assist with spill response activities outlined within this plan. This list contains key response providers 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 6-3: List of spill response support notifications

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
AMOSC, AMOSC Duty Manager	As soon as possible	Verbal Service Contract	Santos is a Participating Company in AMOSC and can call upon AMOSC personnel and equipment (including oiled wildlife). Under the AMOSPlan, Santos can also call upon mutual aid from other trained industry company personnel and response equipment AMOSC's stockpiles of equipment include dispersant, containment, recovery, cleaning, absorbent, oiled wildlife and communications equipment. Equipment is located in Geelong, Fremantle, Exmouth and Broome	**Step 1.** Obtain approval from Incident Commander to mobilise AMOSC **Step 2.** Notify AMOSC that a spill has occurred. Put on standby as required – activate if spill response escalates in order to mobilise spill response resources consistent with the AMOSPlan **Step 3.** E-mail confirmation and a telephone call to AMOSC will be required for mobilisation of response personnel and equipment, and callout authorities will be required to supply their credentials to AMOSC. A signed service contract must also be completed by a call out authority and returned to AMOSC prior to mobilisation	The IMT EUL (or delegate) will notify AMOSC (upon approval from Incident Commander)
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)

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
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	When Shoreline Clean-up is activated (**Section 13**)	Verbal	Santos has contract arrangements in place with North West Alliance to take overall responsibility to transport and dispose of waste material generated through clean up activities.	Phone call to the Primary Contact Person. In the event the Primary Contact Person is not available, the Secondary Contact Person will be contacted.	IMT Logistics Team Leader (or delegate)
Astron	Scientific Monitoring Plan initiation criteria are met (**Section 17**)	Verbal and written	Astron has been contracted by Santos to provide Standby Services for Scientific Monitoring Plans (SMPs) 1-11. This includes provision of personnel and equipment. Aston annually reviews the SMPs for continual improvement.	**Step 1.** Obtain approval from Incident Commander to activate Astron for Scientific Monitoring **Step 2.** Verbally notify Astron followed by the submission of an Activation Form (Environment Team Leader Folder) via email **Step 3.** Provide additional details as requested by the Astron Monitoring Coordinator on call-back **Step 4.** Astron initiates Scientific Monitoring Activation and Response Process	IMT Environment Team Leader (or delegate)
Intertek Geotech (WA) Environmental	When characterisation of oil is activated	Verbal	Oil analysis including GC/MS fingerprinting Ecotoxicology	**Phone call**	IMT Environment Team

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
Services and Ecotoxicology	(**Section 9.7**)				Leader (or delegate)
Oil Spill Response Limited (OSRL), OSRL Duty Manager	If spill requires additional resources or technical expertise	Verbal OSRL Mobilisation on Authorisation Form	Santos has a Service Level Agreement with OSRL, which includes the provision of support functions, equipment and personnel to meet a wide range of scenarios. 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)
RPS Group	Within 2 hours	Verbal and written	Santos has an agreement in place with RPS Group to allow rapid marine hydrocarbon spill modelling capability to be activated at any time during activities, which will be undertaken for any spill greater than Level 1. AMOSC can also run modelling on behalf of Santos, if required, as part of contracting arrangements with RPS Group	Contact RPS Group Duty Officer	IMT EUL (or delegate)
Wild Well Control (WWC)	Within four hours of a loss of well control incident	Loss of well control 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	Drilling Team Leader

Organisation	Indicative Timeframe	Type of Communication	Resources Available	Activation instructions	Santos person responsible for activating
	having been identified			Step 2. As soon as practical after initial notification and once the scale of the subsea loss of containment is confirmed, an emergency mobilisation authorisation form (saved in ECM) must be filled out, signed off by the authorised Santos Manger sent through to WWC. The form is located on the Santos Intranet Procedures Index under Emergency Procedures (http://ausintranet.enerylimited.com/dept_data/Procedure_data/index.htm). Email as directed by WWC point of contract provided by the emergency hotline attendant.	

7 Incident Action Plan (IAP)

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 7-1**.

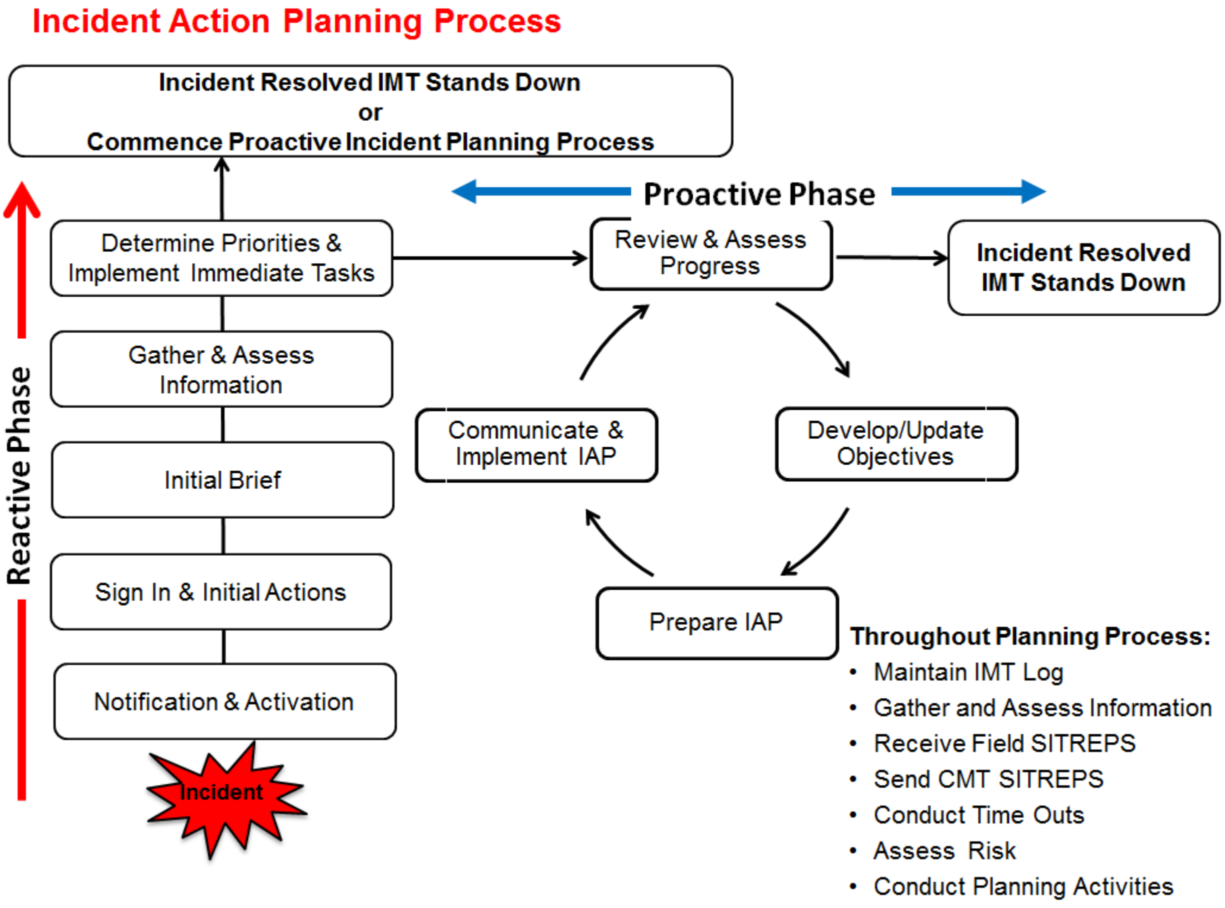

Figure 7-1: Incident Action Plan process

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 5**. 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?

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 copy 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 Source Control

The initial and highest priority response to an oil spill incident, following the safety of personnel, is to prevent or limit further oil loss into the marine environment; however, this will only be attempted if safe to do so. In most circumstances, the net benefit of source control outweighs impacts of further oil being released into the marine environment. Further risks may arise due to increased vessels and the associated increased health and safety risks for the team involved in the response.

8.1 Vessel and Platform Releases (hydrocarbon storage, handling and transfer)

Spills of up to 4 m^3 (marine diesel, lube oils, hydraulic fluids) are considered credible from leaks and spills associated with hydrocarbon storage, handling and transfer on offshore platform and vessels.

Spills of up to 15 m^3 are considered credible for diesel transfers between support vessels and the diesel storage system on VI which is State waters scenario only.

These scenarios do not include vessel fuel/cargo tank rupture, covered in **Section 8.2**.

The environmental performance outcome, initiation and termination criteria and the implementation guide for vessel and platform releases are provided in **Table 8-1** and **Table 8-2** respectively.

Table 8-1: Vessel and Platform Releases – 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 spill.				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	X	X	✔	X
Termination criterion	Release of oil to the marine environment has ceased and the workplace environment is deemed environmentally safe and free of hydrocarbon.				

Table 8-2: Vessel and Platform Releases Implementation Guide

<table>
<tr><th colspan="5">Vessel and Platform Releases (hydrocarbon storage, handling and transfer)</th></tr>
<tr><td colspan="2">Activation time</td><td colspan="3">Immediately upon notification of a vessel or platform release.</td></tr>
<tr><th colspan="2">Action</th><th>Consideration</th><th>Responsibility</th><th>Complete</th></tr>
<tr><td rowspan="3">Initial Actions</td><td>In the event of a loss of production hydrocarbons from platform topside production equipment, consult the Varanus Hub Incident Response Plan (QE-00-ZF-00044)</td><td></td><td>Offshore Platform Designated Person/ Facility On Scene Commander</td><td>❑</td></tr>
<tr><td>For refuelling and chemical transfers between support vessels and between support vessels and VI Hub offshore platforms, consult the Refuelling and Chemical Management Standard (QE-91-IQ-00098)</td><td rowspan="2">In all situations, consider the following:
+ For spills during pumping operations, pumping activity to cease immediately;
+ 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;</td><td>Offshore Platform Designated Person/ Vessel Master/ Facility On Scene Commander</td><td>❑</td></tr>
<tr><td>For refuelling of support vessels at East or West Wharf from VI diesel tanks, consult the Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200)</td><td>Offshore Platform Designated Person/ Vessel Master/ Facility On Scene Commander</td><td>❑</td></tr>
</table>

<table>
<tr><th colspan="4">Vessel and Platform Releases (hydrocarbon storage, handling and transfer)</th></tr>
<tr><td>Activation time</td><td colspan="3">Immediately upon notification of a vessel or platform release.</td></tr>
<tr><th>Action</th><th>Consideration</th><th>Responsibility</th><th>Complete</th></tr>
<tr><td></td><td>+ Disposal of contaminated waste to licensed waste contractor; and
+ Isolation and repair of damaged, leaking equipment.</td><td></td><td></td></tr>
<tr><th colspan="2">Resources</th><th colspan="2">Location</th></tr>
<tr><td>Equipment</td><td>Refer to vessel, platform and activity specific procedures for details of equipment available.</td><td colspan="2">Refer to vessel, platform and activity specific procedures for details of equipment locations.</td></tr>
<tr><td>Personnel</td><td>Refer to vessel, platform and activity specific procedures for details of personnel.</td><td colspan="2">Refer to vessel, platform and activity specific procedures for details of personnel.</td></tr>
<tr><td>Maintenance of response</td><td colspan="3">Spills of this nature are expected to be handled by the resources available at the spill location due to the relatively small credible release volumes and hydrocarbon types. The resources on hand are expected to be sufficient to maintain the response until the termination criteria are reached. If required, Santos has access to additional resources internally and through service providers to maintain this response.</td></tr>
</table>

8.2 Vessel Tank Rupture

Credible vessel tank ruptures during VI Hub operations include marine diesel releases from support vessel collision/grounding and release of HFO or crude oil from offtake tanker collision/grounding.

Diesel tank ruptures are credible within State and Commonwealth waters.

HFO tank ruptures are only credible in State waters.

Through the implementation of these controls, the amount of hydrocarbons released to the marine environment may be reduced. However, there are several influencing factors that would result in delay or failure to implement controls, potentially resulting in a full discharge of a fuel tank compartment; such as a high sea state, a significantly large rupture, or injuries to personnel.

The environmental performance outcome, initiation and termination criteria and the implementation guide for vessel tank ruptures are provided in **Table 8-3** and **Table 8-4** respectively.

Table 8-3: Vessel Tank Rupture - , Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Vessel Tank Rupture					
Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment.				
Initiation criteria	Notification of incident/spill.				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	X	✔	✔	✔
Termination criterion	The cargo in the ruptured fuel or storage tank is secured and release to the marine environment stopped.				

Table 8-4: Vessel Tank Rupture Implementation Guide

Vessel Tank Rupture				
Activation time		Immediately upon notification of a vessel 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*	❑
Resources			**Location**	
Equipment		Refer to vessel specific procedures for details of equipment available.	Refer to vessel specific procedures for details of equipment locations.	
Personnel		Refer to vessel specific procedures for details of personnel.	Refer to vessel specific procedures for details of personnel.	

Vessel Tank Rupture			
Activation time	Immediately upon notification of a vessel tank rupture.		
Action	Consideration	Responsibility	Complete
Maintenance of response	Source control measures on vessels are typically contained in the vessel-specific SOPEP and / or Emergency Response Plan (ERP). The need for additional resources to support vessels undertaking source control measures will be specific for each spill. Santos has a range of potential resources (e.g. support vessels with capacity to store liquids) available through its VI Hub operations.		

8.3 Loss of Well Control

Credible loss of well control events during VI Hub operations include releases of gas/condensate from subsea or platform wells in Commonwealth waters (Halyard-1, Spar-2, John Brookes) or release of gas/condensate or crude oil from platform/monopod wells in State waters (Wonnich, Linda, Simpson-B, Harriet –A/B, Agincourt, Double Island, Victoria, Gibson/Sth Plato).

For all loss of well control events, the installation of a subsea Capping Stack is not considered applicable. The primary means of controlling a well that cannot be brought under control using onsite resources is the drilling of a relief well to intercept the well bore and kill the flow of hydrocarbons. In the process of relief well planning the option of top-killing the well from platform or vessel will also be evaluated.

The environmental performance outcome, initiation and termination criteria and the implementation guide for loss of well control are provided in **Table 8-5** and **Table 8-6** respectively. The implementation guide provides a high level overview of actions contained within the Santos WA Source Control Emergency Response Plan (SCERP) (DR-00-ZF-1001) and this document should be consulted for further detail.

Table 8-5: Loss of Well Control - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Loss of Well Control					
Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment.				
Initiation criteria	Notification of incident/ spill.				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	✔	✔	X	X
Termination criterion	The primary well is contained and killed to prevent any further release of hydrocarbon to the environment.				

Table 8-6: Loss of Well Control Implementation Guide

Loss of Well Control				
Activation time		Immediately upon receiving notification of incident/ spill.		
Action		**Consideration**	**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	❑
	Monitor progress of relief well drilling and communicate to IMT		IMT Drilling Team Leader	❑
Supporting Documentation				
Document Title		**Reference**	**Note**	

Loss of Well Control			
Activation time	Immediately upon receiving notification of incident/ spill.		
Action	**Consideration**	**Responsibility**	**Complete**
Source Control Emergency Response Plan (SCERP)	DR-00-ZF-1001		
Well Operations Management Plans (WOMPs)	Various	Refer Santos WA Intranet	
Santos Drilling & Completions Management Process			
Source Control Plan – as required			
Memorandum of Understanding: Mutual Assistance (To facilitate the transfer of Drilling Units and Well-Site Services between operators in Australian and Timor Leste administered waters to overcome emergency conditions)	N/A	Maintained on Santos WA Emergency Response Website	
Maintenance of response	Santos WA has the resources available from existing operations on the NWS to maintain and operate a MODU for as long as the response is required. Santos WA D&C personnel and well control specialists will be rotated and the MODU will be maintained with support vessels through existing contracts with vessel suppliers. Additional response tactics that may be implemented following a pipeline release (e.g. containment and recovery) are discussed separately.		

8.3.1 Emergency Shutdown (ESD)

The Varanus Hub Incident Response Plan (QE-00-ZF-00044) details the initial actions to be taken by offshore and onshore personnel to activate well ESD systems, where they are not already triggered automatically. All wells are monitored by the VI Control Building (VICB) Central Control Room (CCR) from where ESD can be activated.

8.3.2 Well kill

The risk of a loss of well control event is introduced during well intervention activities due to the requirement to breach and enter the pressure envelope of the well.

Controlling a loss of well control through the drilling of a relief well by a MODU, or through top-kill of platform wells from the platform or vessel, are strategies that will be pursued if the well cannot be brought under control using existing onsite well control systems. Relief well drilling is the primary strategy; top-kill may not be applicable due to technical and safety constraints.

VI Hub wells are managed in accordance with an accepted Well Operations Management Plan (WOMP) (Commonwealth water wells) or an accepted Well Management Plan (WMP) (State waters wells). Source control requirements, including any well kill planning requirements, are specified in these documents.

Planning for relief well drilling is conducted as per Santos Drilling & Completions Management Process. Findings from the planning will inform pumping/well-kill requirements for top-kill (if possible) and the technical design and MODU requirements for drilling a relief well.

Santos

Surface/Top Well Kill:

For clarity, the top-kill scenario is modelled on a small uncontrolled leak to atmosphere at the production tree that cannot be isolated upstream, that may still allow safe access to the platform, and tie-in to the leaking well via existing infrastructure (i.e. connecting to the production tree via the kill wing outlet), and safe operation of a vessel located alongside the John Brookes platform. It does not apply to subsea wells (i.e. Halyard/Spar). It is estimated that this leak rate would be in the range of 400cc/min, small enough not to generate an explosive gas cloud and access to the platform is still preserved. This methodology would not be considered should safe access to the platform or ability to operate a vessel alongside the platform not be achievable.

A high-pressure pumping package would be deployed on a vessel, the vessel is moored alongside the platform, and a flexible high pressure kill line is deployed from the vessel to the platform.

Santos has previously modelled a "top-kill" scenario on analogue wellhead platform wells (Reindeer, Schlumberger Report 1-1BAORA3). The simulation assessed the ability to bullhead the well dead from a shut-in gas to surface scenario, whilst out-running the surface leak and not exceeding the safe working pressure of the surface equipment.

The top-kill model utilised a leak rate of up to 10,000cc/min (which is the lowest leak surface leak rate the modelling software allows) and demonstrated that utilising a minimum kill rate of 350gpm (~10bpm) the gas could be effectively bull-headed without excessive well bore pressures. A large range of reservoir injectivity values were assessed for both seawater and kill-weight mud with a maximum pump pressure of less than 3,000psi. This is well within the capability of high-pressure pumping equipment (e.g. cement units/triplex pumps, high-pressure treating iron pipe-work and flexible high-pressure hoses) readily available within the region.

Santos WA has successfully planned and executed well kill/bull-heading/flushing operations during routing non-leaking well suspension activities on numerous platforms using this technique with local personnel and equipment.

Relief Well Drilling:

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.

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 in Phase 2 (Evaluate) to generate a credible rate for oil spill modelling, as well as providing an input for the dynamic kill modelling, part of the Well Specific Source Control Plan (WDW Act 3.5); 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 (WDW Activity 3.5) to the appropriate level of detail.

The worst case credible loss of well control 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 8-7**.

For noting, loss of well control 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 VI Hub Operations.

Table 8-7: Schedule for MODU arriving onsite

Loss of well control		
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 John Brookes 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)
- NOPSEMA safety case (yes/no)

The campaign specific source control plan (including relief well study) for the John Brookes 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 loss of well control, 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.

Prior to the 2019 John Brookes memory-gauge campaign, which involved well activities entering the pressure envelope of the well (and as such introduced the risk of a loss of well control), a relief well study was conducted for the John Brookes wells.

Blowout modelling was performed for John Brookes-5 (JB-5) using a surface atmospheric blowout (through completion tubing) worst case discharge scenario. JB-5 was used as it has the highest deliverability of all the John Brookes wells.

The process of selecting an acceptable surface location for drilling a relief well involves:

- Reviewing the seasonal prevailing conditions
- Establishing relief well MODU requirements (pinning etc)
- Reviewing the actual debris field generated in the well control incident.

Fluids venting from an uncontrolled John Brookes well will be carried by both wind and local sea conditions, and the relief well locations should not be downwind, or downstream of a blowing well.

The relief well location is proposed to be 700m South of the John Brookes platform (7737190.2m N, 303901.1m E), in 48m of water. This is based on the following:

- Requirement to be upwind of predominantly South-Westerly winds experienced throughout the year
- Current speeds oriented mainly towards Southwest
- Wave action mainly towards Northeast

- Shallow open water location with a generally benign seabed suitable for Jack-up
- Location enables relief well approach from behind to align for ranging and intercept. Also avoids drilling 'backwards'
- No collision risks with other John Brookes wells associated with relief well approach

A site survey is considered unnecessary based on the following:

- A site survey was performed in 2003/04.
- A geotechnical site investigation done in 2003 at the platform, with spud can penetrations at the time ranging from 1.2-3.4m.
- The geophysical and geotechnical survey performed at Davis-1 (~6km ESE) in 2015, and subsequent use of the NTP jack-up MODU at this location.
- A 2km quadrant from the South-West to South-East contains no seabed infrastructure, presenting a clear rig approach face. The spud location is away from the Halyard EHU (Electro-Hydraulic Umbilical) and export pipeline.

A nominal well trajectory has been developed for the relief well, an example of which for JB-5 is shown in **Figure 8-1**. The planned intercept point for the relief well is below the 9 5/8" casing shoe;

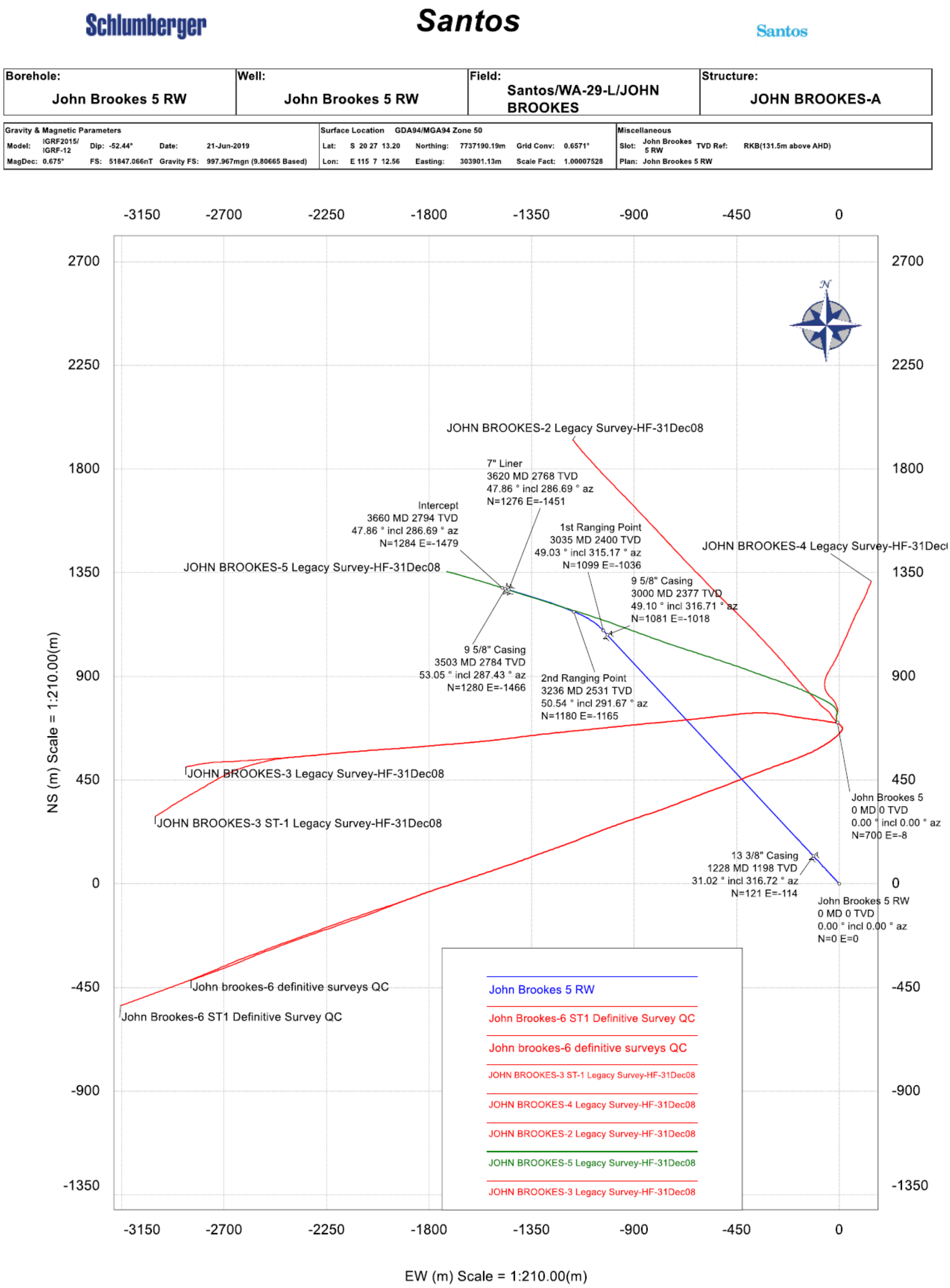

Figure 8-1: John Brookes-5 Nominal Relief Well Plan View

A full dynamic kill model can be found in the Schlumberger SIS report (Report No. 1-1KBOVKT). Key assumptions made in the dynamic kill simulation modelling included:

+ The wellbore is completely loaded with 100% gas. Therefore, there is no water column in the tubing or 9-5/8" casing above the perforations.
+ The well will produce at the gas rate forecasted by the system calculation in another reservoir program and lift all liquids (condensate and water) to surface.
+ Some reservoir pressure depletion will occur as per the history matched material balance model using a Gas-Initially-In-Place (GIIP) volume reflecting a 'Best Estimate' or 2P Reserves position.
+ The well will produce at the forecasted rates for the full 11-week period required to conduct the relief well well kill.

Findings of the well kill model include;

+ The well kill can be achieved by pumping 1.10 SG kill mud at a rate of 15 bpm. The flow rate is best delivered via the drill pipe to avoid high unnecessary pressures in the annulus when pumping through the 7" liner.
+ The pressures in the wells are moderate with no issues for the cased target well and little impact on the relief well casing shoe.
+ No limits are exceeded in the simulated well kill.
+ About 1350bbl of kill mud is required for the well kill including additional 40 minutes of pumping for displacing remaining hydrocarbons from the target well.
+ This is a straightforward well kill achievable with one relief well and standard rig pump configuration. **Table 8-8** outlines the relief well kill summary results.

Table 8-8: Relief Well Kill Summary Results for John Brookes-5

Dynamic Kill Requirements	Executable
Intersection in 7" liner below upper completion 1.02SG seawater @ 15bpm (450bbl req.) 1.10SG Kill Mud @ 15bbl/min w/ 3,080psi (1,350bbl req.)	**Yes** 1.10SG MW 2-3 x Lewco W-2215

The relief well design was proposed to be similar to the original John Brookes wells but with a simplified casing design. At the time of the well services activities in Q3 2019, provision for the availability of relief well casing was checked and verified against the Company's OCTG inventory which included the required 20" conductor, 13-3/8" 68ppf L80, 9-5/8" 53.5ppf L80 and 7" 29ppf casing strings.

At the time Santos has access to the following surface wellhead systems:

+ Two complete wellhead systems are currently held in inventory in Perth. Including:
  - 21-1/4" 2M A-Section,
  - 13-5/8" 5M B-Section,
  - 9-5/8" 5M Casing Hanger,
  - All running tools and accessories were confirmed available for use.

The water depth at the relief well location is ~50m, and as such a jack-up would be required to drill any relief well. The jack-up requirements are;

+ Able to pin in 48m of water.
+ A 5,000 psi BOP
+ A current Australian safety case (preferred) or a recent Australian safety case (possible).
+ Mud pumps – 3 x Lewco W-2215 or equivalent. Minimum pump power requirement 1125 HP

8.4 Pipeline release

Credible pipeline release events during VI Hub operations are:

+ Condensate/gas release from production pipelines
+ Crude oil release from production pipelines

Condensate/gas release from production pipelines is a credible event in both Commonwealth and State waters.

Crude oil release from production pipelines is credible in State waters only.

A release from the sales gas export line between VI and the mainland (State waters only) is considered credible, however such a release would be dry gas (no condensate) and therefore not covered under this OPEP.

The Varanus Hub Incident Response Plan (QE-00-ZF-00044) details the initial actions to be taken by offshore and onshore personnel to activate riser/ pipeline ESD systems, where they are not already triggered automatically. All pipelines are isolatable by way of ESD activated from the VI Control Building (VICB) Central Control Room (CCR).

The environmental performance outcome, initiation and termination criteria and the implementation guide for pipeline releases are provided in **Table 8-9** and **Table 8-10** respectively.

Table 8-9: Pipeline Release - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Pipeline Releases					
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	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	✔	✔	X	X
Termination criterion	The hydrocarbon release to the environment has stopped.				

Table 8-10: Pipeline Release Implementation Guide

Pipeline Release				
Activation time		Immediately upon receiving notification of incident/ spill.		
Action		**Consideration**	**Responsibility**	**Complete**
Initial Actions	Consult Varanus Hub Incident Response Plan (QE-00-ZF-00044) to activate riser / pipeline		On-Scene Commander	❑

Pipeline Release				
Activation time		Immediately upon receiving notification of incident/ spill.		
Action		Consideration	Responsibility	Complete
	emergency shut down (ESD).			
	Where and when safe to do so, an inspection class ROV and support vessel, will be mobilised to visually identify any subsea incident location		*Incident Commander/ Operations Team Leader*	❑
Resources			Location	
Equipment		Inspection class ROV.	On vessels of opportunity Contracted at the time of incident.	
		Vessels	Santos WA operational sites Vessels of opportunity	
Personnel		Santos WA Facility Incident Response Team members	Santos WA Operational sites	
Maintenance of response		The resources to activate the pipeline ESDs are always present within the VI Hub control room. Additional response tactics that may be implemented following a pipeline release (e.g. containment and recovery) are discussed separately.		

8.5 Crude oil cargo loading

A spill of crude oil from the rigid 30” export pipeline (Tanker Loading Line) or the connected 12” hose (Tanker Loading Hose) is considered credible during offtake tanker cargo loading.

<u>A release could occur onshore or offshore within State waters only.</u>

The environmental performance outcome, initiation and termination criteria and the implementation guide for crude oil cargo releases are provided in **Table 8-11** and **Table 8-12** respectively.

Table 8-11: Crude Oil Cargo Loading Spill - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Crude Oil Cargo Loading	
Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment.
Initiation criteria	Notification of a spill.

Crude Oil Cargo Loading					
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	X	✔	X	X
Termination criterion	The oil cargo in the ruptured subsea export pipeline is secured and release to the marine environment stopped.				

Table 8-12: Crude Oil Cargo Loading Implementation Guide

Crude Oil Cargo Loading					
Activation time		Immediately upon receiving notification of incident/ spill.			
Action		**Consideration**	**Responsibility**	**Complete**	
Initial Actions	Isolate tanker loading line - consult Varanus Hub Incident Response Plan (QE-00-ZF-00044)		*On-scene Commander*	❑	
	Use suck back pump at shore crossing to pump remaining crude oil in the Tanker Loading Line into the adjacent Harriet Alpha pipeline, until the Tanker Loading Line is flushed with seawater and free of hydrocarbon – consult Start up and Shutdown of Suck Back Pump (VI-91-IP-10197)		*On-scene Commander*	❑	
Resources			**Location**		
Equipment		Suck Back Pump	*Varanus Island*		
Personnel		*VI IRT*	*Varanus Island*		
Documentation		Shutdown of Suck Back Pump (VI-91-IP-10197) Varanus Hub Incident Response Plan (QE-00-ZF-00044)	*Document Management System*		
Maintenance of response		This response can be maintained by normal staffing levels and equipment available at the VI Hub. Additional response tactics that may be implemented following a pipeline release (e.g. containment and recovery) are discussed separately.			

8.5.1 Initial Response

Procedures for offtake tanker loading, including supervision and communications requirements, to prevent and detect spills during cargo loading, are included in the Berthing Handbook Tanker Loading Facilities Port of Varanus Island (LT-10-ZG-00001) and Procedure for VI Tanker Loading, Crude Sampling and Quality and Quantity Determination (QE-91-IG-00007).

The Tanker Loading Line and cargo loading pumps are controlled and operated from the VI Control Building (VICB) Central Control Room (CCR). The Tanker Loading Line can be isolated from process equipment by manual ESD in the event that a leak rupture is detected by or communicated to the CCR. The activation of ESD and other initial actions to a major oil spill event at VI are covered in the Varanus Hub Incident Response Plan (QE-00-ZF-00044).

Following shutdown of loading pumps and isolation of the Loading Line, a suck back pump position at the shore crossing can be used to pump remaining crude oil in the Tanker Loading Line into the adjacent Harriet Alpha pipeline, until the Tanker Loading Line is flushed with seawater and free of hydrocarbon. The procedure for operating the suck back pump is outlined within: Start up and Shutdown of Suck Back Pump (VI-91-IP-10197).

8.5.2 Identification and Repair

Where and when safe to do so, Tanker Loading Line inspection and repair will involve the mobilisation a repair team including the use of divers. Loading Hose damage can be rectified by repair offsite or new hose replacement.

Santos WA maintains limited certified spare pipe and pipeline end connectors for sectional replacement of the Tanker Loading Line for localised damage.

8.6 Onshore Hydrocarbon spills

Onshore hydrocarbon spills on VI include the following:

+ minor spills associated with storage and handling of hydrocarbons (lube oils, hydraulic fluids, marine diesel, petrol, aviation fuel, waste oil);
+ spills associated with bunkering marine diesel via the Diesel Distribution System;
+ spills from process equipment;
+ spills from the bulk crude oil storage tanks;
+ spills from the onshore section of the 30” export pipeline (Tanker Loading Line); and
+ spills from the onshore sections of live production pipelines.

Onshore spills from production pipelines and the Tanker Loading Line are covered in **Sections 8.4** and **8.5**, respectively.

All areas and process skids that may contain hydrocarbon or chemicals within Varanus Island processing plants drain into local constructed metal or concrete sumps within bunded areas or to humeceptors. Runoff from the shipping pump areas outside of the bunded areas, drains into a triple trap and then into a humeceptor.

The bulk crude oil storage tanks are located within an earthen bund lined with a HDPE liner. Rain and wash down water from external hardstand areas of the maintenance workshop and wash-down pad, chemical and fuel storage areas, water maker areas, and roof of the bulk crude oil storage tanks drain to the crude oil storage tank bund. Water from this bund is pumped to the Corrugated Plate Interceptor (CPI) for removal of hydrocarbons and then disposal to deep injection bores on the island.

Bunded areas are designed to contain the contents of hydrocarbons from worst case spills and prevent spread of hydrocarbons off-lease or to the groundwater. Further details on secondary containment around hydrocarbon storage and processing equipment on VI is provided within the Varanus Island Hub Operations Environment Plan (EA-60-RI-186).

The environmental performance outcome, initiation and termination criteria and the implementation guide for onshore hydrocarbon spills are provided in **Table 8-13** and **Table 8-14** respectively.

Table 8-13: Onshore Hydrocarbon Spills - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

<table>
<tr><th colspan="6">Onshore Hydrocarbon Spills</th></tr>
<tr><td>Environmental Performance Outcome</td><td colspan="5">Implementation of source control methods to stop the release of hydrocarbons into the marine environment.</td></tr>
<tr><td>Initiation criteria</td><td colspan="5">Notification of an onshore spill</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>Lube oil/ hydraulic fluids</td><td>Condensate</td><td>Crude oil</td><td>Marine Diesel</td><td>HFO</td></tr>
<tr><td>✔</td><td>✔</td><td>✔</td><td>✔</td><td>✔</td></tr>
<tr><td>Termination criterion</td><td colspan="5">The cargo in the leaking or ruptured pipeline/tank/vessel is secured and release to the onshore (terrestrial) environment is stopped.</td></tr>
</table>

Table 8-14: Onshore Hydrocarbon Spills Implementation Guide

Onshore Hydrocarbon Spill					
Activation time		Immediately upon receiving notification of incident/ spill.			
Action		**Consideration**	**Responsibility**	**Complete**	
Initial Actions	For manual handling of hydrocarbons on VI, minimum standards for equipment and processes to prevent and control a spill are provided in Refuelling and Chemical Transfer Management Standard (QE-91-IQ-00098).		*On-scene Commander*	❑	
	For marine diesel transfer operations the Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200) outlines requirements to limit the flow of hydrocarbons in the event of a spill.		*On-scene Commander*	❑	
	Minor spills are to be contained using onsite resources including spill kits containing sorbent materials and the use of secondary containment (equipment bunding, drip trays etc).		*On-scene Commander*	❑	
	Varanus Hub Incident Response Plan (QE-00-ZF-00044) details the initial actions to be taken by onshore personnel to respond to major oil spill incidents including release from VI process equipment and storage, including the activation of ESD systems.		*On-scene Commander*	❑	
Resources			**Location**		
Equipment		spill kits containing sorbent materials and the use of secondary	At Facility		

Onshore Hydrocarbon Spill			
Activation time	Immediately upon receiving notification of incident/ spill.		
Action	**Consideration**	**Responsibility**	**Complete**
	containment (equipment bunding, drip trays etc).		
Personnel	Incident Response Team	VI Hub	
Document	Refuelling and Chemical Transfer Management Standard (QE-91-IQ-00098). Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200) Varanus Hub Incident Response Plan (QE-00-ZF-00044)	Document Management System	
Maintenance of response	This response can be maintained by normal staffing levels and equipment available at the VI Hub. Additional response tactics that may be implemented following a pipeline release (e.g. containment and recovery) are discussed separately.		

8.6.1 Identification and Repair

Identification of leaks onshore is from automated systems, monitored through the VICB CCR (applicable to spills from process and storage equipment) or through visual observations. Following detection of leaks and implementation of source control, repairs to equipment will be conducted once safe to do so, taking into consideration any requirements to leave equipment intact for incident investigation purposes.

8.7 Source Control Environmental Performance

Table 8-15 indicates the Environmental performance outcomes, controls and performance standards for the Source Control response strategy.

Table 8-15: Source Control Performance Standards and Measurement Criteria

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**
Source control – loss of well control	**Response Preparedness**		
	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	(Well specific) Source Control Plan
	MODU Capability Register	Monthly monitoring of the availability of MODUs to meet specifications for source control	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
	Industry Mutual Aid to facilitate and expedite the mobilisation of a relief well	APPEA MoU for mutual assistance for relief well drilling	Signatory of APPEA MoU
	Response Implementation		
	Drilling and Completions Source Control Team	Drilling and Completions Source Control Team mobilised within 24 hours of loss of well control	Incident Log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within 5 days of loss of well control	Incident Log
	Well Control Specialists	Well control specialists mobilised within 72 hours of loss of well control	Incident Log
	Relief Well MODU	A Safety Case Revision for the relief well rig to be submitted within 14 days from the loss of well control	Incident Log Submission of Safety Case Revision
	Relief Well MODU	MODU for relief well drilling to be onsite by Day 34 from the start of a well release.	Incident Log
	Relief Well Drilling	First well kill attempt within 77 days of loss of well control	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**
	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 loss of well control	Incident Log
Source control vessel collision	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
	As per the vessel SOPEP	Actions to control vessel tank rupture followed in accordance with SOPEP.	Vessel logs
		SOPEP source control measures will be undertaken to contain and clean up oil spills on vessels.	Incident log Vessel logs
		Clean-up waste will be stored in bunded or sealed area for onshore disposal.	Incident log Vessel logs
		In the event of a hydrocarbon release from a fuel tank rupture, vessel master is to follow procedures outlined with the vessel's SOPEP.	Incident log Vessel logs
		Response terminated when end-point criteria is met.	Incident log
Source Control – Onshore release	On-shore Infrastructure Leak Procedures.	The Varanus Island Incident Response Plan (QE-00-ZF-00044) will be initiated when the integrity of a pipeline/valve or a storage tank/vessel is compromised.	Incident log

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9 Monitor and Evaluate Plan (Operational Monitoring)

Operational monitoring is key to gaining situational awareness of an oil spill and in helping to identify, assess and adapt spill response strategies such that environmental impacts are reduced to ALARP. Operational monitoring provides information that can be used to answer the following questions:

+ How much hydrocarbon has been spilt?
+ Is the source under control?
+ Where is the hydrocarbon going?
+ What are the chemical and physical properties of the hydrocarbon?
+ What is the observed and expected behaviour of the hydrocarbon that has been spilt?
+ Is there anything in the path of the predicted hydrocarbon travel zones?
+ Can the hydrocarbon be approached or are there safety concerns?
+ Will shoreline contact occur and protection/clean-up be required?
+ Will wildlife be affected and require response?
+ Are the current response strategies effectively meeting the response objectives?

The sections below outline the operational monitoring strategies considered applicable to worst case spill events identified for VI Hub operational activities.

9.1 Vessel Surveillance

Direct observations from the platform or vessels can be used to assess the location and visible extent of an oil spill, aid with the verification of spill trajectory modelling and inform the application and effectiveness of response strategies. 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 (e.g. gas/condensate).

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for vessel surveillance are provided in **Table 9-1** and **Table 9-2** respectively. Environmental performance is described in **Table 9-22.**

Table 9-1: Vessel Surveillance – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Vessel Surveillance				
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 for a Level 1 spill if deemed beneficial by the On-scene Commander			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Vessel-based surveillance is undertaken at scheduled intervals during daylight hours, and continues for 24 hours after the source is under control			

Vessel Surveillance	
	and a surface sheen is no longer observable, or no net environmental benefit being achieved. Vessel surveillance will terminate if there are unacceptable safety risks associated with gas and VOCs at the sea surface.

Table 9-2: Vessel Surveillance Implementation Guide

Vessel Surveillance				
Activation time		Within 90 minutes for available onsite vessels		
Action		**Consideration**	**Responsibility**	**Complete**
Initial Actions	Request Vessel Master of nearest available Support Vessel to commence surveillance- direct to spill location	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 TL	❑
	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 F: Aerial Surveillance Surface Slick Monitoring Template**.	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	❑
Resources			**Location**	
Equipment		Santos WA Contracted Support Vessel Vessels of Opportunity	Santos WA Operational Areas Dampier port	
Personnel		Support Vessel Crew	With vessel	

Systems	AIS vessel tracking software	Santos WA ER intranet
Documentation	Bonn Code of Oil Appearance	Santos WA Procedures Index
Maintenance of response	This response will be maintained through Santos WA's existing contractual arrangements with vessel suppliers, which will ensure that sufficient surveillance can be maintained. Regular rotations of vessel crews and refuelling runs will be timed with other surveillance vessels to maintain the response.	

9.2 Aerial Surveillance

Aerial surveillance is used to record the presence and characteristics of oil at surface and 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.

Santos WA maintains a trained pool of Aerial Observers comprising both field staff and office staff. Aerial Observers based in Perth can be mobilised to the airbase the day following activation. In the absence of Aerial Observers, untrained observers (e.g. pilots) can perform initial surveillance of the spill to gain situational awareness.

Helicopter support can be provided by Santos WA on-contract helicopters based at Karratha. Flying time to offshore facility locations is up to 45 minutes.

Time onsite for the purpose of observations will depend on the location of the spill, the airbase of departure, the endurance of the aircraft and the number of personnel onboard.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for aerial surveillance are provided in **Table 9-3**, **Table 9-4** and **Table 9-22** respectively.

Table 9-3: Aerial Surveillance – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Aerial Surveillance				
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 for a Level 1 spill if deemed beneficial by the On-scene Commander			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	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 no net environmental benefit being achieved.			

Table 9-4: Aerial Surveillance Implementation Guide

Aerial Surveillance				
Activation time		Within 3 hours from notification		
Action		**Consideration**	**Responsibility**	
Initial Actions	Contact contracted helicopter provider – provide details of incident location and request aerial surveillance	Untrained oil observers (e.g. pilots) can perform initial surveillance of the spill to gain situational awareness. - recording extent and appearance of oil (including using photos where possible)	Operations TL Logistics TL	❑
	Identify available Santos WA Aerial Observers and deploy them to flight departure location	Santos WA maintains a record of current trained Aerial Observers comprising both field staff and office staff. Aerial Observers based in Perth can be mobilised to the airbase the day following activation. Field based observers may be available same day as notification.	Santos WA Emergency & Oil Spill Coordinator Logistics TL	❑
	Develop flight plan (frequency and flight path) to meet IMT expectations. Expected that 2 overpasses per day of the spill area completed.	Flight plan to confirm with On-Scene Commander that aircraft are permitted in the vicinity of the spill. Flights are only to occur during daylight and in weather conditions that do not pose significant safety risks.	Operations Team Leader / Aviation Superintendent	❑
	Determine the spill extent by completing Aerial Surveillance Log (**Appendix E: Aerial Surveillance Observer Log**) and Aerial Surveillance Surface Slick Monitoring Template. Calculate volume of oil (**Appendix F: Aerial Surveillance Surface Slick Monitoring Template**). Take still and/or video images of the		Aerial Observer	❑

Aerial Surveillance				
Activation time		Within 3 hours from notification		
Action		**Consideration**	**Responsibility**	
	slick. Thickness estimates are to be based on the Bonn Agreement Code (Santos WA Procedure Index)			
	Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (**Appendix G: Aerial Surveillance Marine Fauna Sighting Record**)		Aerial Observer	❑
	Record shoreline habitat type and degree of oiling by completing the Shoreline Aerial Reconnaissance Log (**Appendix H: Aerial Surveillance Shoreline Observation Log**)	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 (Operations/Planning TLs) following completion of survey (nominally 2 reports per day)	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	❑
Resources			**Location**	
Equipment		Helicopters through Santos WA contracted aircraft suppliers.	Karratha	
		Aerial Observer Kits (GPS, camera, forms)	Perth, Varanus Island	
Personnel		Santos WA Trained Aerial Observers, Industry Aerial Observers through AMOSPlan Mutual Aid	Perth, NWS various	
Document		Bonn Agreement Code	Santos WA Procedure Index	

Aerial Surveillance		
Activation time	Within 3 hours from notification	
Action	**Consideration**	**Responsibility**
Maintenance of response	Aerial surveillance will be maintained through continual procurement of additional aircraft as required from Perth, the Pilbara regions and interstate. Trained Aerial Observers will be rotated on a roster throughout the response.	

9.3 Tracking Buoys

Santos WA maintains a minimum of 12 spill tracking buoys across their North West Shelf operations available for deployment in the event of a spill. These are located on Santos WA facilities, contracted drilling rigs and support vessels. Each buoy acquires GPS data at 20 second intervals and transmits once every 30 minutes.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for tracking buoys are provided in **Table 9-5**, **Table 9-6** and **Table 9-22** respectively.

Table 9-5: Tracking Buoys – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Tracking Buoys				
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	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✓	✓	✓	✓
Termination criterion	Tracking buoy deployment will continue for 24 hours after the source is under control and a surface sheen is no longer observable or NEBA is no longer being achieved.			

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Table 9-6: Tracking Buoys Implementation Guide

Tracking Buoys					
Activation time		Mobilisation within 2 hours upon request from IMT or On-Scene Commander (deployment time subject to vessel locations and weather conditions)			
Action		**Consideration**	**Responsibility**	**Complete**	
Initial Actions	Organise vessel to mobilise tracking buoys from Varanus Island or Santos WA Dampier logistics yard to the spill site.	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 Supervisor/ Operations Team Leader	❑	
	Deploy tracking buoy at leading edge of plume:	Note deployment details and weather conditions in incident log	Vessel Master	❑	
	Monitor movement of tracking buoys	Refer login details of tracking buoy monitoring website on Santos WA ER intranet site	On-Scene Commander and/or IMT Planning Team Leader/GIS	❑	
	Use tracking buoy data to integrate into Common Operating Picture		IMT Planning Team Leader/GIS	❑	
	Relay information to spill fate modelling supplier for calibration of trajectory modelling		Environmental Team Leader	❑	
Escalation and Ongoing Response Actions	Mobilise additional tracking buoys if required from other Santos WA operations (Santos WA presently has 12 Tracker Buoys located on the NWS). Develop plan for rolling recovery and deployment of buoys if there is a continuous release.		Logistics Team Leader Operations Team Leader	❑	
Resources			**Location**		
Equipment		Santos WA Contracted Support Vessel Vessels of Opportunity	Santos WA Operational Areas Dampier Port		

Tracking Buoys			
Activation time	Mobilisation within 2 hours upon request from IMT or On-Scene Commander (deployment time subject to vessel locations and weather conditions)		
Action	**Consideration**	**Responsibility**	**Complete**
	Tracking buoys (12 in total)	Various	
	Additional tracking buoys	AMOSC/ AMSA/ OSRL	
Personnel	Vessel crew	With vessel	
Systems	AIS vessel tracking software	Santos WA ER intranet	
	Tracking buoy tracking software	Santos WA ER intranet	
Maintenance of response	Additional tracking buoys will be procured as required during the response through existing contracts with service providers. The need for additional monitoring buoys will be determined by the Santos WA Emergency & Oil Spill Coordinator based on available information.		

9.4 Spill Fate Modelling

A spill modelling service provider will be used to provide forecast spill fate modelling to assess the direction, speed, and potential impacts of the spill. At the time of OPEP preparation, Santos WA has engaged RPS APASA to provide forecast spill fate modelling. RPS APASA use SIMAP and OILMAP modelling systems that comply with *ASTM Standard F2067 "Standard Practice for Development and Use of Oil Spill Models"*. APASA 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.

The spill fate modelling service is to be initiated by the submission of the RPS APASA trajectory modelling request form by the IMT. RPS APASA 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. Operational surveillance data (aerial, vessel, tracker buoys) is to be provided to RPS APASA to verify and adjust fate predictions of the spill and improve predictive accuracy.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for spill fate modelling are provided in **Table 9-7**,

Table 9-8 and **Table 9-22** respectively.

Table 9-7: Spill Fate Modelling – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Spill Fate Modelling				
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	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✓	✓	✓	✓
Termination criterion	Spill fate modelling will continue for 24 hours after the source is under control and surface sheens or in-situ hydrocarbons are no longer detectable, or until no longer beneficial to predict spill trajectory and concentrations.			

Table 9-8: Spill Fate Modelling Implementation Guide

Spill Fate Modelling				
Activation time		Oil Spill Modelling provider will be contacted immediately (within 2 hours) upon notification of a Level 2 or 3 spill. Spill modelling to be initiated within 24 hours. As per contractual agreements with the modelling service provider RPS APASA, upon activation and when requested by Santos WA, will provide trajectory models with the following minimum delay (or otherwise agreed with Santos WA on a case-by-case basis); Within 2 hours for OILMAP model for offshore and open ocean Within 4 hours for OILMAP operation for near-shore		
Action		Consideration	Responsibility	Complete
Initial Actions	Initiate spill modelling by submission of a trajectory modelling request form (Santos WA Procedure Index) to RPS APASA. Request for 3 day forecast trajectory modelling	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	Environmental Team Leader	❑
	Determine requirement for gas/VOC modelling and request initiation from RPS APASA	Gas/condensate 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	❑
	Any operational surveillance data (aerial, vessel, tracker buoys) to be provided to RPS APASA to verify and adjust fate predictions of the spill and improve predictive accuracy		Environment Team Leader Planning Team Leader	❑
	Login to the RPS APASA data sharing website and maintain connection. Download modelling results and report to GIS		Planning Team Leader GIS Support	❑

Spill Fate Modelling			
Activation time	Oil Spill Modelling provider will be contacted immediately (within 2 hours) upon notification of a Level 2 or 3 spill. Spill modelling to be initiated within 24 hours. As per contractual agreements with the modelling service provider RPS APASA, upon activation and when requested by Santos WA, will provide trajectory models with the following minimum delay (or otherwise agreed with Santos WA on a case-by-case basis); Within 2 hours for OILMAP model for offshore and open ocean Within 4 hours for OILMAP operation for near-shore		
Action	**Consideration**	**Responsibility**	**Complete**
Support (refer Santos WA Procedure Index)			
Place RPS APASA modelling data onto the Santos WA Mapping System (Common Operating Procedure)		GIS Support	❑
Update IMT on spill trajectory.	Spill trajectory modelling is key data that will identify environmental sensitivities at risk, guide response strategies and objectives and help determine relevant jurisdictional spill response arrangements.	Planning TL	❑
Resources		**Location**	
Equipment	Modelling provided by service provider (e.g. RPS APASA).	Perth	
Personnel	Modellers	RPS APASA	
Documentation	Trajectory Modelling Request Form and Login Instructions	Santos WA Procedures Index	
Maintenance of response	This response will be maintained through contracts with suppliers to maintain spill trajectory modelling services to Santos WA. Modelling service providers have a 24 hr, 7 day capability.		

9.5 Satellite Imagery

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 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.

Requests for satellite imagery through OSRL can be made through the OSRL notification and mobilisation form (http://www.oilspillresponse.com/activate-us/activation-procedure/) and actioned by the OSRL Duty Manager.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for spill fate modelling are provided in **Table 9-9**, **Table 9-10** and **Table 9-22** respectively.

Table 9-9: Satellite Imagery – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Satellite Imagery				
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	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Satellite monitoring will continue until no further benefit is achieved from continuing; or as advised by relevant Control Agency.			

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Table 9-10: Satellite Imagery Implementation Guide

Satellite Imagery					
Activation time		3-4 hours			
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		Incident Commander 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	❑	
Resources			**Location**		
Equipment		Satellite access provided by service providers (AMOSC and OSRL)	Provided by AMOSC and OSRL		
Personnel		Provided by service providers (AMOSC and OSRL)	Provided by AMOSC and OSRL		
Maintenance of response		This response will be maintained through contracts with suppliers to maintain satellite imagery services to Santos WA.			

9.6 Initial Oil Characterisation

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for initial oil characterisation are provided in **Table 9-11, Table 9-12** and **Table 9-22** respectively.

Table 9-11: Initial Oil Characterisation – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Initial Oil Characterisation				
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 for a Level 1 spill if deemed beneficial by the On-scene Commander			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Oil sample and analysis to occur to terminate once enough data has been collected to profile the oil behaviour throughout weathering and to provide oil for toxicity testing. As directed by the relevant Control Agency. NB: Vessel surveillance will terminate if there are unacceptable safety risks associated with volatile hydrocarbons at the sea surface.			

Table 9-12: Initial Oil Characterisation Implementation Guide

Initial Oil Characterisation				
Activation time		Source and spilled oil samples collected with 24 hrs of activation of initial oil characterisation response tactic		
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	❑
Initial Actions	Confirm suitable equipment onboard for sampling. Confirm sampling methodology Confirm laboratory for sample analysis Develop H&S requirements/ controls	Oil sampling kits incl sample bottles for laboratory analyses are currently being procured with the intent to store at Varanus Island and logistics yards at Exmouth and Dampier. available. Appendix A and D of CSIRO Oil Spill Monitoring Handbook	Environment TL Safety TL	❑

Initial Oil Characterisation				
Activation time		Source and spilled oil samples collected with 24 hrs of activation of initial oil characterisation response tactic		
	Action	**Consideration**	**Responsibility**	**Complete**
		provide suitable procedure PPE and gas/VOC monitoring to be considered in context of release scenario (gas/condensate has highest rick)		
	Vessel directed to sampling location	Sampling of oil at thickest part of slick – typically leading edge	Operations Team Leader Environment TL	❑
	Vessel crew to undertake sampling and delivery of samples to VI or Dampier for dispatch to laboratory. Environmental TL to confirm analysis of oil with lab	Varanus Island Hub and/or Dampier Supply Base personnel to assist with logistics of sending oil samples to laboratory for analysis.	Operations Team Leader Environmental TL Logistics TL	❑
	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	❑
Resources			**Location**	
Equipment		Hydrocarbon sampling equipment	Opportunistically with vessel or source locally (in first instance). Oil sampling kits incl sample bottles for laboratory analyses are currently being procured with the intent to store at Varanus Island and logistics yards at Exmouth and Dampier Also provided through Monitoring	

Initial Oil Characterisation			
Activation time	Source and spilled oil samples collected with 24 hrs of activation of initial oil characterisation response tactic		
Action	**Consideration**	**Responsibility**	**Complete**
		Service Provider (once activated)	
	Nominated laboratories (Intertek Geotech / ESA or suitable alternatives).	Australia	
	Vessels of opportunity and contracted vessels	Within area of operations	
Personnel	Vessel crew Monitoring Service Provider	With vessel Perth, WA	
Documentation	Appendix A and D of CSIRO Oil Spill Monitoring Handbook	Santos WA Procedure Index	
Maintenance of response	Given the frequency and nature of hydrocarbon fingerprinting analysis, any of the analytical laboratories in area capable of sustaining hydrocarbon fingerprinting throughout a response.		

Given marine diesel and HFO are common fuel types with known general properties and condensates and crude oils processed at VI Hub have 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, as well as providing information on the effect of natural weathering at sea on these properties over time.

Using onsite vessels of opportunity, oil samples (3 x samples per location up to 2L per sample) are to be taken daily where possible from fresh oil, and from the weathered oil locations and dispatched to Laboratory for analysis. Where possible, larger volumes of oil (6-10L) required for ecotoxicity testing can be recovered. Appendix A and D of CSIRO Oil Spill Monitoring Handbook provide suitable procedure. 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 following the initial assessment as part of operational water quality monitoring studies (refer **Section 9.7.1**). Forensic fingerprinting of the released hydrocarbon potentially allows contamination to be traced back to the source where this is otherwise unclear on in dispute.

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

Sampling and analysis will allow for forensic fingerprinting of the released hydrocarbon, potentially allowing contamination to be traced back to the source where this is otherwise unclear on in dispute.

Sampling of the released hydrocarbon will also 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 Australian and New Zealand Water and Sediment Quality Guidelines (ANZECC/ARMCANZ 2000 Guidelines). A minimum of 5 species across 4 taxonomic groups are to be used as the basis of toxicity tests. 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 ANZECC/ARMCANZ 2000 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.

9.7 Operational Water Quality Monitoring

9.7.1 Operational Water Sampling and Analysis

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. This monitoring is particularly applicable to subsea releases where an understanding on the distribution of oil entrained and dissolved underwater is required.

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 17**).

Key aspects of this monitoring program is provided below. The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for operational water sampling and analysis are provided in **Table 9-13**, **Table 9-14** and **Table 9-22,** respectively.

Table 9-13: Operational Water Sampling and Analysis – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Operational Water Sampling and Analysis				
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 for a Level 1 spill if deemed beneficial by the On-scene Commander			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Operational water sampling and analysis will continue for 24 hours following control of the source provided oil is no longer detectable. Vessel surveillance will terminate if there are unacceptable safety risks associated with volatile hydrocarbons at the sea surface.			

Table 9-14: Operational Water Quality Sampling and Analysis Implementation Guide

Operational Water Quality Sampling and Analysis				
Activation time		Activation is to follow that for mobilising water quality sampling personnel and equipment for the Water Quality Scientific Monitoring Plan (SMP1).		
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 – Monitoring	Sites to be selected using oil spill trajectory modelling and distribution of oil from surveillance tactics. Refer **Table 9-15** for considerations for Sampling and Analysis Plan	Monitoring Service Provider Environment Team Leader	❑

Operational Water Quality Sampling and Analysis				
Activation time		Activation is to follow that for mobilising water quality sampling personnel and equipment for the Water Quality Scientific Monitoring Plan (SMP1).		
	Action	Consideration	Responsibility	Complete
	Service Provider to take over this sampling once mobilised.			
	Develop health and safety plan including potential exposure to volatile gases/VOCs when sampling condensate/ marine diesel spills	Refer Oil Spill Response Safety Management Manual (QE-91-RF-10016)	Monitoring Service Provider Safety Team Leader	❑
	Source vessels for monitoring meeting Monitoring Service provider requirements	Monitoring Service provider to outline requirements in resource request form	Logistics Team Leader	❑
	Monitoring Service Provider to assemble team/s and water quality monitoring equipment			❑
	Organise Vessels, accommodation and transport requirements to mobilise monitoring team/s to site		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	❑
	Monitoring results to be conveyed to IMT through common operating picture and provided to		Planning Team Leader GIS Support	❑

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Operational Water Quality Sampling and Analysis				
Activation time	Activation is to follow that for mobilising water quality sampling personnel and equipment for the Water Quality Scientific Monitoring Plan (SMP1).			
Action		**Consideration**	**Responsibility**	**Complete**
	spill trajectory modeller to validate predictions.		Environment Team Leader	
Resources			**Location**	
Equipment		Water sampling equipment to be provide through Monitoring Service Provider (MSP)	Perth, WA	
		Vessels of Opportunity, Santos WA contracted vessels	In the area of Operations	
Personnel		Monitoring Service Providers (MSPs), vessel crew	Perth, WA, in the area of operations,	
Maintenance of response	Response to be maintained through rotation of monitoring teams/vessel crew as required with monitoring action plan reviewed and assessed each operational period as part of IAP revision.			

Table 9-15: 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. The sampling will occur within the predicted or observed position of the spill on surface or the underwater plume. The positioning of water quality locations will be informed by other operational monitoring inputs (for example spill fate modelling, aerial surveillance).
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

Considerations for Operational Water Quality Sampling and Analysis	
	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).
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.

9.7.2 Continuous Fluorometry Surveys

In addition to operational water sampling and sensor deployment at discrete locations, a continuous fluorometry survey(s) run across the expected plume extent, as well as vertically through the water column will allow a far greater area of coverage than discrete sampling, aiding in the mapping of entrained and dissolved oil movement. This strategy is most applicable for subsea releases where there is greater potential for entrained oil to exist throughout the water column.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for continuous fluorometry surveys are provided in **Table 9-16, Table 9-17** and **Table 9-22** respectively.

Table 9-16: Continuous Fluorometry Surveys – Objectives, Initiation Criteria and Termination Criteria

Continuous Fluorometry Surveys				
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 for a Level 1 spill if deemed beneficial by the On-scene Commander			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Operational water sampling and analysis will continue for 24 hours following control of the source provided oil is no longer detectable; or Until sampling is no longer beneficial in determining oil presence; or As directed by the relevant Control Agency			

Sub surface gliders containing fluorometers built into the body of the glider will be used preferentially for this monitoring. 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.

In the event that sub surface fluorometers are unavailable, towed fluorometers towed behind vessels will be used as an alternative or complementary approach.

Sub surface gliders with fluorometer sensors and towed fluorometry equipment for the monitoring of entrained and dissolved oil are available from OSRL through Santos WA's Associate Member Contract.

Table 9-17: Continuous Fluorometry Survey Implementation Guide

Continuous Fluorometry Surveys				
Activation time		Within 24 hours of request by IMT. Deployment within 5 days of activation.		
Action		**Consideration**	**Responsibility**	**Complete**
Initial Actions	Activate OSRL and determine availability of subsea gliders and towed fluorometry equipment.		Incident Commander Environment TL	❑

Continuous Fluorometry Surveys				
Activation time		Within 24 hours of request by IMT. Deployment within 5 days of activation.		
Action		**Consideration**	**Responsibility**	**Complete**
	If gliders and pilot/s available, 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 TL	❑
	If gliders unavailable and towed flurometers to be used, engage Monitoring Service Provider to develop Monitoring Action Plan for towed fluorometry as part of Operational Water Sampling and Analysis –	OSRL can provide specialist technical advice on operation of towed flurometers. Consider: Engaging OSRL for review and input into Monitoring Action plan for towed fluorometry Mobilising OSRL responder to assist with towed fluorometry survey.	Monitoring Service Provider Environment TL OSRL Technical Adviser/ responder	❑
	Source vessel for deployment of glider	Deployment may be achieved by Monitoring Service Provider using vessel tasked for operational monitoring.	Logistics TL Operations TL	❑
	Deploy glider near intended monitoring location	Deployment may be achieved by Monitoring Service Provider using vessel tasked for other operational water quality monitoring activities.	Operations Team Leader Monitoring Service Provider/ Glider provider	❑
	Pilot glider remotely along glide path considering daily predictions of spill trajectory provided by modelling provider		Glider provider	❑
	Provide real time data uploads from sub surface gliders to be available to IMT/ Spill Modelling Provider through web portal.		Glider provider	❑

Continuous Fluorometry Surveys				
Activation time		Within 24 hours of request by IMT. Deployment within 5 days of activation.		
Action		**Consideration**	**Responsibility**	**Complete**
	Monitoring results to be incorporated into common operating picture		Planning TL GIS Support Environment TL	❑
Resources			**Location**	
Equipment		Sub surface gliders, remote support system, pilot and deployment personnel	Blue Ocean Monitoring (Perth)	
		Towed fluorometers	OSRL (Singapore)	
		Santos WA Vessel/s for glider deployment or towed fluorometry	Santos WA Operational areas Dampier port	
Personnel		Glider pilots/ deployment personnel (Perth)	Perth	
		Monitoring Service Provider	Perth	
		OSRL Technical Adviser (fluorometry)	Singapore	
Maintenance of response		Response to be maintained through rotation of monitoring personnel/vessel crew as required with monitoring action plan reviewed and assessed each operational period as part of IAP revision.		

9.8 Low Flow Well Leak Monitoring

Table 9-18 provides the Environmental Performance Outcome, initiation criteria and termination criteria for this activity.

Table 9-18: Low Flow Leak Monitoring - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Low Flow Well Leak Monitoring				
Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.			
Initiation criteria	Subsea inspection activities identify a low flow well leak.			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	x	x	x
Termination criterion	Operational monitoring will terminate when risk assessment indicates negligible risk to the environment and well integrity risk assessment indicates no risk of escalation.			

The Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003) and the Varanus Island Hub Operations Environment Plan (State waters) outline the potential for a very low flow leak to occur from plugged and abandoned wells in Commonwealth and State waters, respectively. While other worst case oil spills are identified and reacted upon immediately due to their size, there is the potential for a low flow subsea well leak (gas and/or liquid hydrocarbon) to go undetected until subsea inspection activities (e.g. ROV surveys) identify the leak. These low flow leaks are not detectable by remote subsea systems (e.g. pressure monitoring systems), or remote monitoring systems are not in place, and may not be observable by visual surveillance at the water surface.

Where a subsea low flow well leak is detected through inspection activities the following will occur:

- A subsea operational monitoring survey (e.g. by ROV) will be undertaken to characterise the volume and composition of hydrocarbon released.
- Where there is potential for liquid hydrocarbon to be released, water quality monitoring will also occur at the release site to determine if detectable hydrocarbons in the water column.
- An environmental risk assessment will be undertaken, informed by survey results, which will consider the following aspects of the leak:
    - Rate of flow,
    - Worst case length of time leak undetected and worst case volume released,
    - composition of hydrocarbon,
    - water quality monitoring results (as applicable),
    - potentially impacted nearby environmental receptors
- An updated well integrity risk assessment will be carried out based on the outcomes of the operational monitoring survey to assess the risk of escalation and establish appropriate action to manage well integrity risk to ALARP.

- Pending the outcomes of the environmental risk assessment and updated well integrity risk assessment, further operational monitoring will be repeated to characterise the change in release rate (and change in water quality as applicable).
- The operational monitoring program and environmental assessment will be documented in an incident action plan, updated to reflect ongoing survey planning and results.

Section 8.4 of the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003) outlines the Environmental Performance Standard and Measurement Criteria for this activity.

The low flow leak environmental risk assessment and water quality monitoring results (as applicable) will determine if initiation criteria for oil spill scientific monitoring as outlined within **Section 17** have been met. If initiation criteria have been met scientific monitoring as per the SMP will occur.

9.9 Shoreline and Coastal Habitat Assessment

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 marine 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 9.2**).

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, the actual survey objectives, methodology, deployment locations and resource allocation will be controlled by DoT, as the Control Agency (with Santos WA acting as a Supporting Agency).

DoT provides guidance on shoreline assessments within their 2015 Oil Spill Contingency Plan.

The environmental performance outcome, initiation and termination criteria, the implementation guide and the performance standards and measurement criteria for shoreline and coastal habitat assessment are provided in **Table 9-19**, **Table 9-20** and **Table 9-22** respectively. This table also 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.

Table 9-19: Shoreline and Coastal Habitat Assessment – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Shoreline and Coastal Habitat Assessment				
Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.			
Initiation criteria	Operational monitoring predicts or observes shoreline contact from surface oil; or As directed by DoT			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	As directed by DoT			

Table 9-20: Shoreline and Coastal Habitat Assessment Implementation Guide

Shoreline and Coastal Habitat Assessment					
Activation time		On initiation criteria			
Action		**Consideration**	**Responsibility**	**Complete**	
Initial Actions	Ensure initial notifications to WA DoT have been made	Refer to **Section 6** 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.		Environment Team Leader Planning Team Leader	❑	
	Actions below are indicative only and are at the final determination of DoT as the Control Agency				
	Mobilising the AMOSC core group responders.		Incident Commander Operations Team Leader Logistics Team Leader	❑	
	Assessment of shoreline character, habitats and fauna.	Assessment includes: + shoreline structured biotic habitats + distribution of fauna + shoreline energy and processes (e.g. wave energy, tidal flows + shoreline substrate (e.g. mud, sand, pebble, rock) shoreline form (e.g. width, shape and gradient) access/ safety constraints	AMOSC Core group and DOT	❑	
	Assessment of shoreline oiling (if present).	Assessment includes: + surface distribution and cover + subsurface distribution	AMOSC Core group and DOT	❑	

Shoreline and Coastal Habitat Assessment				
Activation time		On initiation criteria		
Action		Consideration	Responsibility	Complete
		+ oil type, thickness, concentration and physical character sampling of oil for laboratory analysis		
	Recommendations for response strategies.	Considerations include: + applicable strategies based on oil type and habitat + potential access, safety and environmental constraints likely resourcing (personnel and equipment) requirements	AMOSC Core group and DOT	❑
Resources			Location	
Equipment		Santos WA contracted vessels and vehicles as required for shoreline access.	Karratha, Exmouth etc (dependent upon spill trajectory).	
		Santos WA aerial surveillance reports	Aerial surveillance monitor and evaluate tactic	
Personnel		Shoreline clean-up specialists and other trained oil spill responders	Perth, WA	
		AMOSC Core Group	Provided by AMOSC	
		DoT State Response Team	Provided by DoT	
		AMSA National Response Team	Provided by AMSA	
Maintenance of response		Santos maintains internal resources, and has contracts with external service providers, by which shoreline and coastal habitat assessment can be maintained for the duration of a spill response. Assessment teams will be supported by Santos' existing logistics and supply arrangements (e.g. vessel providers, freight etc.)		

9.10 Operational Monitoring Data Collection and Frequency

Table 9-21 outlines details of operational monitoring data that will be collected. This includes details on frequency of collection and reporting/data transfer back to the IMT. Operational monitoring informs situational awareness, which feeds into the Incident Action Planning/NEBA process carried out for each operational period. This is typically on a daily basis during the initial stages of incident response where information is changing rapidly and response strategies are being initiated. **Section 7** provides further detail on how situational awareness information is used through the IAP process.

Table 9-21 Details of Operational Monitoring Data Collection and Transfer

Strategy	Initiation	Platform	Data Provided	Tools	Field Personnel	IMT Reporting Contact	Frequency
Vessel surveillance	Within 90 minutes of spill	Santos WA contracted support vessels Vessels of opportunity	Spill location Weather conditions Slick appearance Marine fauna presence	Digital imagery GPS Vessel surveillance forms Bonn agreement code	Vessel crew Company site representative	Operations Team Leader Planning Team Leader	Collection: Minimum daily while surveillance is undertaken Reporting: minimum daily while surveillance is undertaken
Aerial surveillance	Initiated within 3 hours of notification of Level 2/3 spill Mobilisation at discretion of On-scene Commander for Level 1 spill	Santos WA contracted helicopter provider	Spill location Slick appearance Marine fauna presence	Imagery and video GPS Aerial surveillance forms and map templates Bonn agreement code	Pilots Trained Aerial Observers	Operations Team Leader Planning Team Leader	Deployment: 2 overpasses per day (am/pm) while surveillance is undertaken Reporting: 2 reports per day (am/pm) while surveillance is undertaken
Tracking buoys	Mobilisation within 2 hours of notification of Level 2/3 spill Mobilisation at discretion of On-scene Commander for Level 1 spill	Santos WA contracted support vessel	Current direction/ spill front movement	Satellite tracking buoys Satellite tracking website	Vessel crew	Operations Team Leader Planning Team Leader	Deployment: As required – nominally up to 4 per day Reporting: Position updates every 30 minutes
Spill trajectory modelling	Level 2/3 spill Mobilisation at discretion of On-scene Commander for Level 1 spill	N/A – office based	Spill trajectory predictions Oil weathering predictions Shoreline loading predictions	Trajectory modelling request form Modelling provider data portal	N/A – office based	Environment Team Leader Planning Team Leader	Reporting: minimum daily updates Trajectory modelling to be provided within 2 hours of initial request.
Satellite imagery	Level 2/3 spill	Satellites	Spill size and location	Satellite imagery data portal	N/A – office based	Environmental Team Leader Planning Team Leader	Reporting: Subject to satellite overflight schedule
Initial oil characterisation	Level 2/3 spill Mobilisation at discretion of On-scene Commander for Level 1 spill	Vessels of opportunity Santos WA contracted vessels	Oil physical and chemical characteristics Oil ecotoxicity	Digital imagery GPS Oil sampling equipment Ecotoxicology and oil analysis laboratories	Monitoring provider Vessel crew	Operations Team Leader Planning Team Leader Environment Team Leader	Oil collection: Daily for 14 days if possible (physical and chemical characteristics) Field reports: Daily Lab reporting: As results available
Operational water sampling and analysis	Initiated on Level 2/3 spill Mobilisation within 72 hours of accepted SoW Mobilisation at discretion of On-scene Commander for Level 1 spill	Santos WA contracted vessels	Water quality samples (surface and at depth) – oil detection and related parameters Real-time CTD readings - oil detection and related parameters	Water sampling equipment CTDs GPS WQ analysis laboratories	Monitoring provider Vessel crew	Operations Team Leader Planning Team Leader Environment Team Leader	Sampling: Daily Field reports: Daily Lab reporting: As results available

Strategy	Initiation	Platform	Data Provided	Tools	Field Personnel	IMT Reporting Contact	Frequency
Continuous fluorometry surveys	Initiated on Level 2/3 spill Mobilisation at discretion of On-scene Commander for Level 1 spill	Santos WA contracted vessels (towed fluorometry) Vessels of opportunity (glider deployment)	Fluorometry – subsea oil detection	Towed fluorometers Subsea gliders with fluorometry Calibration standards	Vessel crew Monitoring provider Subsea glider deployment and monitoring personnel	Operations Team Leader Planning Team Leader Environment Team Leader	Field reports: Daily Data reports: daily during survey period
Shoreline and coastal habitat assessments	Operational monitoring predicts or observes shoreline contact from surface oil; or As directed by DoT	Vehicles Santos WA contracted vessels By foot	Shoreline character Access constraints Distribution flora and fauna Degree of oiling	Shoreline survey forms Digital imagery and video GIS mapping	AMOSC core group responders State and National Response Teams	Operations Team Leader Planning Team Leader	Field reports: Daily

9.11 Monitor and Evaluate Plan Environmental Performance

Table 9-22 indicates the Environmental performance outcomes, controls and performance standards for the Monitor and Evaluate response strategy.

Table 9-22: Monitor and Evaluate Performance Standards and Measurement Criteria

Environmental Performance Outcome	**Implement 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

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	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
		Aerial surveillance continues until termination criteria are met	Incident log
	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
		Tracking buoys utilised until termination criteria met	Incident log
	Oil Spill Modelling	**Response Preparedness**	

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	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 available	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
		Modelling continues until termination criteria are met	Incident Log
	Satellite Imagery	**Response Preparedness**	
	Satellite imagery available	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 available	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

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	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 Implementation**	
	Initial Oil Characterisation	Oil samples sent to laboratory for initial fingerprinting	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

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
	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	IAP records assessment records

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		assessment is conducted prior to nearshore activities.	
	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.

10 Mechanical Dispersion Plan

In the event of thin oil sheens resulting from a marine diesel or crude spill following weathering, vessel based mechanical dispersion can be used to assist with the natural dispersion process, encouraging localised areas of an oil slick to mix and suspend within the water column where it can be more easily biodegraded. This is especially beneficial if patches of floating oil are in close proximity to sensitivities at risk from floating oil (e.g. birdlife, mangrove habitat). To do this vessels are deployed to implement mechanical dispersion by way 'prop washing' through the slick. As with other vessel based techniques the health and safety risks of potential gas and Volatile Organic Compounds (VOCs) exposure must be considered and gas monitoring should occur prior to commencing.

Assessment for the applicability of mechanical dispersion will continue throughout the spill response, and utilised when weather and sea conditions are not conducive to natural dispersion of thin oil sheens, and wildlife are under threat.

The environmental performance outcome , initiation and termination criteria and the performance standards and measurement criteria for mechanical dispersion are provided in **Table 10-1**, and **Table 10-3** respectively. **Table 10-2** provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this tactic. This table also 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.

Table 10-1: Mechanical Dispersion – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

<table>
<tr><th colspan="5">Mechanical Dispersion</th></tr>
<tr><td>Environmental Performance Outcome</td><td colspan="4">Implement mechanical dispersion to reduce the concentration of surface hydrocarbons to reduce contact with protection priorities.</td></tr>
<tr><td>Initiation criteria</td><td colspan="4">Monitoring by the IMT 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. Assessment by the IMT indicates the oil is thin enough on the surface of the water to be dispersible using vessel prop-washing techniques</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>Condensate</td><td>Crude oil</td><td>Marine Diesel</td><td>HFO</td></tr>
<tr><td>✔</td><td>✔</td><td>✔</td><td>X</td></tr>
<tr><td>Termination criterion</td><td colspan="4">There is no further environmental benefit or observed effectiveness in dispersing floating oil underwater through mechanical dispersion; or as directed by the relevant Control Agency.

NB: Mechanical dispersion will terminate if there are unacceptable safety risks associated with gas and VOCs at the sea surface.</td></tr>
</table>

Table 10-2: Mechanical Dispersion Implementation Guide

Mechanical Dispersion				
Activation time		As directed by the IMT.		
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	Operations Team Leader Environment Team Leader Planning Team Leader	❑
	Safety team lead to develop a safety plan for the activity with respect to dangerous gasses and VOC's (including applicable controls).		Operations Team Leader Safety Team Leader	❑
	Notify Vessel Master of nearest available Support Vessel to commence 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 the Operational NEBA.		Vessel Master/s Santos WA AMOSC Core Group Responders	❑
	Source additional contracted vessels if possible need for assistance.		Operations Team Leader Logistics Team Leader	❑
Resources			**Location**	
Equipment		Deployment vessels Vessel availability accessed through Santos WA Emergency Response Intranet Site	Santos WA Operational sites	
Personnel		Santos WA Facility Incident Response Team members	Santos WA Operational sites (including Devil Creek and Varanus Island)	

Mechanical Dispersion			
Activation time	As directed by the IMT.		
Action	**Consideration**	**Responsibility**	**Complete**
	Santos WA AMOSC Core Group Responders		
	Vessel Personnel	With Vessel	
Maintenance of response	Santos WA has access to vessel service providers by which this response strategy can be maintained. Vessel availability may be restricted by other needs (e.g. implementing more effective response tactics).		

10.1 Mechanical Dispersion Environmental Performance

Table 10-3 indicates the Environmental performance outcomes, controls and performance standards for the Mechanical Dispersion response strategy.

Table 10-3: Mechanical Dispersion – Environmental Performance

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

11 Offshore Containment and Recovery Plan

Offshore containment and recovery involves the use of offshore containment boom and skimmers deployed from response vessels (typically two per operation). The effectiveness of this response will be dependent on spill characteristics, hydrocarbon type, and the operating environment (**Table 11-1**). This strategy is considered applicable for HFO spills from offtake tankers undergoing berthing operations at the Varanus Island Terminal in State waters and crude oil spills and may be applicable for crude oil release in State waters at the platform, export pipeline or during an offtake tanker release due to vessel collision/vessel grounding. It is not considered applicable for Commonwealth water spills due to the properties of hydrocarbons potentially spilled in these waters (condensate and marine diesel). On this basis offshore containment and recovery is considered primarily a State waters activity with DoT as the relevant Control Agency. Santos WA as a Supporting Agency will provide first strike response and then all necessary resources (equipment and personnel) to support DoT.

Table 11-1: Criteria for the Use of Booms and Skimmers

Criteria	Recommended	Not Recommended
Spill characteristics	Patchy slick Fresh or emulsified Extended operations Surface concentrations >50 g/m^2 min, 100 g/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

The environmental performance outcomes, initiation and termination criteria, implementations actions and the performance standards and measurement criteria for Containment and Recovery are provided in **Table 11-2**, **Table 11-3** and **Table 11-4** respectively. 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 11-2: Offshore Containment and Recovery – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Offshore Containment and Recovery				
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 Level 2/3 spill			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	✔	X	✔
Termination criterion	IMT assess that greater than 1 m^3/day / vessel operation of oil cannot be collected; OR NEBA is no longer being achieved; and Agreement is reached with Jurisdictional Authorities to terminate the response			

Table 11-3: Offshore Containment and Recovery Implementation Guide

Offshore Containment and Recovery					
Activation time		Deployment within 4 hrs of activation			
	Action	**Consideration**	**Responsibility**	**Complete**	
Initial Actions	Assess the spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to identify priority areas for C&R deployments.	Refer to **Table 11-1** for guidance	Environment Team Leader Planning Team Leader	❑	
	Confirm conditions are suitable for containment and recovery activities	Refer to **Table 11-1** for guidance	Operations Team Leader Planning Team Leader	❑	
	Identify containment and recovery equipment stockpiles based on nominated deployment locations. Initial deployment of C&R equipment is to be from Varanus Island (Santos WA equipment) with equipment for secondary deployments stockpiled at Dampier (Santos WA/ AMSA) and Exmouth (AMOSC).	Stockpile information accessed through Santos WA Emergency Response Intranet Site	Operations Team Leader Logistics Team Leader Supply Team Leader	❑	
	Identify suitable deployment vessels/crew. Mobilise resources to a designated port location with laydown and loading facilities for deployment. Varanus Island vessels will be used for the initial deployment. Secondary mobilisations through Dampier and Exmouth using vessels/crew with Santos WA boom deployment experience as available.	Vessel availability is accessed through Santos WA Emergency Response Intranet Site Preference will be for vessels that are exercised in annual booming exercises with Santos WA; sea-fastenings are in place to bolt the boom reels to the decks and the crews have been trained in deployment techniques	Operations Team Leader Logistics Team Leader Supply Team Leader	❑	
	Mobilise deployment personnel to nominated marine bases. Initial personnel requirements to be filled through Varanus Island Incident Response Team. Personnel for	Each vessel conducting containment and recovery is to be manned with a trained AMOSC or Santos WA Core Group Oil Spill Responder, who is the Team Leader	Operations Team Leader Logistics Team Leader	❑	

Offshore Containment and Recovery				
Activation time		Deployment within 4 hrs of activation		
Action		**Consideration**	**Responsibility**	**Complete**
	Dampier/Exmouth deployments to be initially provided by Santos WA trained crew and onsite logistics personnel.	tasked with controlling the operations and implementing in a safe and responsible method. The Team Leader has the responsibility of evaluating the effectiveness of the containment and recovery operations and communicating the information to the IMT Operations Team Leader		
	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 that threaten priority receptors and are of a sufficient thickness whereby contain and recover activities will be effective	Planning Team Leader Operations Team Leader Environment Team Leader	❑
	Direct containment and recovery operations to designated operational zones		Operations Team Leader	❑
	Seek approval from DoT and AMSA for decanting oily water.		Operations Team Leader	❑
	Inform Waste service provider of predicted volumes and collection points from Offshore Containment and Recovery operations. Refer to Waste Management Plan (**Section 16**)		Operations Team Leader	❑
Resources			**Location**	
Equipment		Offshore boom - inflatable and self-inflating Skimmers Waste oil containers Pumps, hoses, tow bridles and other ancillary equipment supporting the above. *Stockpiles of the above equipment accessed through Santos WA Emergency Response Intranet Site*	Santos WA stockpiles (Dampier, Varanus Island, Exmouth) – first strike deployment from Varanus Island AMSA National Stockpiles – first strike deployment from Dampier AMOSC Stockpiles (Exmouth/Fremantle/Geelong) – initial deployment from Exmouth	

<table>
<tr><th colspan="5">Offshore Containment and Recovery</th></tr>
<tr><th>Activation time</th><td colspan="4">Deployment within 4 hrs of activation</td></tr>
<tr><th>Action</th><th>Consideration</th><th colspan="2">Responsibility</th><th>Complete</th></tr>
<tr><td rowspan="4"></td><td rowspan="3"></td><td colspan="2">DoT State Stockpiles</td><td></td></tr>
<tr><td colspan="2">Industry Mutual Aid (Barrow Island, Onslow, Dampier)</td><td></td></tr>
<tr><td colspan="2">OSRL (Singapore)</td><td></td></tr>
<tr><td>Deployment vessels.
Vessel availability accessed through Santos WA Emergency Response Intranet Site</td><td colspan="2">Santos WA Operational sites (Dampier, Exmouth, Varanus Island) – first strike deployments from Varanus Island and Dampier
AMOSC Stockpiles (Exmouth/Fremantle/Geelong) – initial deployment from Exmouth</td><td></td></tr>
<tr><td rowspan="6">Personnel</td><td>Santos WA Facility IRT members
Santos WA AMOSC Core Group Responders</td><td colspan="2">Santos WA Operational sites – first strike from Varanus Island</td><td></td></tr>
<tr><td>Santos WA Trained Vessel Deployment personnel – vessel crew and Dampier/Exmouth based logistics personnel</td><td colspan="2">Dampier and Exmouth</td><td></td></tr>
<tr><td>Industry AMOSC Core Group Responders</td><td colspan="2">Mobilised through AMOSC</td><td></td></tr>
<tr><td>National Response Team (NRT)</td><td colspan="2">Mobilised through AMSA</td><td></td></tr>
<tr><td>State Response Team (SRT)</td><td colspan="2">Mobilised through DoT</td><td></td></tr>
<tr><td>Additional Field Personnel as required (Santos WA Labour Hire)</td><td colspan="2">Mobilised through Santos WA labour hire arrangements</td><td></td></tr>
<tr><td>Maintenance of response</td><td colspan="4">Offshore containment and recovery is considered applicable for HFO and crude oil spills in State waters and therefore ongoing response to be directed by DoT as the relevant Control Agency.
Santos WA will provide all necessary equipment and personnel to assist with the response under direction from DoT.
Response crews will be rotated on a roster basis from nominated marine bases, with new personnel procured on an as-need basis.</td></tr>
</table>

Offshore Containment and Recovery			
Activation time	Deployment within 4 hrs of activation		
Action	Consideration	Responsibility	Complete
	Equipment will be maintained and replaced if necessary through existing stockpiles.		

11.1 Equipment and Personnel

Offshore containment and recovery equipment available for use by Santos WA is a combination of Santos WA owned, AMOSC, AMSA, DoT and OSRL equipment as well as other operator resources available through the AMOSPlan mutual aid arrangements.

Offshore containment and recovery personnel available to Santos WA are a combination of Santos WA Facility Incident Response Team (IRT) members, AMOSC Core Group Responders (comprising AMOSC trained Santos WA and Industry personnel), Santos WA trained vessel crew and logistics personnel, State Response Team members and National Response Team members.

Deployment of equipment and personnel will be commensurate to the severity of the spill and timing/ location of potential shoreline impact.

First-strike deployment of containment and recovery equipment for an offtake tanker release of HFO is to be from Varanus Island using vessels, offshore boom and oil skimmer available onsite. Personnel to be provided through the Varanus Island IRT and onsite vessel crew. Regular boom deployment exercise are run from Varanus Island which provides training for IRT and vessel crew members and tests the functionality of the equipment. Deployment of offshore boom can be achieved within 4 hours from activation.

Secondary deployment of offshore boom would most likely be from Dampier, using Santos WA and AMSA offshore booms and skimming equipment stockpiled in Dampier. Santos WA contracted vessel provider will be used preferentially for vessel deployments out of Dampier. Regular boom deployment exercise are run from Dampier which provides training for vessel crew members and Dampier based logistics personnel and tests the functionality of Santos WA equipment stockpiled in Dampier. Offshore boom and skimming equipment can be loaded and ready for deployment within 4 hours from activation.

Further deployments as required, would be provided from Dampier and Exmouth using Santos WA, AMOSC and AMSA equipment, Santos WA contracted vessel providers and personnel from Santos WA IRTs, AMOSC Core Group and State/National Response Teams.

As a backup to AMOSC stockpiles, significant quantities of offshore boom are available through OSRL out of Singapore.

11.2 Deployment Locations

Santos WA will direct first strike deployments of offshore containment and recovery resources, as required based on spill trajectory mapping and operational monitoring. DoT will assume control of the response as the relevant Control Agency for State waters response activities and will direct deployment following hand-over of control.

During a spill response, offshore boom deployment locations will be based on predicted trajectories and the relative locations of shoreline sensitivities. Information sources include:

+ Santos WA GIS Mapping;
+ DoT Oil Spill Response Atlas (OSRA) Web Map Application (WMA);
+ Pilbara Region Oiled Wildlife Response Plan; and

- Aerial Surveillance and Shoreline Assessment records where available.

Stochastic spill modelling already undertaken for worst-case spill scenarios has been assessed for shoreline receptor contact at floating oil thresholds and shoreline accumulation. Results show that oil from a worst case HFO spill the shorelines of Barrow, Lowendal and Montebello islands have the highest likelihood of shoreline contact (19.5-49.5% for a concentration >100 g/m^2) and have the shortest minimum contact times (2-12 hours), noting that predicted contact is from separate modelled simulations. These islands were also shown to have the highest potential loading volumes (1183-1480 m^3). All other coastal areas were shown by modelling to have lower probabilities of HFO contact (<4% at >100 g/m^2), longer contact times (>127 hours at >100 g/m^2) and lower maximum loading volumes (<854 m^3).

Based on the spill modelling work undertaken, deployment of containment and recovery equipment should initially focus on waters adjacent to the Lowendal, Barrow and Montebello islands.

In all areas, the primary shoreline protection priorities are mangrove environments and shorelines identified as important for turtle nesting and hatching and shorebird/seabird nesting, roosting or foraging. Key areas for these shoreline sensitivities are outlined in **Section 3.5**.

11.3 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).

11.4 Offshore Containment and Recovery Environmental Performance

Table 11-4 indicates the Environmental performance outcomes, controls and performance standards for the Offshore Containment and Recovery response strategy.

Table 11-4: Offshore Containment and Recovery – Environmental Performance

Environmental Performance Outcome	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Offshore Containment and Recovery	**Response Preparedness**		
	Access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
	Varanus Island Incident Response Teams and protection & deflection equipment	Santos WA will maintain the capability to deploy first strike protection and deflection resources within the first 24 hours of a spill notification.	VI oil spill response exercise records
	Response Implementation		
	Competent Personnel	Containment and recovery shall only be undertaken under the supervision of a AMOSC Core Group member	Incident Log
	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 following period Incident Action Plan	IAP/Incident Log

12 Shoreline Protection Plan

Booms can be used to create physical barriers on the water surface to protect sensitive receptors in intertidal and nearshore environments with the intent of taking the oil plume off its trajectory path. Booms can also be used to deflect the oil spill to locations easier for shoreline clean-up, for example moving oil from rocky shorelines to sandy shorelines.

The effectiveness of this response will be dependent on spill characteristics, hydrocarbon type, and the operating environment and is recommended for slicks greater than 100 g/m^2. 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 9**).

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.

Table 12-1, Table 12-2 and **Table 12-3** provide the environmental performance outcome, initiation criteria and termination criteria, implementation actions and performance standards, measurement criteria for this strategy. The On-Scene Commander and/or Incident Commander are ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 12-1: Shoreline Protection – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Shoreline Protection				
Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities.			
Initiation criteria	Monitor and evaluate activities predict potential contact from surface oil to key sensitive receptors ; or As directed by DoT			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Oil no longer posing a risk to sensitive receptors; or Booming operations are no longer effective; or As directed by DoT			

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:

- The utilisation of earthen booming and sandbags where needed to prevent ingress of oil into tidal creeks;
- Nearshore booming using vessel-based operations while the spill remains on a predicted shoreline impact trajectory; and
- Placement of shoreline boom around areas to protect and to deflect the oil back to ocean or to easier locations for shoreline clean-up.

The effectiveness of these techniques will be dependent on local bathymetry, sea state, current and wind conditions. The shoreline protection plan activation process is provided in **Table 12-2** below.

Table 12-2: Shoreline Protection Implementation Guide

Shoreline Protection				
Activation time		Where monitor and evaluate activities predict potential contact to key sensitive receptors as risk from surface oil; or As directed by DoT		
Action		**Consideration**	**Responsibility**	**Complete**
Initial Actions	Ensure initial notifications to WA DoT have been made	Refer to **Section 6** 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.		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		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 using information from shoreline assessments and any tactical response plans for the area.	Shoreline Protection Plan may include (but not be limited to): + Priority nearshore and shoreline areas for protection (liaise with Control Agency for direction on locations) + Locations to deploy protection and deflection equipment + Permits required (if applicable) + Protection and deflection tactics to be employed for each location + List of resources (personnel and equipment) required	Operations Team Leader Planning Team Leader	❑

Shoreline Protection				
Activation time		Where monitor and evaluate activities predict potential contact to key sensitive receptors as risk from surface oil; or As directed by DoT		
	Action	**Consideration**	**Responsibility**	**Complete**
		+ 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 zones (to minimise disturbance to sensitive receptors)		
	Identify resources for shoreline protection activities based on nominated deployment locations.		Operations Team Leader	❑
	Mobilise protection and deflection equipment to designated location for deployment	Potentially contacted locations include (>5% probability, at or above 100 g/m^2 accumulation concentration) + Montebello Islands + Lowendal Islands + Barrow Island	Logistics Team Leader	❑
	Identify vessels with relevant capabilities (e.g. shallow draught) 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	❑

Shoreline Protection				
Activation time	Where monitor and evaluate activities predict potential contact to key sensitive receptors as risk from surface oil; or As directed by DoT			
Action		**Consideration**	**Responsibility**	**Complete**
	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	❑
	Response teams to conduct daily inspections and maintenance of boom arrays		Operations Team Leader	❑
	Report to the Operations Team Leader on the effectiveness of the boom arrays		Shoreline Response Team Leader – AMOSC core group responder	❑

Resources		Location
Equipment	Sea Curtain, Near-shore and Beach Guard Booms and associated equipment	AMOSC Santos WA (VI) Other Operators through AMOSC mutual aid
	General purpose containment boom; inflatable general-purpose boom	AMSA (Dampier)
	Vessels	Santos WA Operational sites
Personnel	Santos WA Facility Incident Response Team members AMOSC Core Group Responders	Santos WA Operational sites
	AMOSC Core Group Responders	Mobilised through AMOSC
	Logistics personnel	Exmouth Freight & Logistics
	National Response Team (NRT)	Mobilised through AMSA

Shoreline Protection			
Activation time	Where monitor and evaluate activities predict potential contact to key sensitive receptors as risk from surface oil; or As directed by DoT		
Action	**Consideration**	**Responsibility**	**Complete**
	State Response Team (SRT)	Mobilised through DoT	
	Tactical Response Plans	Santos WA Procedures Index	
Maintenance of response	Conduct daily re-evaluation of NEBA to assess varying net benefits and impacts of continuing to conduct shoreline protection and deflection activities. Shoreline protection efforts will be maintained through the forward operation(s) facilities setup at mainland locations under direction of DoT. Equipment will be installed and maintained by response crews who will be rotated on a roster basis from the forward operations centres, with new personal procured on an as-need basis from existing human resource suppliers. The protection and auxiliary equipment (dinghies, tools etc.) will be maintained and replaced if necessary through existing suppliers of this equipment or through supplies from existing stockpiles.		

12.1 Equipment and Personnel

Shoreline protection equipment available for use by Santos WA is a combination of Santos WA owned, AMOSC, AMSA, DoT and OSRL equipment as well as other operator resources available through the AMOSPlan mutual aid arrangements.

Shoreline personnel available to Santos WA are a combination of Santos WA Facility Incident Response Team members, AMOSC Core Group Responders (comprising AMOSC trained Santos WA and Industry personnel), State Response Team members and National Response Team members.

The level of deployment of equipment and personnel for shoreline protection will be commensurate to the spatial extent of shoreline contact, and the nature of the shoreline contacted, in terms of sensitivities to be protected. Once activated as Control Agency, deployment will be under the direction of DoT and the advice of shoreline specialists from AMOSC/ AMOSC Core Group and National/State response teams. Shoreline Assessments (**Section 9**) and existing Tactical Response Plans will provide information to guide the strategy and deployment of resources.

Worst case modelling (HFO scenario) had identified the Lowendal Islands to have the shortest potential contact time of floating oil (2 hours for oil >100 g/m^2). For this scenario, first-strike deployment arrangements would come from personnel and equipment based at Varanus Island. This includes Santos WA AMOSC Core Group personnel, IRT members and shoreline/nearshore booming equipment held at Varanus Island. Regular deployment exercises conducted by Varanus Island AMOSC Core Group and IRT personnel of spill response equipment demonstrate loading of Varanus Island field support vessels within relatively short timeframes (<4 hours). Deployment of nearshore/shoreline boom is also conducted regularly.

12.2 Deployment Locations

Pre-planning has identified shoreline Protection Priority Areas which have high environmental value and which modelling indicates could receive floating oil and shoreline loading with greater than 5% probability:

+ Lowendal Islands;
+ Montebello Islands; and
+ Barrow Island.

Of these Lowendal Islands have the shortest potential contact time of floating oil (2 hours for oil >100 g/ m^2) and one of the highest potential loading volumes (1,324 m^3 of HFO). Monitor and Evaluate information and NEBA will help validate contact to this and other Protection Priority areas, identify other contacted areas and prioritise shoreline sites for clean-up operations. Shoreline sensitivity and mapping data provided in the following data sources will be used to assist in evaluation of priority protection areas for response:

+ Santos WA GI;
+ DoT Oil Spill Response Atlas –Web Map Application (OSRA WMA);
+ Pilbara Region Oiled Wildlife Response Plan;
+ Aerial Surveillance and Shoreline Assessment records where available; and
+ The EP.

Santos WA GIS and the OSRA WMA, provides detailed information on shoreline features, sensitive receptors, and potential spill response equipment mobilisation locations in the North West Shelf region.

12.3 Protection and Deflection Plan Environmental Performance

Table 12-3 indicates the Environmental performance outcomes, controls and performance standards for the Protection and Deflection response strategy.

Table 12-3: Shoreline Protection – Environmental Performance

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
	Varanus Island Incident Response Teams and protection & deflection equipment	Santos WA will maintain the capability to deploy first strike protection and deflection	VI oil spill response exercise records

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**
		resources within the first 24 hours of a spill notification.	
	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 development of following period Incident Action Plan	IAP/Incident Log
		Ensure operational NEBA considers waste management, to ensure environmental benefit outweighs the environmental impact of strategy implementation which may include secondary contamination	Incident Log IAP
	Spill response activities selected on basis of a Net Environmental Benefit Analysis (NEBA)	A NEBA is undertaken for every operational period	Incident Log contains NEBA

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**
	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

13 Shoreline Clean Up Plan

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 (refer below), 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 9**), 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 determined as opposed to natural attenuation for sensitive sites. Selection of the shoreline clean-up methods and controls to prevent further damage from the clean-up activities are to be undertaken in consultation with the HMA, and selected based on NEBA.

Spill modelling indicates loading of hydrocarbons onto shorelines could occur from spills during VI Hub operations and therefore clean-up of shorelines may be required.

<u>Condensate is the only product that could load onto shorelines from credible spills in Commonwealth waters.</u>

<u>Marine diesel, condensate, crude oil and HFO may load onto shorelines from credible spills in State waters.</u>

Marine diesel and condensate are likely to be difficult to handle for removal given their light nature but are readily washed from sediments by wave and tidal flushing; contaminated sand and debris the likely waste products from a shoreline response.

HFO lends itself more to manual removal techniques due to its higher viscosity, residual fraction and greater potential for adherence. Crude oils produced at VI Hub are relatively light Group II oils, and are therefore likely to behave more similarly to condensates and diesels than HFO.

Table 13-1, **Table 13-2** and **Table 13-3** provides the Environmental Performance Outcome, initiation criteria and termination criteria, implementation actions and performance standards and measurement 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 13-1: Shoreline Clean-up – Objectives, Initiation Criteria and Termination Criteria

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.			
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	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	As directed by DoT			

Table 13-2: Shoreline Clean-up Implementation Guide

Shoreline Clean-up				
Activation time		+ 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		
	Action	**Consideration**	**Responsibility**	**Complete**
Initial Actions	Undertake shoreline assessment as outlined **Section 9.8**		Refer to **Section 9.8**	❑
	Identify resources for shoreline clean-up activities based on nominated deployment locations, recommendations from shoreline assessments and requests from the Control Agency. Equipment stockpile information accessed through Santos WA Emergency Response Intranet Site	Equipment list to support forward operational areas, decontamination systems, welfare infrastructure, and operation deployments are located in **Appendix I: Shoreline Clean-up Equipment**. These are for reference for procurement plans and must be modified to suit actual deployment numbers and locations, which will be dependent on incident specific circumstances. Tactical Response Plans also contain information outlining shoreline clean-up resources for some protection priority areas.	Operations Team Leader	❑
	In consultation with the Control Agency identify vessel requirements for transferring personnel, equipment, and waste to/from offshore islands		Operations Team Leader Logistics Team Leader Deputy Logistics Officer (DoT IMT)	❑
	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	❑

Shoreline Clean-up				
Activation time	+ 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			
	Action	**Consideration**	**Responsibility**	**Complete**
			Deputy Logistics Officer (DoT IMT)	
	Deploy shoreline clean-up response teams to each shoreline location selected to begin operations under direction of the Control Agency.		Operations Team Leader Logistics Team Leader Deputy Logistics Officer (DoT IMT)	❑
	Monitor progress of clean-up efforts and report to the Control Agency		Operations Team Leader On-Scene Commander Deputy On-Scene Commander (DoT FOB)	❑

Resources		**Location**
Equipment	Mobile plant (if required)	Karratha/ Exmouth/ Perth
	Vessels for personnel, equipment and waste transfer to/from offshore islands	Santos WA contracted vessel providers
	Shoreline Clean-up Equipment (Decontamination, Beach Wash Down, Beach Clean-up kits and Temporary Waste Storage)	Santos WA (Varanus Island)/ AMOSC / AMSA/ OSRL / Spot purchase from various suppliers
	Waste skips and associated waste equipment (as defined in **Section 16**)	North West Alliance

Shoreline Clean-up			
Activation time	+ 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		
Action	**Consideration**	**Responsibility**	**Complete**
	Beach Clean-up equipment and PPE	Perth Petroleum Services/ PPE specialists/ Hardware stores	
Personnel	Shoreline Clean-up specialists	AMOSC, NRT (AMSA), SRT (DoT), OSRL	
	Santos WA AMOSC Core Group and IRT Personnel	Santos WA Facilities	
	Logistics personnel	Exmouth Freight & Logistics	
	Waste handling and transportation personnel	Through North West Alliance contract	
	Manual clean-up personnel	Santos WA labour hire	
Maintenance of response	This response will be maintained through Santos WA's existing contractual arrangements with equipment and personnel suppliers, which will ensure that clean-up activities can be maintained. Santos WA maintains waste management arrangements that can be scaled dynamically to accommodate potential wastes generated during the clean-up.		

13.1 Equipment and Personnel

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 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 Santos WA Facility Incident Response Team members, AMOSC Core Group Responders (comprising AMOSC trained Santos WA and Industry personnel), 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 emergency response labour hire arrangements.

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 9.8**) and NEBA process will provide information to guide the clean-up tactics and deployment of resources.

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. Across all credible spill scenarios, modelling has indicated that a worst case HFO release from an offtake tanker in State waters would result in the highest potential shoreline loading of oil. Further to this, HFO is the most persistent and viscous of all oils that could potentially be release during VI 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 marine diesel and condensate may not be possible or recommended due to the degree of infiltration into sediments that could occur.

HFO spill modelling indicates that shoreline loading of up to ~1,500 m^3 could occur on shorelines of the Montebello islands (refer **Table 3-8**). Similarly high volumes could also load onto shorelines of the Lowendal Islands (~1,300 m^3) and Barrow Island (1,200 m^3), noting that these worst case loadings come from different model simulations and these combined loadings could not occur given the maximum credible release of 1,900 m^3.

Given the likelihood of HFO binding to sediments a bulking factor of 10x is considered appropriate to account for addition of sand and debris, up to 15,000 m^3 of oily waste could be required to be removed in a worst-case scenario. 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 1,500 m^3 (15,000 m^3 oily waste) in roughly 84 days. This assumes oil is accessible for removal (i.e. on accessible sections of coastline) and there would be a net benefit in removing all oil.

13.2 Clean-up activities

Shoreline clean-up can be an effective technique for mitigating shoreline impacts and reducing the potential for oil to remobilise and spread 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 offshore islands (Montebello, Barrow, Lowendal) 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 islands and their sensitive species.

13.2.1 Shoreline Clean-up Decision Guides

A number of shoreline types are found within the area potentially contacted by a spill during VI Hub operations, including:

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

To assist with planning purposes, guidance for the selection of appropriate shoreline response strategies based on the type of 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.

13.2.2 Onsite waste management

Waste consolidation and storage at forward operations areas is an important aspect of the shoreline clean-up response and will have implications for the management of waste by the Waste Service Provider (WSP). DoT as the Control Agency for shoreline response is responsible for overseeing the consolidation and storage of collected waste prior to collection of the waste by the WSP.

The DoT Waste Management Sub-Plan to the DoT OSCP (2015) provides guidelines to assist DoT with preparing site-specific waste management plans for clean-up activities controlled by DoT.

Santos WA will provide a contracted WSP for the collection, treatment and disposal of waste from an oil spill response as detailed in **Section 16**.

13.3 Deployment locations

Pre-planning has identified shoreline Protection Priority areas which have high environmental value and which modelling indicates shoreline loading meets or exceeds the actionable oil threshold concentration of 100 g/m^2, above 5% probability, are:

- Lowendal Islands;
- Montebello Islands;
- Barrow Island;

Monitor and Evaluate information and NEBA will help prioritise shoreline sites for clean-up operations. Shoreline sensitivity and mapping data provided in the following data sources will be used to assist in evaluation of priority protection areas for response:

- Santos WA GIS;
- DoT Oil Spill Response Atlas –Web Map Application (OSRA WMA);
- Pilbara Region Oiled Wildlife Response Plan;
- Spill trajectory modelling;
- Aerial Surveillance and Shoreline Assessment records where available; and
- the EP.

Santos WA GIS and the OSRA WMA, provides detailed information on shoreline features, sensitive receptors, and potential spill response equipment mobilisation locations in the North West Shelf region.

In all areas, the primary shoreline protection priorities are mangrove environments and shorelines identified as important for turtle nesting and hatching and shorebird/seabird nesting, roosting or foraging. Key areas for these shoreline sensitivities are outlined in **Section 3.5**.

13.4 Shoreline Clean-up Environmental Performance

Table 13-3 indicates the Environmental Performance Outcomes, Controls and Performance Standards for the shoreline clean-up response strategy.

Table 13-3: Shoreline Clean-up – Environmental Performance

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	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
		Shoreline clean-up response continues until termination criteria is met, as outlined within the Shoreline Clean-up Plan.	Incident Log
	Prioritise use of existing roads and tracts	Unless directed otherwise by the designated Control Agency (i.e. DoT) access plans for shoreline	IAP demonstrates requirement is met.

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**
		operations will prioritise use of existing roads and tracks	
	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.
	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	Consultation records

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
		deployment of resources to townships and marine/coastal areas	

14 Onshore Response

Onshore hydrocarbon spills on Varanus Island (VI) include the following:

+ minor spills associated with storage and handling of hydrocarbons (lube oils, hydraulic fluids, marine diesel, petrol, aviation fuel, waste oil);
+ spills associated with bunkering marine diesel via the Diesel Distribution System;
+ spills from process equipment;
+ spills from the bulk crude oil storage tanks;
+ spills from the onshore section of the 30” export pipeline (Tanker Loading Line); and
+ spills from the onshore sections of hydrocarbon containing production pipelines.

VI is excluded as a response areas for DFES under the State Hazard: HAZMAT Plan. Therefore, for VI onshore spills, Santos WA will remain the Control Agency for response. The State Hazard: HAZMAT Plan nominates direct on-site recovery and clean-up of hazardous materials and infrastructure to be the responsibility of the owner of the hazardous materials (Santos WA). In a scenario where a Level 2/3 hydrocarbon spill at an onshore location at VI reached marine waters, DoT would be engaged as the relevant Control Agency.

Remediation of contamination at an onshore spill site declare a contaminated site under *Contamination Sites Regulations 2006* will be under the direction of DWER.

The Environmental Performance Outcome, initiation and termination criteria and the implementation guide for shoreline response are provided in **Table 14-1** and **Table 14-2** and the performance standards and measurement criteria for onshore response are provided in **Table 14-3** respectively.

Table 14-1: Onshore Response – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Onshore Response				
Environmental Performance Outcome	Control the spread of hazardous material Remove surface oil and debris where present and when the strategy provides a net benefit Remediate the site as directed by DWER as applicable.			
Initiation criteria	Notification of an onshore release.			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✓	✓	✓	**N/A**
Termination criterion	The site has been cleaned and remediated to the satisfaction of DWER			

Table 14-2: Onshore Response Implementation Guide

Onshore Response			
Activation time	Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by On-Scene Commander)		
Action	**Consideration**	**Responsibility**	**Complete**
Use VI onsite resources if required to stop spread of hydrocarbon outside of bunded areas reaching sensitive onshore and coastal areas and marine waters where spill can spread further.	Safety constraints associated with the hazardous material Use of booms, sorbents and manual/mechanical earthmoving equipment available on VI	On Scene Commander	❑
In consultation with on-scene commander determine if further resources required to be mobilised to site to contain spill.		On Scene Commander Incident Commander Operations Team Leader Logistics Team Leader	❑
Notification of DFES, DWER and DBCA with respect to onshore release and contamination		Incident Commander Environmental Team Leader	❑

Onshore Response				
Activation time		Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by On-Scene Commander)		
	Action	**Consideration**	**Responsibility**	**Complete**
	Notification of DoT if spill reaching coastal area of island and marine waters		Incident Commander Environmental Team Leader	❑
	In conjunction with relevant authorities determine if net environmental benefit in cleaning removing surface oil and oiled sediment/debris.	Follow process of operational NEBA as for clean-up of oiled shorelines. Intrusive techniques may make situation worse.	Environmental Team Leader Planning Team Leader Operations Team Leader	❑
	Identify and mobilise additional resources to site to undertake clean up and waste management activities onsite.		Operations Team Leader Logistics Team Leader	❑
Ongoing	Conduct ongoing remediation of soil and groundwater affected by hydrocarbon contamination. The relevant Jurisdictional Authority for remediation is DWER and relevant legislation being the Contaminated Sites Act and Contaminated Site Regulations.	Available remediation options to reduce source contamination include methods such as: + use of down-well sorbent materials + use of down-well and trench skimmers + single/dual-phase extraction + vacuum extraction + Thermal and chemical flushing treatments Available remediation options to reduce the spread contamination include methods such as: + Bentonite slurry walls + Sheet pile walls + Permeable reactive barriers + Funnel and gate systems Hydraulic containment systems	Santos WA Contaminated Sites Project Team	❑
Resources			**Location**	

Onshore Response			
Activation time	Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by On-Scene Commander)		
Action	**Consideration**	**Responsibility**	**Complete**
Equipment	Spill kits	Throughout VI Hub onshore facilities	
	Sorbent booms, shore-sealing boom, nearshore boom, skimmer, shoreline clean-up container (shovels, sorbents, wheel barrows, PPE)	VI storage shed	
	Additional booms (sorbent, shore-sealing and nearshore), shoreline flushing/ clean-up equipment and temporary waste storage	Refer **Sections 12** and **13**	
	Waste skips/containers for transportation	North West Alliance	
Personnel	VI Incident Response Team members	VI	
	Santos WA AMOSC Core Group Members	Santos WA operational sites	
	Industry AMOSC Core Group Responders	Industry personnel mobilised through AMOSC	
	National Response Team	Mobilised through AMSA	
	State Response Team	Mobilised through DoT	
Maintenance of response	Santos WA has equipment and personnel available to implement and maintain a shoreline response at the VI Hub. Santos WA has arrangements in place with service providers (e.g. AMSOC) that allows the response to be scaled and sustained beyond the limits of the equipment and personnel from the VI Hub if required.		

14.1 Source Control

Controlling the spill source is the first step in an onshore spill response, following the safety of onshore personnel. This is detailed in **Section 7**.

14.2 Containment and clean-up

Minor spills from handling and storage of hydrocarbons within the onshore Lease area will be contained and removed through the use of onsite secondary containment and spill kits while larger potential releases from process equipment and crude oil storage tanks are contained and controlled through bunding and drainage systems. These pre-existing containment measures within the VI Lease area are described in **Section 8.6** and are not discussed further.

Spill from onshore sections of production pipelines and from the Tanker Loading Line may not be contained and controlled through existing secondary containment systems. Based on the analysis provided in **Section 3.4.1**, onshore contamination at surface would likely be within a 50 m buffer of these pipelines. The use of sorbent materials, including sorbent pads and boom immediately available of VI may be applicable to contain and soak up any hydrocarbons that have not infiltrated sediments and are pooling at surface in this area.

The greatest potential for spread of hydrocarbons at surface is likely to be from any hydrocarbons reaching the tidal zone of shorelines where mobilisation of floating oil could occur. Gradients in the vicinity of onshore pipelines typically slope towards shorelines and while infiltration is expected to be significant oil may be available for mobilisation.

In these instances, deployment of boom (sorbent, shore sealing or nearshore) available on VI may be applicable to contain floating hydrocarbon against the shoreline for removal by sorbents or skimming. This is applicable for the purpose of preventing the spread of hydrocarbons along shorelines, including along Pipeline Beach (used seasonally for turtle nesting/hatching) and towards mangroves at Mangrove Bay. For noting, Level 2/3 onshore spills reaching shorelines and marine waters are under the jurisdiction and control of DoT as the relevant HMA and Control Agency and therefore strategies on shoreline response may be directed by DoT.

Clean up of terrestrial contamination may follow the decision guidelines as per shoreline clean-up identified in **Section 13**, noting that physical removal of contaminated sediments may not be the preferred strategy, depending upon the expected additional environmental impacts of removal. Mangroves, seabird nesting and turtle nesting are existing sensitivities to be considered in decision making for clean-up of terrestrial contamination. If physical removal of surface contamination from an onshore spill is possible and considered to provide greatest environmental benefit, existing clean-up equipment and personnel on VI supplemented with offsite resources as defined in **Section 13**, are considered to apply.

14.3 Site Remediation

The sediments and sub-surface geology at VI encourage infiltration. Investigations of existing contamination at VI suggest a complex subsurface groundwater system influence by the Karstic geology and tidal forcing (refer **Section 3.4.2**).

Spill from onshore sections of production pipelines and from the Tanker Loading Line may not be contained and controlled through existing secondary containment systems. Based on the analysis provided in **Section 3.4.1**, onshore contamination at surface would likely be within a 50 m buffer of these pipelines. The use of sorbent materials, including sorbent pads and boom immediately available of VI may be applicable to contain and soak up any hydrocarbons that have not infiltrated sediments and are pooling at surface in this area.

The greatest potential for spread of hydrocarbons at surface is likely to be from any hydrocarbons reaching the tidal zone of shorelines where mobilisation of floating oil could occur. Gradients in the vicinity of onshore pipelines typically slope towards shorelines and while infiltration is expected to be significant oil may be available for mobilisation.

In these instances deployment of boom (sorbent, shore sealing or nearshore) available on VI may be applicable to contain floating hydrocarbon against the shoreline for removal by sorbents or skimming. This is applicable for the purpose of preventing the spread of hydrocarbons along shorelines, including along Pipeline Beach (used seasonally for turtle nesting/hatching) and towards mangroves at Mangrove Bay. For noting, Level 2/3 onshore spills reaching shorelines and marine waters are under the jurisdiction and control of DoT as the relevant HMA and Control Agency and therefore strategies on shoreline response may be directed by DoT.

Clean up of terrestrial contamination may follow the decision guidelines as per shoreline clean-up identified in Section 13, noting that physical removal of contaminated sediments may not be the preferred strategy, depending upon the expected additional environmental impacts of removal. Mangroves, seabird nesting and turtle nesting are existing sensitivities to be considered in decision making for clean-up of terrestrial contamination. If physical removal of surface contamination from an onshore spill is possible and considered to provide greatest environmental benefit, existing clean-up equipment and personnel on VI supplemented with offsite resources as defined in **Section 13**, are considered to apply.

In the event of an onshore spill, additional monitoring of soil and groundwater would likely be required under contaminated sites legislation, building on historical groundwater monitoring activities.

14.4 Onshore Response Environmental Performance

Table 14-3 indicates the Environmental performance outcomes, controls and performance standards for the onshore response strategy.

Table 14-3: Onshore Response – Environmental Performance

Environmental Performance Outcome	Control the spread of hazardous material Remove surface oil and debris where present and when the strategy provides a net benefit Remediate the site as directed by DWER as applicable.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Onshore Response	Onshore Response	Response undertaken in consultation with DFES and DWER	Incident Log
		Santos WA will make available AMOSC Core Group Responders for onshore 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

Environmental Performance Outcome	Control the spread of hazardous material Remove surface oil and debris where present and when the strategy provides a net benefit Remediate the site as directed by DWER as applicable.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
		Onshore response continues until termination criteria is met, as outlined within the Onshore Response Plan.	Incident Log
	Remediation	Undertake remediation and monitoring as required under Contaminated Sites Regulations 2003	Contaminated Sites records incl. Detailed Site Investigation (DSI) and Remedial Action Plan RAP)

15 Oiled Wildlife Response Plan

Santos WA will provide all necessary resources to assist Department of Transport (DoT) in an oiled wildlife response (OWR) 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 Oiled Wildlife response advice to industry through an Oiled Wildlife Response Advisor. Industry Oiled Wildlife responders are also available through AMOSC mutual aid arrangements. This team will work in conjunction with Department of Biodiversity, Conservation and Attractions (DBCA) OWR capability under the direction of the DoT Incident Command. 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 Incident Command.

The key plan for 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, to define the minimum standards for OWR in WA as a sub-plan to the State Hazard: MEE. The WAOWRP can also be used for guidance to OWR in Commonwealth waters, noting that OWR requirements in State waters are typically greater. The Pilbara Region OWRP, which sits under the WAOWRP provides operational guidance to respond to injured and oiled wildlife in the Pilbara Region and covers the areas potentially contacted by a spill from VI Hub operations.

The sections below provide guidance to the Santos WA IMT on OWR stages of response and implementation. In some cases, the implementation guidance (**Table 15-5**) includes detail which is additional to what is provided in the WAOWRP. The information below should be used in conjunction with the WAOWRP.

Note: For Spill contained solely in Commonwealth Waters, Santos WA is the Control Agency for OWR. DoT is the Control Agency and Department of DBCA is the Jurisdictional Authority for OWR within State waters. DoT is also the lead IMT for Oiled Wildlife Response where the spill covers both Commonwealth and State Waters. The OWR Environmental Performance Outcome, initiation and termination criteria are found in **Table 15-1**.

Table 15-1: Oiled Wildlife Response – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

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			
Initiation criteria	Operational monitoring shows that wildlife are contacted or are predicted to be contacted by a spill			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	+ Oiling of wildlife have not been observed over a 48 hour period; + Oiled wildlife have been successfully rehabilitated; and + Agreement is reached with Jurisdictional Authorities and stakeholders to terminate the incident response.			

15.1 OWR Stages of Response

The WAOWRP includes eight stages to an OWR, which are described in Table 15-2. If an OWR is initiated, implementation will follow these stages, as appropriate to the nature and scale of the incident.

Table 15-2: 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 monitor and evaluate tactics (**Section 9**) 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 Response 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, 2004)
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	Description
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping, release and post-release monitoring
Stage 8: Oiled wildlife response termination	Demobilisation of the OWR should be undertaken in accordance with parameters or endpoints established in the IAP and supplementary Wildlife Response Sub-plan. This decision will be made in consultation with the relevant jurisdictional authorities and support agencies

15.2 OWR Levels and Resourcing

An impact assessment threshold of 10 g/m^2 for impacts on fauna from floating hydrocarbons is provided in the in the Varanus Island Hub Operations Environment Plan (EP) for Commonwealth Waters (EA-66-RI-10003) and the Varanus Island Hub Operations EP (State Waters) (EA-60-RI-00186). This conservative threshold is broadly accepted as being the minimal thickness of surface hydrocarbons that may result in adverse impacts to seabirds through adhesion to feathers and secondary effects (French et al., 1996; French-McCay 2009) and is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997).

Review of the worst-case spill modelling indicates that floating HFO concentrations above 10g/m^2 may extend up to 396 km from the spill location and have a maximum shoreline loading of 1480 m^3, at 100 g/m^2, at the Montebello Islands and effecting 67 km of shoreline. Surveys at the Montebello Islands have recorded 70 bird species, including 12 species of seabird and 14 species of migratory shorebirds (Burbidge et al. 2000). These islands also include both major and minor nesting areas for green, hawksbill, and flatback turtles (Commonwealth of Australia, 2017), with hundreds of turtles nesting annually. Offshore of the Montello Islands, dugong and migrating pygmy blue whales are known to occur.

As a case-study, the grounding of the MV Rena in the Bay of Plenty, New Zealand, which was carrying 1733 tonnes (approx. 1777 m^3) and lost over 360 tonnes (approx. 369 m^3) of HFO, and impacted over 60 km of coastline, resulted in an OWR that lasted 136 days and the treatment of 407 oil affected birds.

Conservative estimates for OWR planning predict a worst-case OWR for this activity will be an OWR Level 5, as defined in the WAOWRP (2014) (**Table 15-3**).

For a Level 5 response, it is expected that up to 116 personnel will be required, with a range of skill levels (**Table 15-4: Oiled Wildlife Response Level and Personnel Numbers**– 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 15-3: 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 15-4: 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

Skill Level	OWR Response Level and Personnel Numbers					
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Total	**7**	**25**	**59**	**77**	**116**	**122**

15.3 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 15-2** will form the key management system which will provide control and oversight over the response.

Table 15-5 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 15-5**) 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 Incident Commander 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 **Table 15-6** and **Appendix L: Oiled Wildlife Response Personnel and Equipment**.

Table 15-5: 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 (OWA) and/or DCBA OWR as outlined in **Section 6.2** 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 **Section 6.1** 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 NEBA. Use this information to help determine: + Initial OWR Response Level (1-6), as defined in the WA OWRP + If OWR activities are likely to result in a net environmental benefit	Oiled wildlife response activities can cause additional stress and mortality on individuals than oil pollution alone. The Environmental Team Leader and Wildlife Division Coordinator will determine via an Operational NEBA whether capture and cleaning of oiled wildlife will result in a net environmental benefit. This may be done in consultation with the DCBA and AMOSC Oiled Wildlife Advisors,	Environmental Team Leader Wildlife Division Coordinator	❑

Action	Consideration	Responsibility	Complete
	and any SME's as relevant (if available, but an Operational NEBA should not be delayed if they are not immediately available)		
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	Consider need for veterinary care	Wildlife Division Coordinator Logistics Team Leader AMOSC OWA DBCA OWA	❑
While waiting for Oiled Wildlife Responders to arrive, Varanus Island HSE Advisors (whom have fauna handling training) may provide a first strike response	Any first strike response will need to occur under the instruction of DBCA	Varanus Island HSE Advisor(s)	❑
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 Liaise with personnel managing monitor and evaluate activities to ensure field activities are coordinated	Wildlife Division Coordinator Wildlife Reconnaissance Officer AMOSC OWA DBCA OWA Planning Team Leader	❑

Action	Consideration	Responsibility	Complete
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 to 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 DBCA OWA OWR field personnel	❑

Action	Consideration	Responsibility	Complete
		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 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	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 temperature-controlled room. The room needs to be well ventilated to disperse the hydrocarbon fumes	Wildlife Division Coordinator Wildlife Veterinarian Wildlife Rehabilitation Officer AMOSC OWA DBCA OWA OWR field personnel Operations Team Leader	❑
Stage 8: Oiled wildlife response termination			

Action	Consideration	Responsibility	Complete
Liaise with Jurisdictional Authorities regarding OWR termination, using endpoints established in the IAP and supplementary Wildlife Response Sub-plan (Termination and Demobilisation section)		Wildlife Division Coordinator AMOSC OWA DBCA OWA Incident Commander	❑

Table 15-6: Oiled Wildlife Response - Resource Capability

Service Provider Capability	Location	Activation Time
WA Oiled Wildlife Response Plan Pilbara Region OWR Plan	N/A	N/A
1. AMOSC oiled wildlife response container and kit (includes wash facility that may treat up to 150 OWR units) 2. AMSA OWR container and kits 3. DBCA OWR container and kit 4. OSRL equipment 5. Vessels via call off contracts	1. Fremantle, plus various locations around Australia (Refer to **Appendix L: Oiled Wildlife Response Personnel and Equipment**) 2. Various locations around Australia (Refer to **Appendix L: Oiled Wildlife Response Personnel and Equipment**) 3. Kensington and Karratha 4. Various locations internationally (Refer to Appendix L) 5. NW Australia	1. 24 hours from Fremantle to Dampier 2. AMSA OWR container positioned in Dampier. 3. 24 hours from Kensington to Dampier 4. 48-72 hours from Singapore to Dampier. 5. 24 + hours
Santos WA is a participating member of AMOSC with access to Mutual aid arrangements. AMSA MoU and OSRL contracts enable access to national and international oiled wildlife expertise (Refer to **Appendix L: Oiled Wildlife Response Personnel and Equipment**)	Various locations around Australia and internationally (Refer to **Appendix L: Oiled Wildlife Response Personnel and Equipment**)	AMOSC Mutual Aid OWR Industry Team can be available within 3 days
Santos WA Capability	**Location**	**Santos WA Activation Time**

Service Provider Capability	Location	Activation Time
5 Santos WA trained Oiled Wildlife Responders	Perth	24 hours
Santos WA HSE Advisors with fauna handling training	Varanus Island	Imminent or actual impact to wildlife
Untrained resources through personnel-hire arrangements	Perth	~72 hours

15.4 Oiled Wildlife Response Plan Environmental Performance

Table 15-7 indicates the Environmental performance outcomes, controls and performance standards for the Oiled Wildlife Response strategy.

Table 15-7 Oiled Wildlife – Environmental Performance

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.
	Varanus Island Oiled Wildlife First Strike Response Plan	Varanus Island Oiled Wildlife First Strike Plan developed prior to end of 2020	Varanus Island Oiled Wildlife First Strike Plan
	Response Implementation		
		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

16 Waste Management Plan

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' 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. The Environmental Performance Outcome, initiation and termination criteria are found in **Table 16-1**.

Table 16-1: Waste Management – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

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			
Initiation criteria	Response activities that will be generating oily waste have been initiated. 2 hours for IMT to activate Waste Service Provider			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	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			

16.1 Waste approvals

Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' 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' 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 activities.

16.2 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)

16.2.1 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. Stochastic modelling conducted for a worst case hydrocarbon release shows that the highest shoreline loading was from an offtake tanker HFO spill (1,900 m3) which could result in a maximum loading of 1480 m^3 on shorelines of the Montebello Islands. Lesser amounts were modelled as potentially arriving at Lowendal Islands (1324 m^3) and Barrow Island (1183 m^3), noting that these worst case loadings come from different model simulations. Conservatively assuming all loaded hydrocarbon are required to be removed from shorelines with a bulking factor of 10x to account for contaminated waste (sediments and organics) collected with the oil, worst case waste storage and transport requirements would be in the order of ~15 000 m3. **Table 16-2** 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, and has been developed based on a significant loss of well control event.

Table 16-2: Waste Service Provider Vehicle and Equipment Availability

Plant and Equipment	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m3)	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
12x Skip Lift Trucks	Lift up to 10 Tonnes	Servicing of skip Bins	7	840	4	3	3	2
10x Front Lift Trucks	28 m^3 Body	Servicing of Front lift bins	7	1960	4	3	2	1
10x Side Loading Truck	18 m^3 Body	Servicing of MGB's	7	1260	1	2	4	3
7x Hook Lift Truck	12 Tonne rated	Servicing of hook lift bins	7	588	3	2	2	N/A
12x Flat Bed Truck	22 pallet spaces	Servicing of bins	7	840	3	6	4	N/A
Waste storage					48 hours	1 week	2 weeks	1 month
500x MGB's	240 litres	Mobile bins	2	48	200	300	N/A	N/A
2x Offshore 8 pack Lifting Cradle (MGB's)	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	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week (m3)	Mobilisation schedule to meet estimated capacity			
					No. Sourced locally	No. Sourced State-wide and Nationally		
6x Lidded Bins	1,100 litres	contain various waste streams	2	13	6	N/A	N/A	N/A
50x Front Lift Bins	3 m^3	various waste streams	2	300	20	30	N/A	N/A
25x Front Lift Bins	4.5 m^3	various waste streams	2	225	10	15	N/A	N/A
100x Offshore Rated Front Load Bins	3 m^3	various waste streams	2	600	40	60	N/A	N/A
45x Offshore Rated Bins	7 m^3	various waste streams	2	630	20	25	N/A	N/A
60x Marrell Skip Bins	6-9 m^3	various waste streams	2	960	20	40	N/A	N/A
12x Hook Lift Bins	15-30 m^3	various waste streams	25	6900	12	N/A	N/A	N/A
4x Forklift	4 tonne Forklift	All areas	continuous	N/A	4	N/A	N/A	N/A

Table 16-3: Implementation Guidance – Waste Management

Action		Consideration	Responsibility	Complete
Initial Actions	Contact WSP (Primary or Secondary Contact Person) and activate Waste Project Manager. Arrange for personnel to attend Emergency Control Centre	Refer to Incident Response Contacts Directory (QE-00-ZF-00025.20) for contact details	Logistics Team Leader (or delegate)	❑
	Provide briefing to WSP personnel once positioned in IMT		Logistics Team Leader (or delegate)	❑
	Using most recent monitor and evaluate data, estimate expected waste volumes to be generated by selected response strategies	It is better to overestimate volumes and scale back resources then to underestimate waste volumes	Logistics Team Leader (or delegate) 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 (or delegate) 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;	Consider facilities for waste segregation at source	Logistics Team Leader Planning Team Leader Deputy Logistics Officer	❑

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Action		Consideration	Responsibility	Complete
	+ Logistical support requirements; + Any approvals required from Ports, Local Governments, Landowners, State Government Agencies (Refer to Waste 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' 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) 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	Alert Logistics Team Leader (or delegate)/ Deputy	WSP Location Responsible	❑

Action		Consideration	Responsibility	Complete
	practices comply with legislative requirements	Logistics Officer (if DoT is the Control Agency) if any non-compliance is anticipated or detected	Person or Operations Supervisor	
	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	❑

Table 16-4: Waste Management- Resource Capability

Service Provider Capability	Location	Service Provider Activation Time
Processes		
Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053)	N/A	N/A
Equipment		
Refer to **Table 16-2** NWA Waste handling and transfer depot	N/A Karratha	48 hours
Personnel		
2 x Project Manager 2 x Operations Supervisor	Perth Karratha	Within 24 hours of activation
Santos WA Capability	**Location**	**Santos WA Activation Time**
Processes		
Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053)	N/A	N/A
Equipment		
Evaporation ponds	Devil Creek Gas Plant	If/when required
Personnel		
Logistics Team Leader or delegate	Perth	On IMT activation
Facility Support Officer		By 8 am of the day following DoT request

16.3 Waste Management Plan Environmental Performance

Table 16-5 indicates the Environmental Performance Outcomes, controls and performance standards for the Waste Management Response strategy.

Table 16-5: Environmental Performance outcomes, controls and performance standards for 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
		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
		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
		Waste management to be conducted in accordance with Santos' 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	Waste reports

17 Scientific Monitoring Plans

The overarching objective of Santos WA's Scientific Monitoring Plans (SMPs) is to provide guidance to staff, consultants and contractors in developing monitoring programs for detecting impacts and recovery to environmentally sensitive receptors contacted by a spill.

Receptor specific SMPs have different objectives as outlined in **Appendix M: Scientific Monitoring Plans**.

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 SMP unless directed otherwise by the relevant Control Agency/s.

Table 17-1 Scientific Monitoring - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

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 or affected by a spill response.				
Initiation criteria	Refer to individual SMPs – **Appendix M f**or receptor specific initiation criteria Monitoring Provider activated within 2 hours of notification from IMT				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔	✔
Termination criterion	Refer to individual SMPs – **Appendix M: Scientific Monitoring Plans**				

17.1 Scope

Santos WA will implement its SMPs, as applicable, for VI Hub spill scenarios 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.

17.2 Relationship to Operational Monitoring

Operational monitoring (**Section 9**) 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.

17.3 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 VI Hub Operations (**Table 17-2**). These are detailed further in **Appendix M: Scientific Monitoring Plans** 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 17-2 : Oil Spill Scientific Monitoring Plans relevant to VI Hub 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 (including Whale Sharks)
SMP9	Marine Reptiles
SMP10	Seafood Quality
SMP11	Fish, Fisheries and Aquaculture
SMP12	Whale Sharks

17.4 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.

There are scientific monitoring components that are suited to pre-impact baseline monitoring. 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. Understanding priority areas for reactive pre-impact baseline monitoring is important. **Section 3** uses stochastic modelling to indicate receptors likely to be contacted at certain thresholds within a specified timeframe. **Section 3** also uses this information to help determine priority protection areas, which would provide an initial focus for reactive pre-impact monitoring.

Santos WA periodically review the status, availability and suitability of existing baseline data sources related to high biodiversity value receptors in their EMBA (for the findings of the latest baseline review refer to **Appendix P**).

In addition to the baseline review, Santos WA is a participant in the Industry-Government Environmental Metadata (I-GEM) Project. The project is a collaborative approach between industry and government to share metadata on quantitative ecological data for key receptors in the mid to north-west of WA.

17.5 Monitoring Service Providers

Oil Spill Scientific Monitoring will be conducted on behalf of Santos WA by a principle contracted Monitoring Service Provider (MSPs) (Astron Environmental Services) and its sub-contracted service provider (BMT), providing capability for the implementation of SMPs 1-11.

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 by the Australian Institute of Marine Science (AIMS) 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.

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 Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) and associated response activation forms; and
+ Participation in audits, workshops, drills and exercise to facilitate readiness.

The specific resourcing requirements and capability for SMP 1-11 first strike monitoring for both Astron and BMT are outlined within 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 capability, and if required, how gaps have been filled. 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. The MSP also provides monthly capability statements outlining availability of resources to implement SMPs. Capability statements are reviewed and filed within the IMT Environment Team Leader folder set and are accessed via the Emergency Response intranet page.

Santos further ensures that its principle monitoring service providers capability and sub-contracting arrangements are adequate through its exercise and auditing program. Santos has conducted exercises and tests with Astron and BMT where the availability of resources has been checked against simulated spill and monitoring requirements. Santo WA has also recently undertaken a tier 2 audit of Astron in 2018 against its Standby Services Manual which demonstrated a high degree of compliance. This included a check of Astron's sub-contracting arrangements. To-date Astron has always demonstrated that it has the required capability in place to meet Santos WA's spill risk needs.

Appendix O 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 Varanus Island Hub Commonwealth water activities.

17.6 Activation

The SMP Activation Process is outlined in **Appendix N: SMP Activation Process.** SMPs are activated as per the initiation criteria for each as outlined in **Appendix M: Scientific Monitoring Plans.** The SMP Activation Form is available on the Santos WA Procedures Index.

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.

17.7 Scientific Monitoring Plan Environmental Performance

Table 17-3 indicates the Environmental performance outcomes, controls and performance standards for the Scientific Monitoring program.

Table 17-3: Environmental performance outcomes, controls and performance standards for 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 or affected by spill response		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Scientific Monitoring	**Response preparedness**		
	Maintenance of Monitoring Service Provider contract for scientific monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity	Contract with monitoring service provider
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Conduct periodical review of existing baseline data sources across the Santos WA combined EMBA	Undertake a review of the status, availability, and suitability of existing baseline data sources every 2 years	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 in finalising monitoring study design, monitoring locations and field methodologies based on operational monitoring information, relative location of sensitive receptors to the spill and the timing of the spill with respect to seasonality of sensitive receptors	Incident Log and Monitoring Service Provider records

18 Forward Operations Plan

The CST and IMT operate from Perth within the Santos WA CST and IMT rooms. These rooms are equipped and subject to regular checks as per Incident Command and Management Manual (QE-00-ZF-00025).

18.1 Forward Operating Base (FOB)

For a significant Level 2/3 response requiring coordination of resources deployed to the field, Santos WA will set up a Forward Operating Base (FOB). For a level 2/3 spill in State waters or a level 2/3 spill crossing from Commonwealth to state waters (cross-jurisdictional spills) DoT will establish a FOB. Section 2.4.3 details requirements for Santos WA providing personnel to a DoT FOB.

For the initial stages of a response to spills associated with infrastructure connected to Varanus Island, the Varanus Island Central Control Room (CCR) will be used as the FOB.

For an ongoing response, a FOB would likely be set-up in Santos WA's Dampier facilities leased from Toll Energy. These facilities are located in Toll Energy's Yard 1 and Yard 2 on Streckfuus Road Dampier; the facilities consist of a conference room and multiple offices that could be used as break-out rooms.

The VI CCR and the Toll Energy Dampier facilities are already connected to the Santos WA internet and telephone system. These facilities are also available to the DoT to establish a FOB for State based response.

18.2 Local facilities

Table 18-1 lists the local facilities around Dampier/ Karratha that may potentially be utilised for response uses.

Table 18-1: Dampier facilities with operational value for response

Facility	Owner / Operator	Potential Uses
Dampier Cargo Wharf	Pilbara Ports Authority	Staging area for vessel loading for spill response equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Toll Dampier Supply Base	Toll Energy Logistics Pty Ltd	Staging area for vessel loading for spill response equipment and waste management
Karratha Airport	City of Karratha	Air freight spill response equipment.
Devil Creek accommodation Searipple Village	Santos WA/Sodexo Searipple Karratha	Spill responders and IMT accommodation Accommodation & messing for clean-up crew
Toll Energy Yard	Toll Energy Logistics Pty Ltd	Transfer yard for truck-based equipment deliveries and waste management, Boom Maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging & repairs Oiled wildlife response centre Laydown / storage area Bunded washing facility for oil booms

Facility	Owner / Operator	Potential Uses
Local boat ramp at Dampier Yacht Club	Leased to Dampier Yacht Club	Load out for near-shore marine based operations Boat launching

18.3 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.

18.4 Wildlife Holding Facility

In the event that handling and rehabilitation of oiled wildlife is required (e.g. birdlife), local facilities will be used in conjunction with mobile oiled wildlife response equipment provided through spill response providers (refer **Section 15**). The Pilbara Region Oiled Wildlife Response Plan details potentially applicable facilities to be used for oiled wildlife response. Based on the potential area of the response and the likely use of Dampier as the closest port for vessel based operations, facilities in the Dampier/Karratha region would be the primary options.

18.5 Freight Movement

The transportation of all equipment and service will be through Santos WA's third party logistics providers.

18.6 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.

18.7 Mobile Plant

Mobile plant and equipment for mechanical clean-up in initial response can be provided from suppliers in Karratha, Exmouth, Port Hedland, Broome or directly from Perth as required.

18.8 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.

18.9 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.

18.10 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.

18.11 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.

18.12 Cleaning and Repair

Cleaning and repair of booms and other operational equipment this can be carried out in bunded areas at the supply base facilities.

18.13 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.

18.14 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.

VI has accommodation facilities and accommodation may also be available on Barrow Island (Chevron facilities) under a request through AMOSC Mutual Aid arrangements.

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.

Santos WA has access to transportable accommodation and messing facilities supplied through Sodexo and its subcontractors.

Where additional support and remote accommodation is required, Santos WA would engage the services of ASCO Transport and Logistics, who provide a complete service for remote messing and accommodation; inclusive of transportation, laundry, potable water etc**.**

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 a 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.

18.15 Providoring

Providoring arrangements when utilising local facilities would be covered under Service Orders / Purchase Order Terms and Conditions. Santos WA has existing contracts with local supplies in Karratha who could be used for additional support for providoring. These supplies would be transported to the respective spill response staging area by one of Santos WA's third party logistics providers.

For transportable and remote messing, the providoring requirements would be provided directly through Sodexo and ASCO Transport and Logistics respectively including the transportation thereof.

18.16 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 Santos WA'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).

18.17 Response Personnel Clean-up Crew

Santos WA can provide an initial clean-up workforce from existing Santos WA and AMOSC staff and contractors. This could provide up to 150 personnel immediately from Varanus Island, Dampier Supply Base, Karratha and Perth office, and AMOSC core group responders from around Australia.

Santos WA has arrangements in place with a number of service providers for providing work-force for its day-to-day operations which would be utilised for providing spill response personnel. Additionally, Santos WA would access labour hire arrangements for untrained work force required for low skill labour intensive operations, including shoreline clean-up and roles within an oiled wildlife facility. On the job training and inductions would be provided to enable personnel to perform their functions safely and effectively.

18.18 Radio Communications

Santos WA would utilise the services of a specialist communication provider, mutual aid arrangements, or control agency arrangements to access 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.

19 Spill Response Termination

The decision to terminate the spill response is made in consultation with the relevant Control Agency/s, Jurisdictional Authorities and other Statutory Authorities that play an advisory role (e.g. DBCA). This decision will be made with consideration of the 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.

20 OPEP Administration

20.1 Document Review and Revision

In line with regulatory requirements, this document shall be reviewed, updated and submitted to DMIRS within every 2.5 years from date of acceptance, and submitted to NOPSEMA within 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 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 State and Commonwealth regulations, i.e. the OPGGS (E) Regulations, P(SL)(E) Regulations and PP(E) Regulations.

20.2 OPEP Custodian

The custodian of the OPEP is Santos WA Senior Oil Spill Advisor:

Position:	Senior Spill Response Advisor
Location	Santos WA Perth Office

21 References

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Appendix A: Hydrocarbon Characteristics and Behaviour

During Varanus Island Hub operational activities, the following hydrocarbons may be unintentionally released to the onshore or marine environment: oily water, hydraulic/ lube oils, petrol, marine diesel, aviation fuel, heavy fuel oil, crude oil and condensate. contains detailed analyses of the condensate and crude oils that are currently produced or stored in bulk. The following sub-sections summarise the characteristics of key hydrocarbons of concern and their weathering behaviour when spilt to the marine environment.

Marine Diesel Oil

ITOPF (and Australian Maritime Oil Spill Centre-AMOSC (2011)) categorises marine diesel as a light group II hydrocarbon. In the marine environment, a 5% residual of the total quantity of marine diesel spilt will remain after the volatilisation and solubilisation processes associated with weathering (**Table A1**).

Table A1: Characteristics of Marine Diesel

Hydrocarbon	Initial density (kg/m3)	Viscosity (cP) @ 25oC	Component	Volatiles (%)	Semi-volatiles (%)	Low volatility (%)	Residual (%)
			Boiling Points (oC)	**<180**	**180–265**	**265–380**	**>380**
Diesel	836.8	4.0	% of total	6	34.6	54.4	<5

In the marine environment marine diesel will behave as follows:

+ Marine diesel will spread rapidly in the direction of the prevailing wind and waves;
+ Evaporation is the dominant process contributing to the fate of spilled marine diesel from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance;
+ The evaporation rate of marine diesel will increase in warmer air and sea temperatures; and
+ Marine 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.

For more details relating to the environmental impacts and risks from marine diesel, see the Varanus Island Hub Operations Environment Plan (EA-60-RI-186) and the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003).

Hydraulic and Lube Oils

Hydraulic oils behave similarly to marine diesel when spilt to the marine environment. These are medium oils of light to moderate viscosity. They have a relatively rapid spreading rate and will dissipate quickly in ocean conditions. Similar to marine diesel, the spill will have a tendency to sit on the surface during calm conditions and will readily entrain during variable winds between 4-19 knots; readily returning to the surface when conditions return to calm. After several days up to 40% could be expected to evaporate and 15% decay (APASA 2013a).

Lubricating oils vary widely but in general are comprised primarily of long-carbon chain, persistent, hydrocarbons (APASA 2013a). 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 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 2013a).

Heavy Fuel Oil (HFO)

Characteristics of HFO were extracted from the Applied Science Associates (ASA) 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 380ºC), that would require weeks to evaporate. A further 83% is composed of non-volatile components (boiling point greater than 380º 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. 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) @ 15oC	Viscosity (cP) @ 25oC	Volatiles (%)	Volatiles (%)	Semi volatility (%)	Low volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (oC)	<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)

The mass balance weathering profile for HFO under the weathering test for variable wind at 27 °C water temperature and 25 °C air temperature is shown in **Figure A1**. The weathering curve indicates that the oil will resist entrainment due to its high viscosity. The oil is forecast to be highly persistent with the majority of the volume remaining as surface oil. The volume on the surface is predicted to drop to approximately 90% of the spill volume, with the decrease evenly balanced between evaporation and decay.

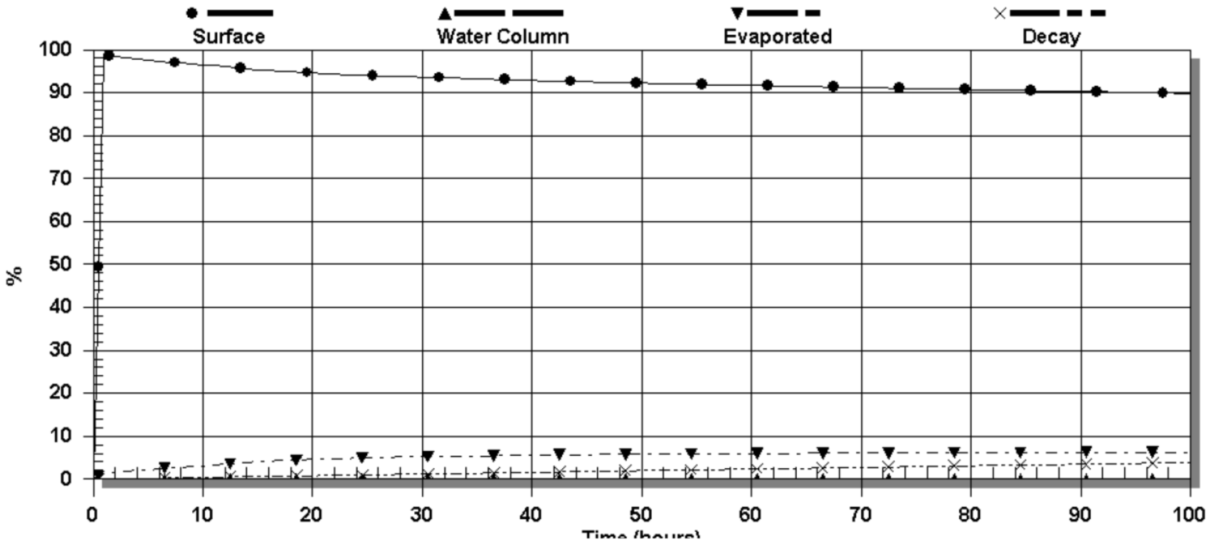


Figure A1: Proportional mass balance plot representing the weathering of Heavy Fuel Oil spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Harriet, Bambra, Simpson and Double Island crude oils

The properties of Harriet crude oil have been derived from analysis of oil collected from the Harriet Alpha platform by Neff et al. (1999) and represents a blend of oils from Harriet wells producing at that platform at time of collection. Detailed data is not available for Bambra, Simpson and Double Island crude oils, however Pressure, Volume, Temperature (PVT) analysis data is available which provides oil density and a derived API gravity as shown in **Table A3**. These densities indicate that Harriet and Bambra are classified as Group 2 light crude oils with API gravity <40 (AMSA, 2015) with Double Island and Simpson-1 exhibiting lighter characteristics as Group 1 oils.

Characteristics of Harriet crude oil derived from the Neff et al. (1999) analysis are summarised in **Table A4**, with further summary data provided in. There is no data relating to compositional breakdown of Bambra (Harriet-B platform), Double Island and Simpson crude oils in terms of boiling point cuts or aromatic hydrocarbon composition. In order to provide this information for spill modelling purposes, data for Harriet crude oil was used. Harriet, Bambra, Double Island and Simpson-1 oils are all light to very light oils. On this basis weathering properties are considered to be broadly similar and Harriet crude properties are considered acceptable for informing the behaviour of oil released to the environment in the absence of field-specific hydrocarbon information.

Harriet crude contains a relatively even distribution of high, moderate and low-volatility components. Approximately 22% of the oil volume is expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 23% has moderate volatility and will evaporate over the first 24 hours, while another 34% will evaporate over a few days. This crude contains a moderate concentration of persistent components (20%) that will resist evaporation and remain on the water surface until decay processes take effect. Harriet Crude is also shown to contain a moderate proportion of aromatic hydrocarbons, being 7% of the whole oil with boiling points below 380 °C.

Table A3: Density/API of Harriet Crude, Bambra, Double Island and Simpson crude oils

Oil Name	Density (g/cm3) @ 25°C	API gravity
Harriet-1 crude	0.8347	38
Bambra crude	0.84156	36.6
Double Island crude	0.7905	47.5
Simpson-1 crude	0.7727	51.6

Table A4: Characteristics of Harriet Crude

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP) (25 °C)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180 C4 to C10	180-265 C11 to C15	265 – 380 C16 to C20	>380 > C20	Of whole oil < 380 °C BP
				NON-PERSISTENT			PERSISTENT	
Harriet Crude	0.83470	4.5	% of total	22.4	23.4	34.0	20.2	7.1
N/A	N/A	N/A	% aromatics	5.1	1.0	1.0	N/A	N/A

Source: APASA (2013b)

The mass balance weathering profile modelled for Harriet Crude under variable winds (4-19 knts) at 27 °C water temperature and 25 °C air temperature is shown in **Figure A2**. The oil is forecast to be moderately persistent with ~50% of the volume remaining as surface oil after a week. The decrease in floating oil is mainly balanced by evaporation, with decayed oil constituting ~5% of the oil mass at the end of the simulation. Evaporation rate is very high during the first 5 hours and then decreases progressively.

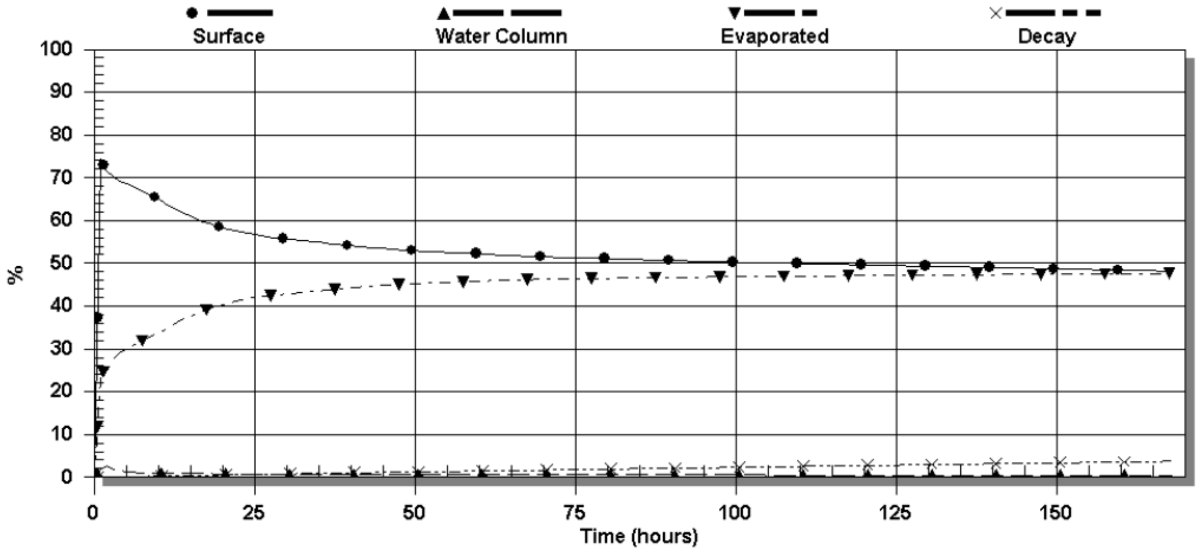


Figure A2: Proportional mass balance plot representing the weathering of Harriet Crude spilled onto the water surface as a one-off release (50 m^3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Agincourt – 1 crude oil

No data on aromatics is available for Agincourt -1 Crude (**Table A5**), therefore for modelling purposes, oil properties were completed using aromatic data from Harriet Crude. The data indicates that Agincourt-1 Crude is relatively volatile, with approximately 62% of the oil volume expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 24% has moderate volatility and will evaporate over the first 24 hours, while another 8% will evaporate over a few days. This crude has a low concentration of persistent components (6%). The aromatic hydrocarbons with boiling point below 380 °C represent approximately 15% of the whole oil.

Table A5: Characteristics of Agincourt–1 Crude

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP) (25 °C)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180 C4 to C10	180-265 C11 to C15	265 – 380 C16 to C20	>380 > C20	Of whole oil < 380 °C BP
				NON-PERSISTENT			PERSISTENT	
Agincourt–1 Crude	0.7884	1.702	% of total	62.2	23.5	8.1	6.2	15.3
N/A	N/A	N/A	% aromatics	14.1	1.0	0,2	N/A	N/A

Source: APASA (2013b)

The mass balance expected for Agincourt -1 Crude under the weathering test for variable wind (4-19 knts) at 27 °C water temperature and 25 °C air temperature is shown in **Figure A3**. It is predicted that there will be very high levels of evaporation to the atmosphere, with 85% of the released crude evaporated at the end of the simulation. It also shows that a small percentage (~2%) of the crude may entrain into the water column with winds of greater strength.

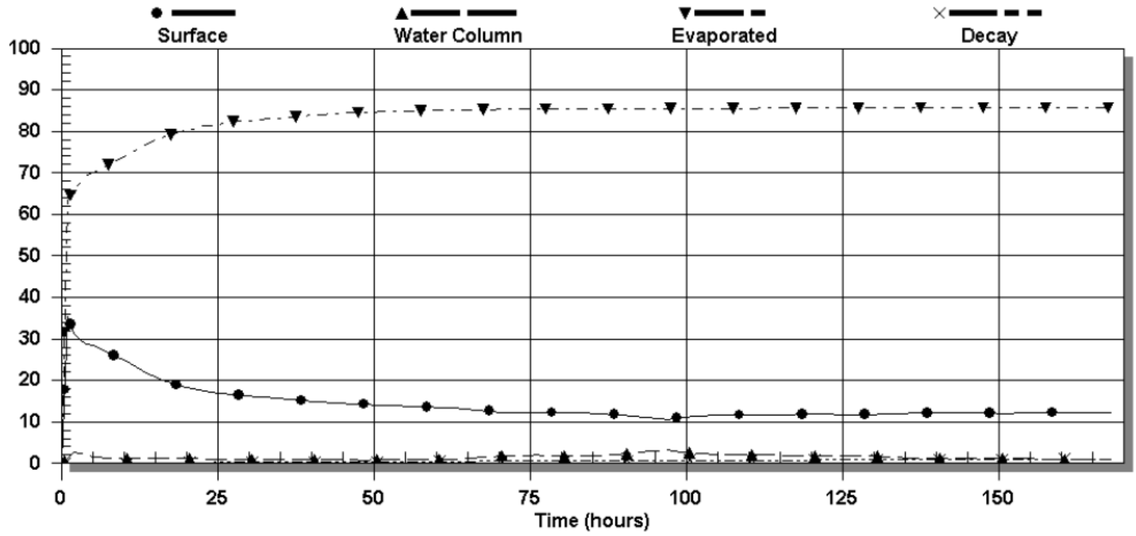


Figure A3: Proportional mass balance plot representing the weathering of Agincourt-1 Crude spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Wonnich, Rose and Linda condensates

Spill modelling has been conducted for credible spill scenarios at the Wonnich and Linda platforms. At the time of modelling there was no assay data available for condensates produced from these platforms, although density data was available for Wonnich and Rose condensates. Modelling studies were therefore undertaken using compositional data of Brunello-1 condensate, for which assay data was available at the time of modelling. Brunello-1 was considered appropriate as a proxy given its similarity as a light Group 1 non-persistent oil with a density of 0.778 g/cm^3 @ 15°C vs 0.775 g/cm^3 @ 20°C (Wonnich) and 0.69 g/cm^3 @ 15°C (Rose).

The characteristics of Brunello – 1 condensate, as obtained from assay reports, are summarised in **Table A6**. The data indicates that Brunello-1 condensate is relatively volatile, with approximately 57% of the oil volume expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 24% has moderate volatility and will evaporate over the first 24 hours, while another 19% will evaporate over a few days. This condensate does not contain persistent components. Brunello-1 Condensate is also shown to contain relatively high proportion of aromatic hydrocarbons, being 12% of the whole oil with boiling points below 380 °C.

Since modelling was conducted, an assay has been performed of condensate produced from the Linda platform (Linda condensate). These results have been added to **Table A6.** and show that Linda condensate shows similar characteristics to Rose condensate in terms of density, and to Brunello condensate in terms of its composition and aromatic content. Both Brunello-1 and Linda condensates show a high proportion of components in the volatile range and significantly lower proportions of components in the semi-volatile and low volatile range (**Table A6**). Full assay date for Linda condensate is included in **Table A6**.

Table A6: Characteristics of Brunello-1 and Linda Condensates

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180 C4 to C10	180-265 C11 to C15	265 – 380 C16 to C20	>380 > C20	Of whole oil < 380 °C BP
				NON-PERSISTENT			PERSISTENT	
Brunello - 1	0.7785	1.260 @25°	% of total	57.0	24.0	19	0.0	11.9
N/A	N/A	N/A	% aromatics	7.9	3.4	0.6	N/A	N/A
Linda	0.7966	1.602 @20°	% of total	56.0	16	28		10.9

Source: APASA (2013b), Intertek (2014)

The mass balance expected for Brunello-1 Condensate under the weathering test for variable winds (4-19 knts) at 27 °C water temperature and 25 °C air temperature is displayed in **Figure A4**. It shows a very high level of evaporation for this oil type, with over 80% of the mass being released to the atmosphere in the first 24 hours. It also shows that with winds of greater strength entrainment into the water column can occur, with approximately 20% of the initial volume entraining after two days, and with an absence of floating oil by the end of the simulation period.

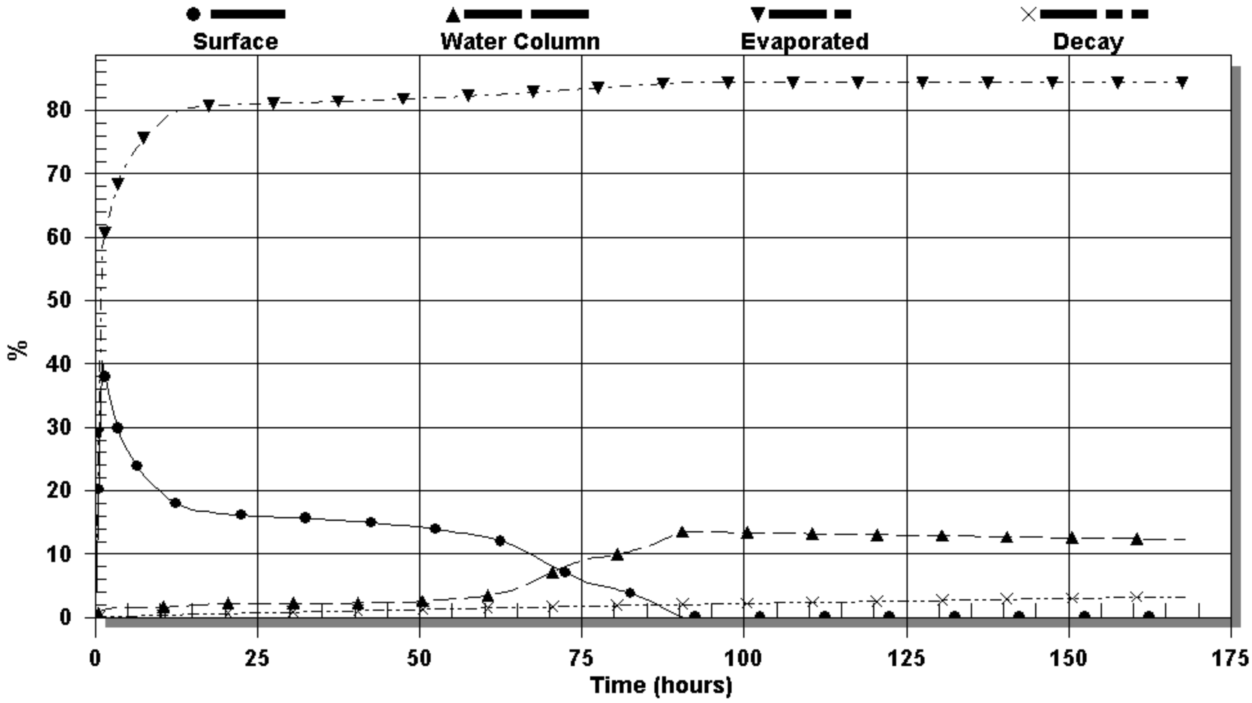


Figure A4: Proportional mass balance plot representing the weathering of Brunello-1 Condensate spilled onto the water surface as a one-off release (50 m^3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

John Brookes condensate

John Brookes condensate is a light oil classed as a “Group 1 Non–persistent oil” (AMSA, 2015). Characteristics of John Brookes Condensate were specified from assay reports, and are summarised in **Table A7**. The data indicated that the condensate is highly volatile, with approximately 64% of the oil, by mass, expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 24% has moderate volatility and will evaporate over the first 24 hours, while another 10% will evaporate over a few days. It is then expected that the remaining 2% will be persistent components that will linger in the marine environment for an extended period of time. If the discharge is released at the seabed, the oil will only be exposed to atmospheric conditions and experience evaporation if it reaches the surface. The soluble aromatic hydrocarbons represent a moderate proportion of the mass of John Brookes Condensate, at approximately 24% with boiling points below 380 °C. Approximately 14% of the whole oil consists of mono-aromatic hydrocarbons with high volatility and solubility while polynuclear aromatic hydrocarbons (PAHs) represent ~10% with lower volatility and solubility.

Modelling studies of spill scenarios from the John Brookes pipeline were conducted prior to an assay for John Brookes condensate being available. For that modelling, Brunello-1 condensate, for which an assay was available, was used to inform spill modelling hydrocarbon parameters. The characteristics of Brunello-1 condensate have been described in **Table A6**. Both Brunello-1 and John Brookes condensate have a similar density and viscosity and are Group1 hydrocarbons. They both have a high proportion of volatile components (57% vs 64%) and negligible proportion of residual components (≤2%). The largest difference between the two condensates is in the proportion of aromatic hydrocarbons (11.9 vs 23.6%). APASA (2014) conducted a study comparing the two condensates in terms of weathering behaviour and its influence on previously modelled results. The study showed the two condensates exhibit a similar weathering pattern under the same environmental conditions. Modelling results comparisons indicate that the use of Brunello-1 condensate as a proxy for John Brookes condensate likely overestimates the concentration of floating oil and entrained oil reaching sensitive receptors but overestimates the exposure of nearby receptors to dissolved aromatic hydrocarbons in the short term.

Table A7: Characteristics of John Brookes condensates

Condensate	Initial density (g/cm3) (15 °C)	Viscosity (cP) (20 °C)	Boiling Points (°C) and Carbon (C) numbers	Volatiles	Semi-volatiles	Low volatility	Residual	Aromatics
				<180 (C4-C10)	180-265 (C10-C15)	265-380 (C16-C20)	>380 (>C20)	Of whole oil <380 BP
				Non-persistent			Persistent	
John Brookes	0.778	1.229	% of total	64	24.3	9.7	2	23.6
			% aromatics	13.9	5.2	4.5	–	

Data source: APASA (2014)

The modelled weathering profile of a worst case John Brookes Condensate spill when released from the surface at a constant rate over 100 days under variable wind conditions is displayed in **Figure A5**. The results indicate that the rate of evaporation would be similar to the rate of discharge. As a result, evaporation would keep the oil volume on the surface low, with evaporation accounting for around 90% of the volume after the first ten days of the blowout. The volume in the water column is forecasted to slowly decrease over the duration of the simulation and by around 30 days into the spill, is expected to account for less than 5% of the volume. Decay and evaporation losses represent approximately 8% (3,100 m^3) and 90% (34,000 m^3), respectively, of the total oil mass by the end of the 128-day simulation period in this example.

The modelled weathering profile of a worst case John Brookes Condensate spill released from the seabed at a constant rate over 100 days under variable wind conditions is displayed in **Figure A6**. The results indicate that condensate would initially build up in the water column in entrained form but this representation would steadily decrease over the duration of the simulation, with around 50% of the volume 40 days after the blowout commencement to around 10% by the end of the simulation, with losses due to degradation and evaporation as the main processes. A low volume of oil is expected at the surface over time (<1% of the release), due to the combination of slow surfacing rates and evaporation. Decay and evaporation losses represent approximately 74% (27,000 m^3) and 14% (5,000 m^3), respectively, of the total oil mass by the end of the simulation period in this example.

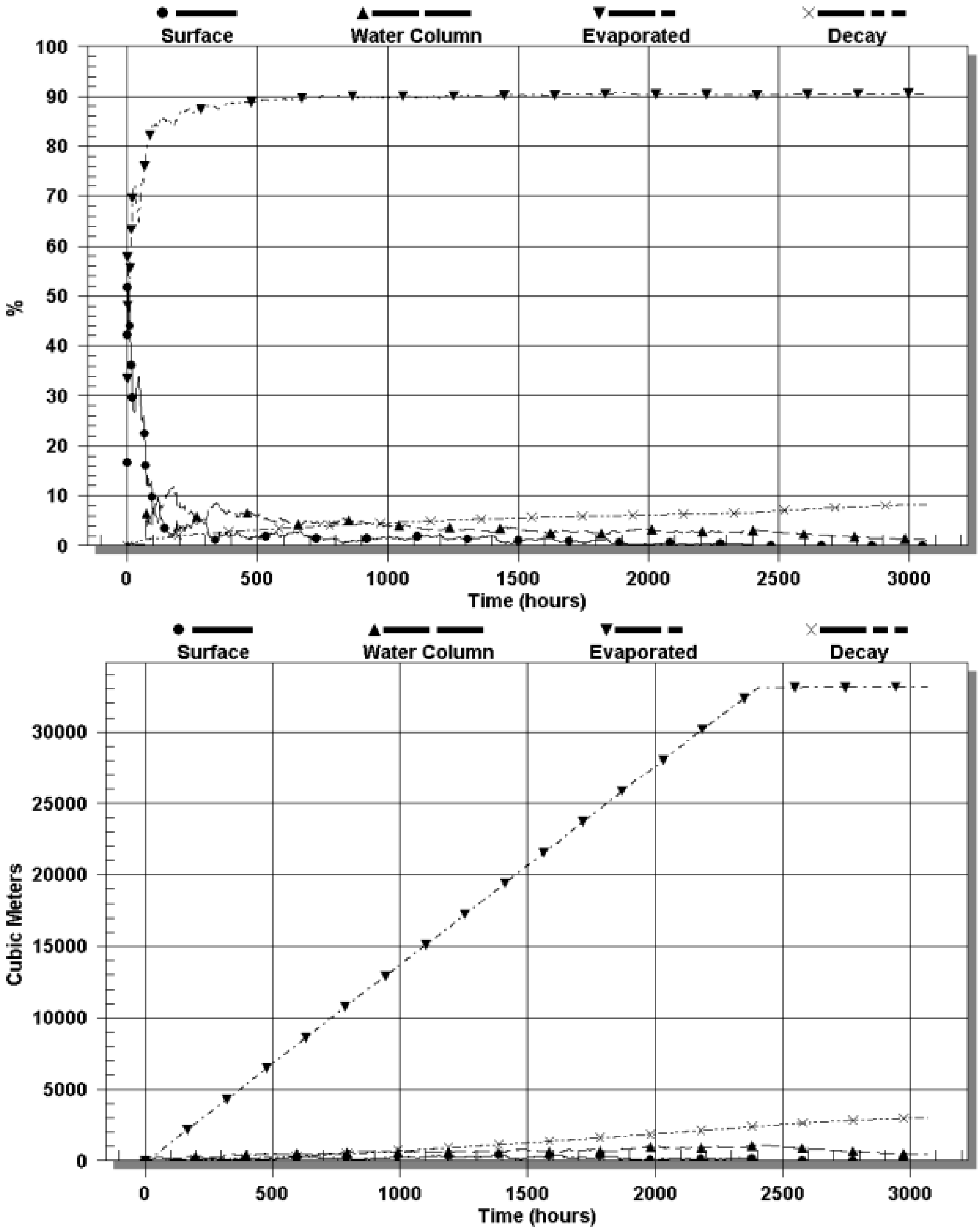


Figure A5: Predictions for the partitioning of oil mass over time through weathering processes for a 39,011m³ surface release of John Brookes Condensate at a constant rate over 100 days, as percentage (top) and by volume (bottom). Predictions are based on examples of time varying environmental conditions.

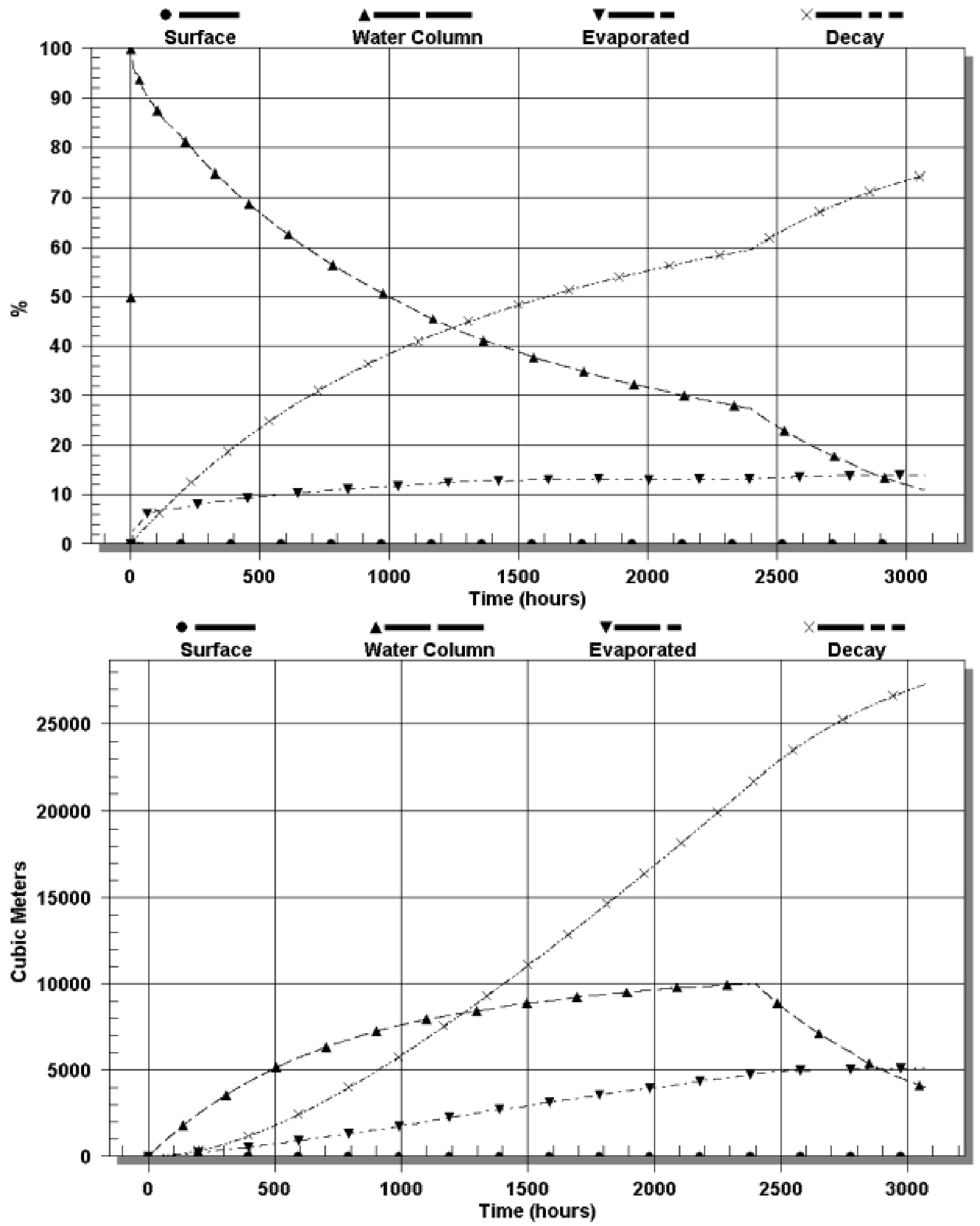


Figure A6: Predictions for the partitioning of oil mass over time through weathering processes for a 39,011m^3 subsea release of John Brookes Condensate at a constant rate over 100 days, *as percentage (top) and by volume (bottom). Predictions are based on examples of time-varying environmental conditions*

Halyard condensate

Characteristics of Halyard-1 Condensate (**Table A8**) were obtained from assay and for the purposes of modelling, completed using Brunello-1 Condensate as a guide to set appropriately-scaled aromatic concentrations. The data indicates that Halyard-1 Condensate is highly volatile, with approximately 86% of the oil volume expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 11% has moderate volatility and will evaporate over the first 24 hours, while another 3% will evaporate over a few days. This condensate contains a very low proportion of persistent components (0.1%). When the discharge is released at the seabed, condensate will only be exposed to atmospheric conditions and experience evaporation if it reaches the surface and becomes floating condensate. Halyard-1 Condensate is also shown to contain a relatively high proportion of aromatic hydrocarbons, being 15% of the whole oil with boiling points below 380 °C.

Table A8: Characteristics of Halyard-1 Condensate

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP) (25 °C)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180 C4 to C10	180-265 C11 to C15	265 – 380 C16 to C20	>380 > C20	Of whole oil < 380 °C BP
				NON-PERSISTENT			PERSISTENT	
Halyard condensate	0.781	1.26	% of total	86.4.	10.7	2.8	0.1	15.2

Predictions for the fate of a continuous surface release of Halyard-1 Condensate at the seabed under representative ambient conditions are shown in **Figure A7**. The results indicate that the oil remained mainly in the water column where it is subject to decay with less than 25% decaying over 14 days. A high proportion of the oil that reaches the surface is rapidly evaporated. This, in conjunction with the entrainment process, stops oil from accumulating on the surface. Around 15% is lost to the atmosphere by the end of the simulation period.

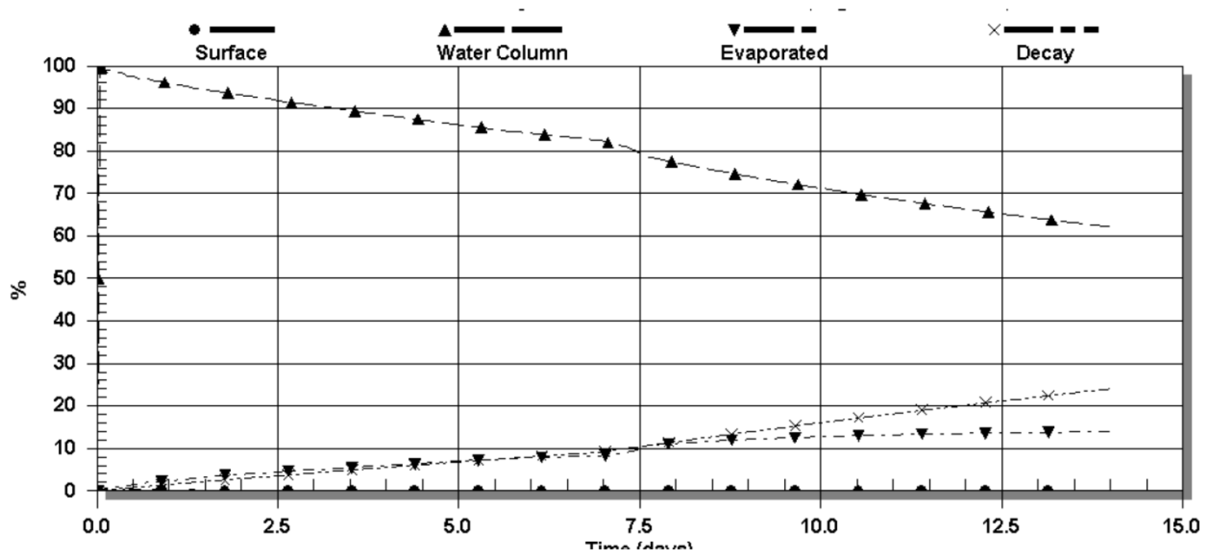


Figure A7: Prediction for the partitioning of oil mass over time through weathering processes (% of total mass) of Halyard-1 Condensate

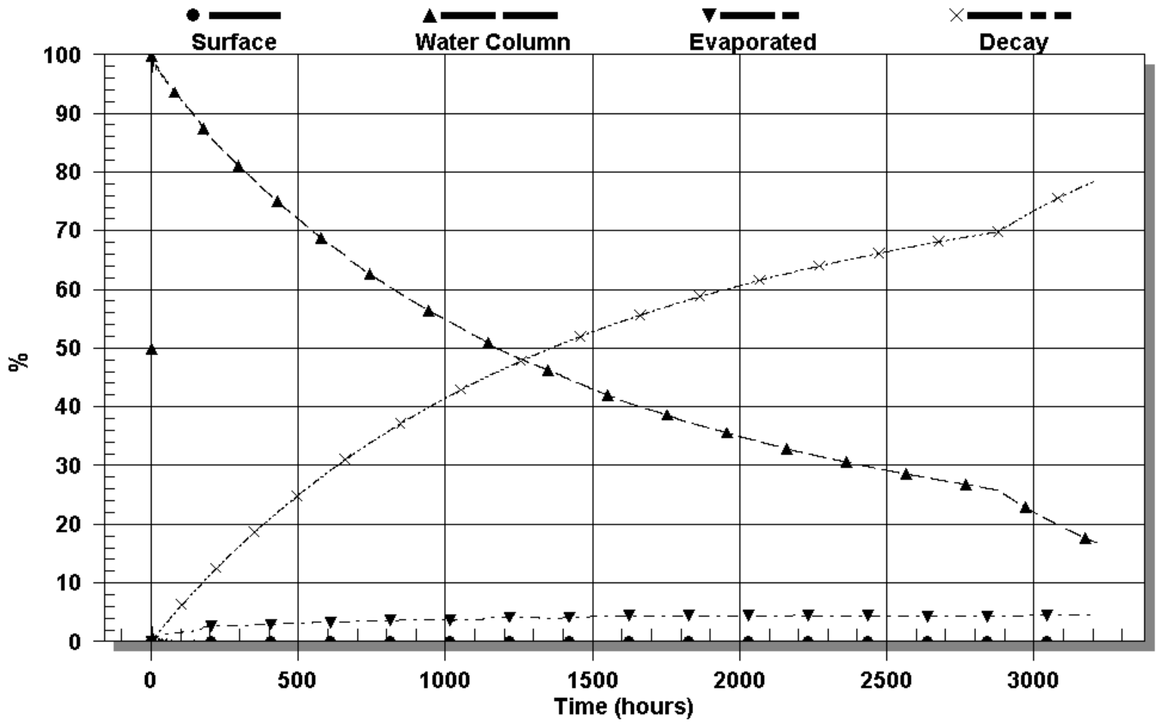
East Spar condensate

The characteristics of East Spar condensate are presented in **Table A9**. This condensate shows greatest proportion of volume is in the volatile and semi-volatile cuts with a low proportion of low volatility hydrocarbons and no residual component following weathering. Aromatic hydrocarbons, representing toxic MAHs (including BTEX) and low molecular weight PAHs, represent 6% of total volume of the condensate (**Table A9**).

Table A9: Characteristics of East Spar condensate

Initial density (g/cm3) (15 °C)	Viscosity (cP) (20 °C)	Component	Volatiles	Semi-volatiles	Low volatility	Residual	Aromatics
		Boiling Points (°C)	<140 C4-C10	180-265 C11-C15	265-380 C16-C20	>380 >C20	Of whole oil <380 °C BP
			NON-PERSISTENT			PERSISTENT	
0.726	1.26	**% of total**	74.7	19.3	6.0	0.0	6
		% aromatics	3.9	2.1	0.0		

Predictions for the fate of a worst case subsea release of East Spar Condensate over 120 days under representative ambient conditions are shown in **Figure A8**. The results indicate that most of the oil would remain in the water column, with decay being the main process that would limit the amount of entrained and dissolved oil. The volume of oil in the water would peak at around 750 m^3 after the end of the 120 day leak. Decay and evaporation losses would represent 70% and 5%, respectively, of the total oil mass by the end of the simulation period.



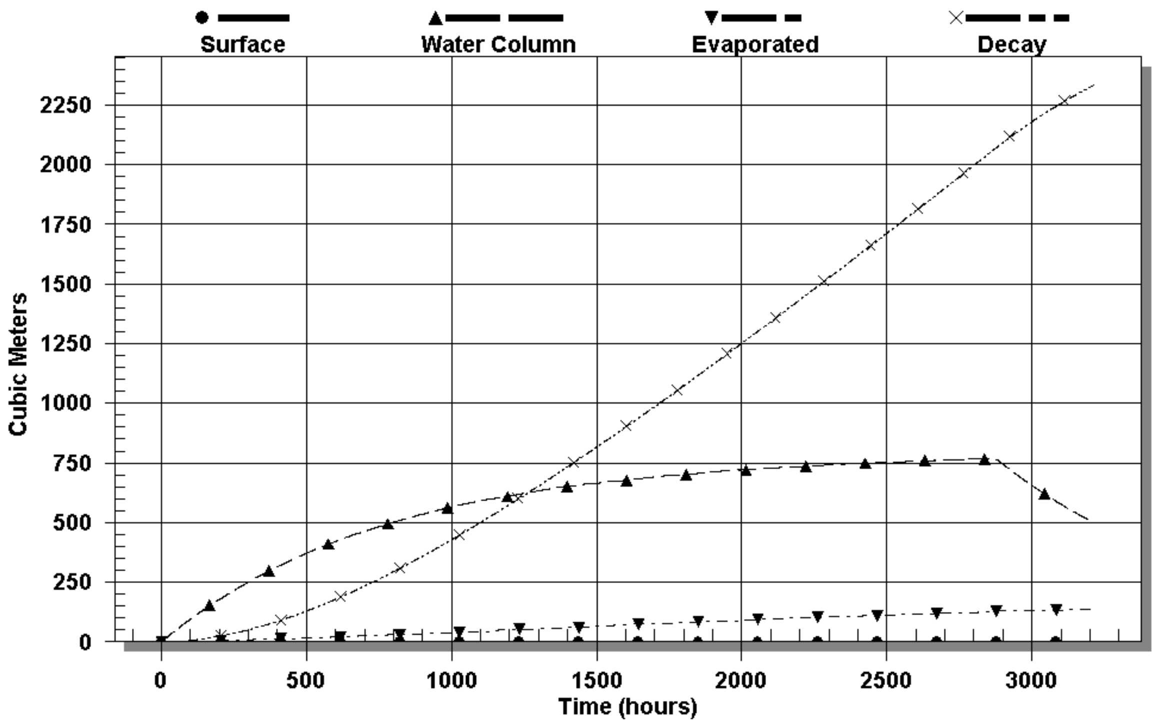


Figure A8: Predictions for the partitioning of oil mass over time through weathering processes for a worst case 3,393m^3 seabed release of East Spar Condensate at a constant rate over 120 days, as percentage (top) and by volume (bottom). Predictions are based on examples of time varying environmental conditions.

Varanus Island Blend crude

Characteristics of Varanus Island Blend crude (**Table A10**) were specified from assay reports and for the purposed of oil spill modelling, completed using Harriet Crude as a guide to set appropriate aromatic concentrations in the upper boiling-point range. The data indicates that Varanus Island Blend crude is relatively volatile, with approximately 55% of the oil volume expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 20% has moderate volatility and will evaporate over the first 24 hours, while another 16% will evaporate over a few days. This crude contains a low proportion of persistent components (9%). When the discharge is released at the seabed, crude will only be exposed to atmospheric conditions and experience evaporation if it reaches the surface and becomes floating crude. Varanus Island Blend Crude is also shown to contain a relatively high proportion of aromatic hydrocarbons, being 9% of the whole oil with boiling points below 380 °C.

Table A10: Characteristics of Varanus Island Blend Crude

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP) (25 °C)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180 C4 to C10	180-265 C11 to C15	265 – 380 C16 to C20	>380 > C20	Of whole oil < 380 °C BP
				NON-PERSISTENT			PERSISTENT	
VI Blend Crude	0.77600	1.007	% of total	55.3	20.4	15.6	8.7	8.8
N/A	N/A	N/A	% aromatics	7.0	1.4	0,4	N/A	N/A

Source: APASA (2013b)

The mass balance weathering profile for Varanus Island Blend crude for variable wind at 27 °C water temperature and 25 °C air temperature is shown in **Figure A9**. It shows a high level of evaporation, with over 75% of the mass being released to the atmosphere in the first 24 hours. It also shows that with winds of greater strength entrainment into the water column can occur, with approximately 30% of the initial volume entraining after two days, and with less than 1% of the oil mass on the surface by the end of the simulation period.

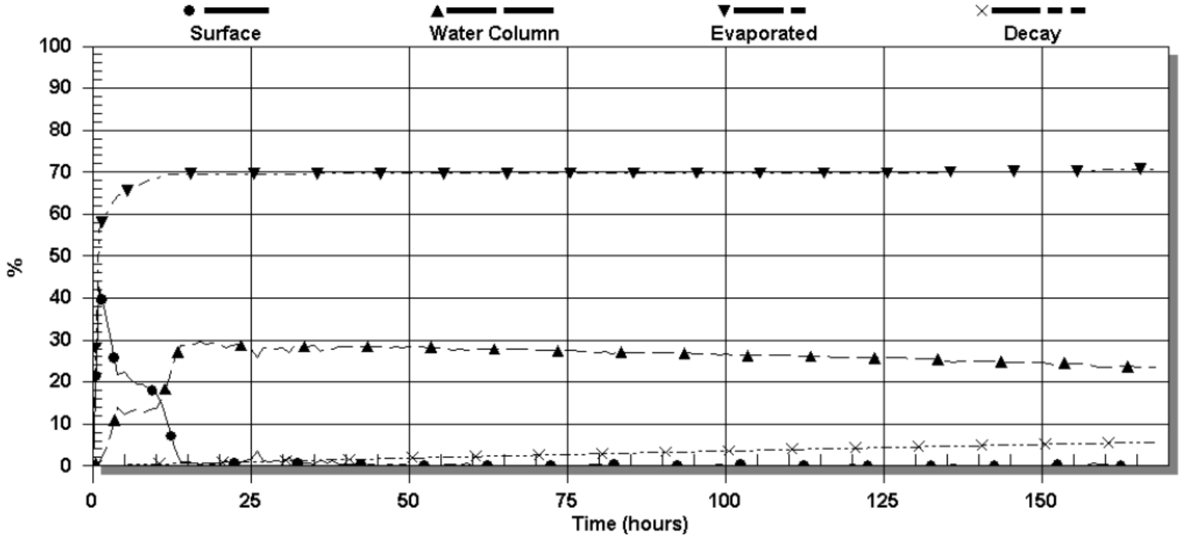


Figure A9: Proportional mass balance plot representing the weathering of Varanus Island Blend Crude spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Appendix B: POLREP

Department of **Transport**

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

Marine Pollution Report (POLREP)

Return completed form to:
Maritime Environmental Emergency Response
Department of Transport
Email: marine.pollution@transport.wa.gov.au and rccaus@amsa.gov.au
Phone (08) 9480 9924
Fax: 1300 905 866

INCIDENT DETAILS

Date of Incident: ________________ Time of Incident *(24 hr format)*: ______________

Location name/description: ____________________

Incident Coordinates Latitude of spill ____________________ **Longitude of spill** ____________________

Format of coordinates used *(select one)* ☐ *Degrees & decimal degrees* ☐ *Degrees, minutes & decimal minutes* ☐ *Degrees, minutes & seconds*

Description of Incident: ____________________

POLLUTION SOURCE

☐ Vessel ☐ Land *(Specify)* ____________ ☐ Other *(Specify)* ____________ ☐ Unknown

Vessel type *(if known)* ☐ Tanker ☐ Container ☐ Bulk ☐ Cargo
☐ Fishing ☐ Defence ☐ Recreational ☐ Other *(Specify)* ____________

Vessel name: ____________ Flag State / Callsign: ____________ Australian vessel? ☐ Yes ☐ No

POLLUTANT

☐ **Oil** *(type)* ☐ Bilge ☐ Diesel ☐ HFO bunker ☐ Crude ☐ Unknown ☐ Other *(Specify)* ____________

☐ **Chemical** Name: ____________ MARPOL cat / UN Nos: ____________

☐ **Garbage** Details/description: ____________

☐ **Packaged** Details/description: ____________

☐ **Sewage** Details/description: ____________

☐ **Other** Details/description: ____________

EXTENT

Size of spill ***(length & width in metres):*** ____________

Amount of pollutant, if known ***(litres):*** ____________

Has the discharge stopped? ☐ Yes ☐ No ☐ Unknown

Weather conditions at site: ____________

☐ **Photos taken** Details: ____________ held by: ____________

☐ **Video taken** Details: ____________ held by: ____________

☐ **Samples taken** Description: ____________ held by: ____________

☐ **Items retrieved** Description: ____________ held by: ____________

ADDITIONAL INFORMATION

Response action undertaken? ☐ Yes ☐ No If yes, provide details below, please include any environmental impact.

Equipment used? ☐ AMSA ☐ State / NT ☐ Industry

Is assistance for an investigation required from DoT ☐ Yes ☐ No

ORIGINAL REPORT SOURCE

Name:______________________________ Position: ______________________ Phone: ______________

Combat agency:________________________ Statutory agency: ______________________________________

SENDER DETAILS

Name:______________________________ Agency: ___________________________ Date:____________

Phone: ______________ Fax: ________________ Email:______________________________________

PRIVACY STATEMENT

The Department of Transport is collecting the information on this form to enable it to carry out its role as Jurisdictional Authority as per WestPlan - Marine Oil Pollution. The Department of Transport and/or AMSA may give some or all of this information to other government bodies, non-government organisations who have responsibilities under the National Plan, and law enforcement agencies.

Once you have completed the form please check that all relevant fields have been filled with accurate data.
To post the form please click on the "POST" button opposite.

POST Reset Form

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

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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

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Aerial Surveillance Observer Log – Oil Spill

Survey Details			
Date:	Start time:	End Time:	Observer/s:
Incident:		Area of Survey:	
Aircraft type:	Call sign:	Average Altitude:	Remote sensing used:

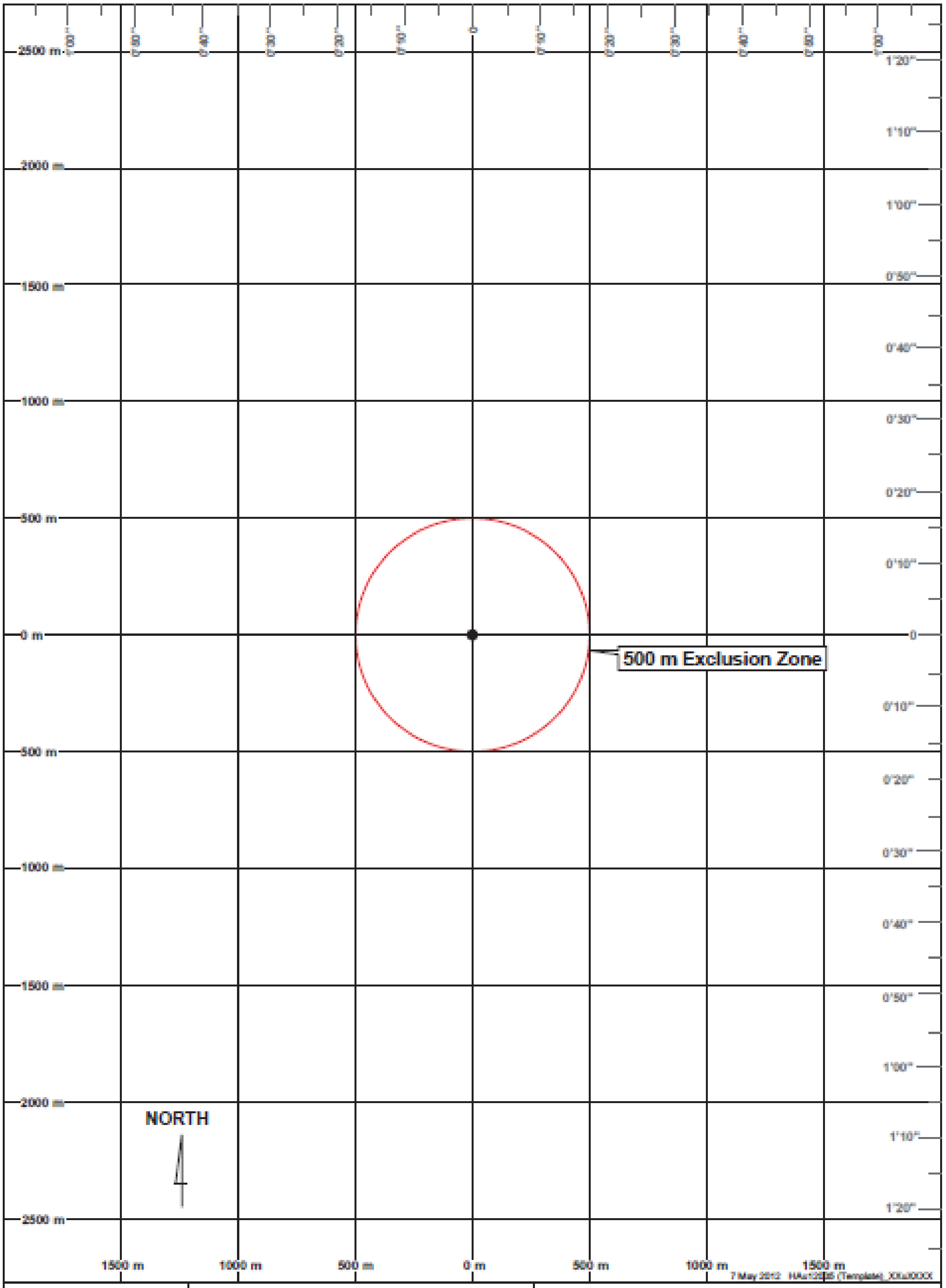
Weather Conditions	
Wind speed (knots)	Wind direction
Cloud base (feet)	Visibility
Time high water	Current direction
Time low water	Current speed (nM)

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

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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					

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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

<u>Observer Name</u>	<u>Observer signature</u>	**Observer** ◯ Inexperienced ◯ Experienced

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Appendix H: Aerial Surveillance Shoreline Observation Log

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Aerial Surveillance Reconnaissance Log – Oil Spill

<table>
<tr><td colspan="6">Survey Details</td></tr>
<tr><td>Incident:</td><td>Date:</td><td>Start time:</td><td>End Time:</td><td colspan="2">Observer/s:</td></tr>
<tr><td colspan="6">Area of Survey</td></tr>
<tr><td colspan="3">Start GPS
LATITUDE:

LONGITUDE:</td><td colspan="3">End GPS
LATITUDE:

LONGITUDE:</td></tr>
<tr><td>Aircraft type</td><td colspan="2">Call sign</td><td colspan="2">Average Altitude</td><td>Remote sensing used (if any)</td></tr>
<tr><td colspan="6">Weather Conditions</td></tr>
<tr><td colspan="2">Sun/Cloud/Rain/Windy</td><td colspan="2">Visibility</td><td colspan="2">Tide Height
L/M/H</td></tr>
<tr><td colspan="2">Time high water</td><td colspan="2">Time low water</td><td colspan="2">Other</td></tr>
<tr><td colspan="6">Shoreline Type - Select only ONE primary (P) and ANY secondary (S) types present</td></tr>
<tr><td></td><td>Rocky Cliffs</td><td></td><td>Boulder and cobble beaches</td><td></td><td>Sheltered tidal flats</td></tr>
<tr><td></td><td>Exposed artificial structures</td><td></td><td>Riprap</td><td></td><td>Mixed sand and gravel beaches</td></tr>
<tr><td></td><td>Inter-tidal platforms</td><td></td><td>Exposed tidal flats</td><td></td><td>Fine-Medium sand grained beaches</td></tr>
<tr><td></td><td>Mangroves</td><td></td><td>Sheltered rocky shores</td><td rowspan="2"></td><td rowspan="2">Other</td></tr>
<tr><td></td><td>Wetlands</td><td></td><td>Sheltered artificial structures</td></tr>
<tr><td colspan="6">Operational Features (tick appropriate box)</td></tr>
<tr><td></td><td>Direct backshore access</td><td></td><td>Alongshore access</td><td></td><td>Suitable backshore staging</td></tr>
<tr><td colspan="6">Other</td></tr>
</table>

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.	-

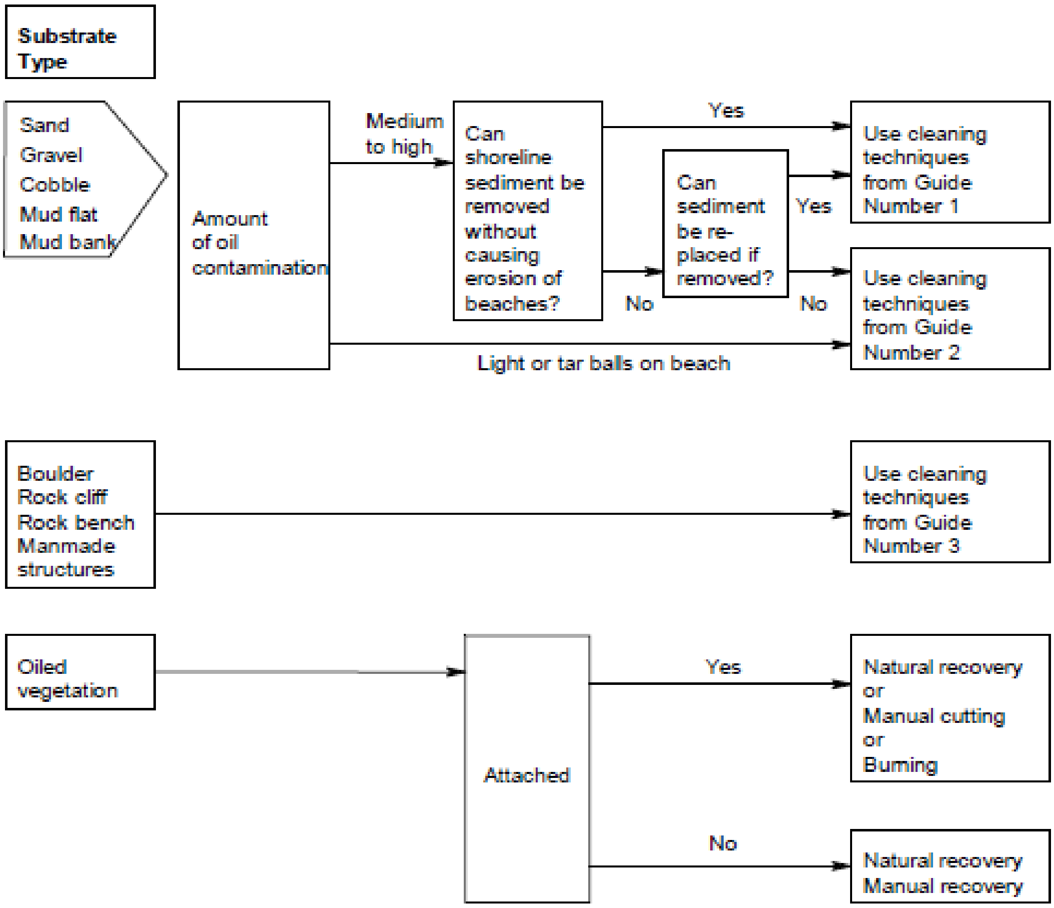

Figure 1: Shoreline Clean-up Master Decision Guide

Shoreline Cleanup Decision Guide Number 1

TRAFFICABILITY		SUBSTRATE TYPE	DEPTH OF OIL PENETRATION	CLEANUP TECHNIQUES IN ORDER OF PREFERENCE	ACCESS
1. Can rubber-tyred equipment operate on beach?	Yes	Sand, Gravel, Mud	Less than 3cm	Motor Grader and Elevated Scraper Combination. Elevated Scraper. Motor-Grader and Front-End Loader (Rubber-Tyred) Combination.	**3.** Is there access to beach for heavy equipment or can access be constructed?
			Greater than 3cm	Elevated Scraper. Front-End Loader (Rubber-Tyred). Bulldozer and Front-End Loader (Rubber-Tyred) Combination.	
		Cobble	Less than 30cm	Front-End Loader (Rubber-Tyred).	
			Greater than 30cm	Bulldozer and Front-End Loader (Rubber-Tyred) Combination. Front-End Loader (Rubber-Tyred).	
		Mud Bank	Not applicable	Backhoe. Front-End Loader (Rubber-Tyred).	
No ↓					
2. Can tracked equipment operate on beach?	Yes	Sand, Gravel, Mud, Cobble	Less than 30cm	Front-End Loader (Tracked). Bulldozer and Front-End Loader (Tracked) Combination.	
			Greater than 30cm	Bulldozer and Front-End Loader (Tracked) Combination. Front-End Loader (Tracked).	

Access (3) → Select most preferable technique

No (from 2) → Use dragline or hydraulic grader or leave to natural recovery.

No (from 3) → Go to next figure, Decision Guide Number 2, Question 4.

Figure 2: Shoreline Clean-Up Decision Guide 1

Shoreline Cleanup Decision Guide Number 2

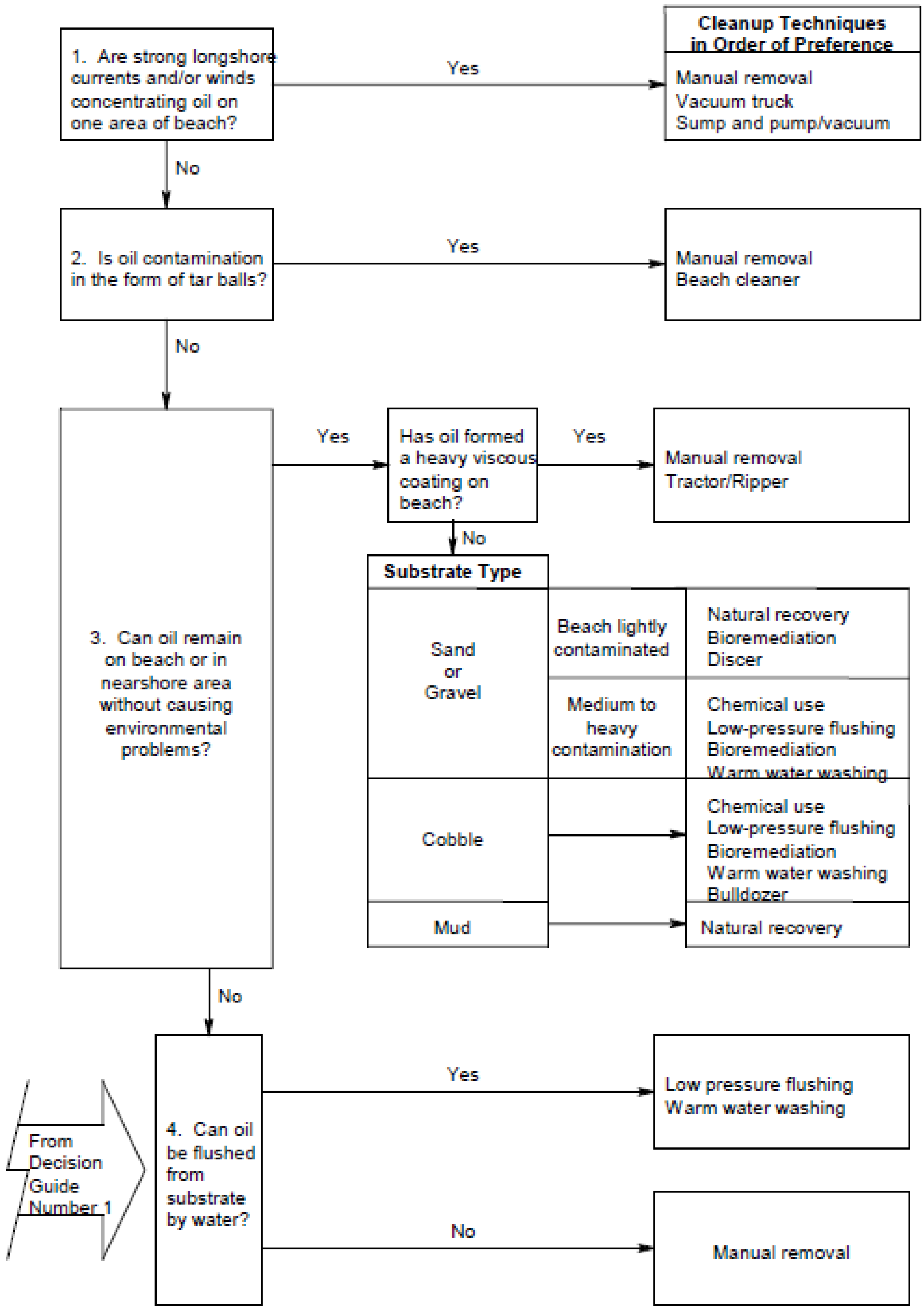

Figure 3: Shoreline Clean-Up Decision Guide 2

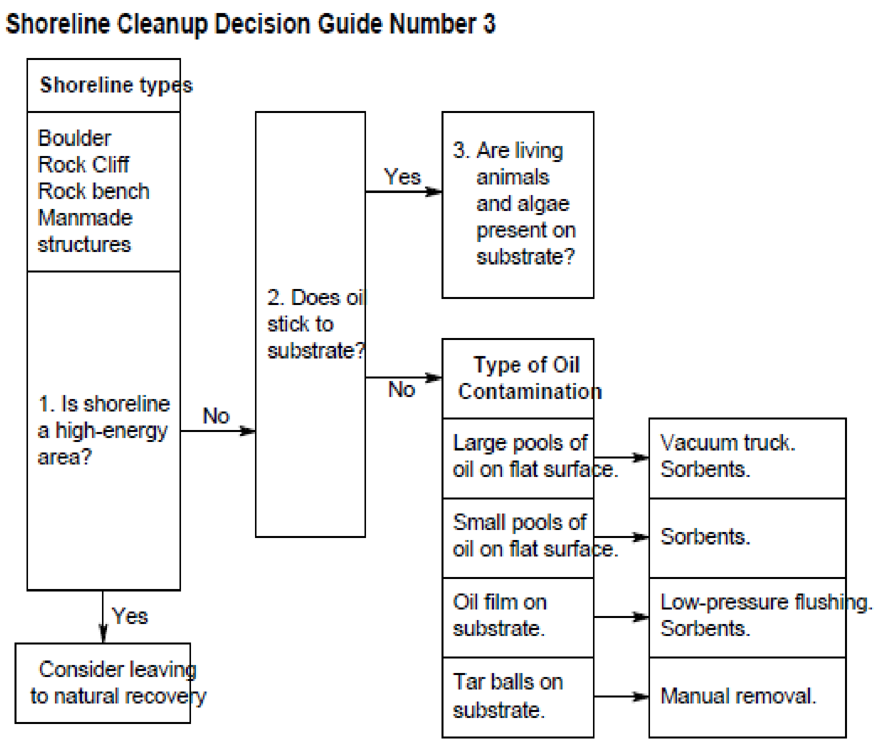

Figure 4: Shoreline Clean-Up decision Guide 3

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	✓ Bins, barrels, skips, tanks
✓ Barrier tape and stakes	✓ Hot and cold beverages Welfare)
✓ Signposting equipment	✓ Cooking oil, soap (Welfare)
	✓ Earthmoving equipment

PRIMARY STORAGE OF WASTE

A primary storage site is:

- ✓ An emergency staging area of the immediate deposit of the waste collected before its transfer to either an intermediate long term storage site or if possible directly to a treatment facility; and
- ✓ A key stage in the waste management process for sorting, labelling and quantifying the types and volumes of waste collected and when possible, reducing volumes to be transported by pre-treatment.

The storage site must be closed as soon as clean-up operations are completed.

The return of the site to its original condition implies:

- ✓ A contamination diagnosis made by an organisation specialised in ground pollution, decontamination operations if needed and the approval of the authorities; and
- ✓ In some cases, botanical evaluations to define a plant cover restoration operation.

✓ Segregate the different types of waste
✓ Protect containers from rain water and to contain odours
✓ Protect containers from prolonged exposure to sunlight if necessary
✓ Ensure security to prevent unauthorised dumping

Primary waste storage sites should meet certain criteria:

- ✓ Close proximity to the site of clean-up;
- ✓ Good access to roads for heavy lorries; and
- ✓ A flat area with enough space away from environmentally-sensitive areas (vegetation, groundwater) and out of reach of the sea tides and waves.

- ✓ Depending on the volume of waste, site characteristics and availability of containers, prepare:
    - o Staging areas
    - o Pits if necessary
    - o Platform within earth berms
    - o Platform for bagged solids and liquids in tank.
- ✓ Protect areas using watertight plastic liners
- ✓ Lay fine gravel or sand at the base of the storage area to protect the membranes
- ✓ Prepare rain water or effluent management
- ✓ Ensure correct labelling of the containers to avoid mixing the different types of waste (liquid, solid, non-biodegradable – oiled plastics, contaminated cleanup equipment, biodegradable – oiled seaweed, faunal)
- ✓ Control access to the cleanup sites and protect access routes using lining and/or geotextiles

BASE CAMP/REST AREA

The rest area (base camp) should at least consist of:

- ✓ Changing rooms;
- ✓ Toilets; and
- ✓ A rest area.

At base camp, operators must be provided with:

- ✓ A first aid kit; and
- ✓ Hot and cold beverages, meals.

Selection of the rest area must meet certain criteria:

- ✓ Close proximity to the clean-up site;
- ✓ Easy access; and
- ✓ A flat area with enough space away from environmentally sensitive areas.

Equipment

- ✓ Shelter/rest area (tent, temporary building;
- ✓ Portable toilets (at least one for men and one for women);
- ✓ Locker rooms;
- ✓ First aid kit;
- ✓ Fire extinguisher; and
- ✓ Communication equipment.

STORAGE AREA FOR EQUIPMENT AND MACHINERY

This area consists of and equipped repair and maintenance site.

In order to avoid incidents and clean-up equipment failures, equipment should only be used by trained personnel and all equipment should regularly be checked for conformity with standard operating procedures and safety.

✓ Check and adjust daily levels of gasoline, diesel, oil, water and other fluids ✓ Regularly maintain the machines (pumps, pressure washers...) ✓ Equipment must be checked, counted by the person in charge of logistics and stored daily at the end of the work day ✓ Some pieces of equipment must be washed or at least rinsed daily, with proper recovery of cleaning effluent, other kinds of equipment should be washed weekly or at the end of operations ✓ Set up a systematic maintenance-cleaning-repair operation at the end of each week ✓ Small tools and equipment and even detachable parts of all equipment remaining outside should be securely stored away (eg stainless steel bucket of small sand screeners) ✓ In case of interruption of operations, large pieces of equipment should be moved to a supervised site ✓ Regularly check equipment for conformity and safety

The storage area for equipment and machinery must meet certain criteria:

- ✓ Close proximity to the site of clean-up;
- ✓ Easy access; and
- ✓ A flat area with enough space away from environmentally-sensitive areas.

Equipment

- ✓ Cabins;
- ✓ Hut;
- ✓ Maintenance equipment and tools; and
- ✓ Cleaning equipment.

1.1.2 Manual clean-up guidelines

Oil, polluted sediment and debris are removed by hand or with the help of manual tools and then stored for disposal.

Conditions of use

- ✓ Pollution : all types ; most often scattered pollution; on large spills, if implementation of other techniques is impossible;
- ✓ Pollutant : all types;
- ✓ Substrate : all types; sufficient load bearing capacity for pedestrians and light equipment; and
- ✓ Site: all types sufficiently accessible and which tolerate intensive traffic.

Equipment

Basic Equipment:

- ✓ Scrapers (paint scrapers, long handle scrapers...), rakes, brushes, forks; and
- ✓ Landing nets, shovels, trowels.

Extra Equipment:

- ✓ Waste containers, big bags, bins, plastic bags; and
- ✓ Front-end loader (for disposal).

PPE: At least protective clothing: overalls, boots, gloves, etc. depending on the nature of the pollutant, expose and responder activity.

- ✓ Divide the response personnel among three functions:
  - o Collection/scraping/gathering
  - o Placing in bags/waste containers
  - o Disposal
- ✓ Rotate the teams among the three functions;
- ✓ The waste can be disposed of manually or with the use of mechanical means if possible;
- ✓ Don't overfill bins, plastic bags; and
- ✓ Don't remove excessive quantities of sediments.

Impact

- ✓ Impact insignificant to heavy, depending on the type of substrate. Risk of destroying the structure of the substrate in marshes. Erosion;
- ✓ Potentially destructive effects on vegetation (dunes, marshland);
- ✓ Deconstruction and destabilisation of the foot of the dune (upper end of beach); erosion, destruction of the dune and the associated vegetation, decrease in biodiversity and fertility by reduction of the low water mark; and
- ✓ Can tend to fragment the oil in certain conditions.

Performance

This is a highly selective technique, but requires a lot of time and personnel. If not done correctly, there is a risk of removal of large quantities of clean sediment.

1.1.3 Mechanical clean-up guidelines

This technique consists of collecting the oil in order to facilitate its removal from the beach. Collection is carried out using a tractor, ATV or earthmoving vehicle or earthmoving equipment.

Conditions of use

- ✓ Pollution : heavy pollution, continuous slick;
- ✓ Pollutant : slightly to very viscous oil;
- ✓ Substrate : vast, flat foreshore with wet fine-grain sand (very damp to saturated) and a good load-bearing capacity, without ripple marks; and
- ✓ Site: accessible and sufficient load bearing capacity for earthmoving equipment, sufficiently large to allow vehicles to manoeuvre.

Equipment

Basic equipment:

- ✓ Backhoe loader;
- ✓ Grader/bulldozer;
- ✓ Tractor or loader with front blade; and
- ✓ Front-end loader or lorry (for removal).

PPE: At least suitable for heavy machinery operation

Impact

- ✓ Normally only removes the oil, but some sediment may also be taken with it (if the operator is poorly supervised or inexperienced), especially if used on light pollution or an unsuitable site;
- ✓ High risk of disturbance due to traffic and mixing of oil with sediment; and
- ✓ May lead to reduction of beach stability and beach erosion/loss of beach area.

Minimum workforce required: 2 people per vehicle (1 drive + 1 assistant)

Waste: oil mixed with a varying quantity of sediment; but can rapidly become unselective if scraping is carried out on moderate pollution (should be avoided)

- ✓ Consists of bringing the oil together in order to facilitate its removal from the beach. Scraping is carried out using a tractor or earthmoving equipment fitted with a front end blade in an oblique position. According to the viscosity of the oil, two options are available:
  - o (case 1) fluid oil: radial or converging scraping towards a collection point on the foreshore; removal by pumping
  - o (case 2) more viscous oil /solids: concentration to form windrows, by successive slightly curing passes parallel to the water line; subsequent removal of windrows
- ✓ Should only be carried out on heavy pollution; do not use on moderate to light pollution
- ✓ Inform and supervise operators; use experienced operators
- ✓ Work methodically
- ✓ Set up traffic lanes on the beach in order to reduce oil and sediment mixing

- ✓ Don’t remove excessive amounts of non-contaminated materials
- ✓ Don’t fill the bucket of loader more than 2/3 capacity
- ✓ Don’t drive on polluted materials

1.1.5 Shoreline vessel access guidelines

There are numerous landing craft vessels available in the North West Shelf area. These vessels are capable of grounding out; therefore the vessels can access a contacted area on high tide, ground out, unload equipment and personnel, reload with waste oil then depart on the next high tide. Landing craft vessels are supplied through Quadrant Energy existing vessel suppliers.

Mechanical equipment and PPE are to be mobilised to the nominated marine operational base for onward movement to the affected locations.

For shoreline clean-up of remote islands the following guidelines will be considered so as to minimise the secondary impacts of high numbers of spill response personnel on shorelines:

Vessels are to be mobilised to the designated deployment Port to mobilise shoreline clean-up teams by water. The shoreline clean-up will be undertaken through on-water deployment to the defined shorelines in 4 stages:

(1) Drop off of 6-person clean-up containers (refer below) to shoreline contact locations defined by IMT through observation data;

(2) Deployment of marine and environmental specialists to demarcate the clean-up zones with barrier posts and tape to prevent secondary impacts to flora and fauna by the clean-up teams;

(3) Deployment of small clean-up teams with a trained/competent shoreline responder as a Team Leader to conduct clean-up methods (flushing, bag and retrieve, etc.) with all waste being bagged and stored in temporary bunding made of HDPE above the high-high tide mark; and

(4) Deployment of the waste pickup barges to retrieve collected wastes from the temporary bunding and to complete the shoreline clean-up and final polishing.

Appendix 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.

Further detail on OWR capacity accessed through AMOSC, OSRL/Sea Alarm and through Santos WA Workforce hire arrangements is provided below.

Table 1: Sources of Oiled Wildlife Response Personnel

<table>
<tr><th colspan="2">AMOSC / INDUSTRY RESPONDERS</th><th>Activated through</th><th>Capability</th></tr>
<tr><td colspan="2">AMOSC Technical Advisor – Oiled Wildlife – assistant in IMT (as industry OWA if required)</td><td rowspan="4">AMOSC Duty Officer</td><td>1*</td></tr>
<tr><td colspan="2">AMOSC OWR Industry Team– Level 2-4 responders (DBCA training)</td><td>18*</td></tr>
<tr><td colspan="2">WA Petroleum Industry Personnel – 20 Trained in OWR management by Massey University through AMOSC</td><td>20</td></tr>
<tr><td colspan="2">WA Petroleum industry personnel – Trained by individual petroleum industry companies – activated via mutual aid</td><td>~50*</td></tr>
<tr><th colspan="2">AUSTRALIAN OWR EXPERTISE</th><th>Activated through</th><th>Capability</th></tr>
<tr><td colspan="2">Blue Planet Marine (ACT and WA) – Oiled Wildlife Responders</td><td rowspan="3">AMOSC Duty Officer</td><td>10-20*</td></tr>
<tr><td colspan="2">Phillip Island National Parks (VIC) – Oiled Wildlife Responders</td><td>~70 staff
~45 volunteers*</td></tr>
<tr><td colspan="2">NatPlan Mutual Aid</td><td>50-100*</td></tr>
<tr><td rowspan="2">Perth Zoo – Duty Veterinarian</td><td>Wildlife care and rehabilitation advice, expertise and management</td><td colspan="2" rowspan="2">Personnel potentially available to petroleum industry (currently there is no formal arrangement)</td></tr>
<tr><td>Links to wildlife</td></tr>
</table>

	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

Santos WA workforce hire arrangements

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 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	OSRL Duty Officer	UK

2 x Cleaning and rehabilitation response package		
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)

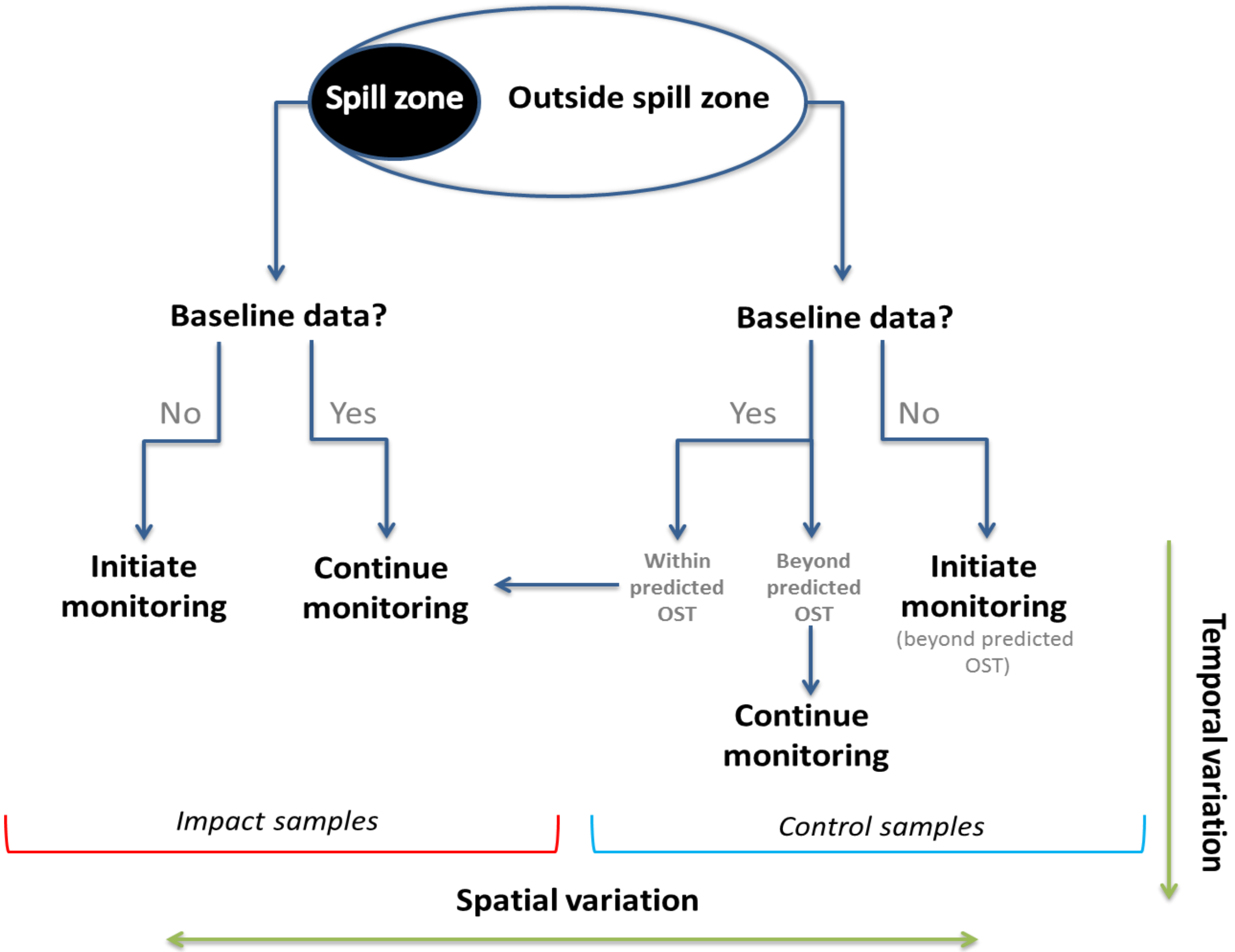

Figure 1: Structured decision making process based on Gregory et al. (2012) in reference to monitoring programs, the availability of baseline data, and oil spill trajectory. In an ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

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.

SMP1 – Marine Water Quality	
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 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).
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.

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

SMP2 - Sediment Quality	
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 7. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 8. 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; 9. 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.

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.

SMP4 - Shorelines and Coastal Habitats – Mangroves	
Receptor impact	Impact to mangroves from pressures including hydrocarbons is measured through change in: • Tree health • Aerial extent. Other pressures to these states are: • Physical disturbance • Discharge of toxicants • Litter • Introduction of marine pests • Dust • Sedimentation from human activities • Climate change.
Methodological approach	Remote sensing data will be accessed for the purpose of detecting change in aerial cover and change in canopy health through and index of plant health (e.g., NDVI or MSAVI) (Astron Environmental Services 2013). Where long term on-ground baseline monitoring has occurred, further post impact 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.
Scope of works	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Implementation	On-ground monitoring will only occur where long-term baseline data has been collected, and hence no post-spill pre-impact data collection will be required. On-ground post-spill data will be collected at an appropriate time as guided by the analysis of remote sensing imagery, and potential on-ground assessment.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to test statistically significant change to parameters associated with hydrocarbon spill. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

2.5 SMP5 Intertidal Mudflats

SMP5 - Shorelines and Coastal Habitats – Intertidal Mudflats	
Rationale	Intertidal mudflat communities are primary producer habitats which support invertebrate fauna, which in turn provides a valuable food source for shorebirds. High diversity of infauna (particularly molluscs) occur within these habitats and may be affected by penetrating oil. At high tide, these habitats become foraging grounds for vertebrates such as rays and sharks. While there is some localised disturbance, most of the communities in the area of interest are generally in an undisturbed condition. These habitats are at high risk of impact as the sheltered environments promote high faunal diversity combined with low-energy wave action.
Aim	To monitor changes in intertidal mudflat communities associated with an oil spill and associated activities.
Baseline	Refer Baseline Data Review (QE-00-BI-20001) . In addition, the IGEM shall be reviewed for applicable intertidal mudflat infauna baseline data.
Initiation criteria	Operational Monitoring, SMP1 or SMP2 indicates that mudflat habitats are contacted or predicted to be contacted by a hydrocarbon spill. 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	Mudflat infaunal assemblages are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated; AND Clean-up of the shoreline site has been completed.
Receptor impact	Impact to mudflat epifauna and infauna from pressures, including hydrocarbons, is measured through change in: • Species diversity • Assemblage composition • Abundance of indicator taxa. Other pressures to these states are: • Physical disturbance • Discharge of toxicants • Overfishing (bait collecting) • Introduction of marine pests • Climate change.

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

<table>
<tr><th colspan="2">SMP6 - Benthic Habitats</th></tr>
<tr><td>Rationale</td><td>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.</td></tr>
<tr><td>Aim</td><td>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.
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).</td></tr>
<tr><td>Baseline</td><td>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.</td></tr>
</table>

SMP6 - Benthic Habitats	
Initiation criteria	Benthic habitat cover and composition Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill. Coral health and reproduction Operational Monitoring, SMP1 or SMP2 indicates that coral habitat is contacted or is predicted to be contacted by a hydrocarbon spill. 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	Benthic habitat cover and composition Cover and composition of benthic habitats are not statistically significantly different from that of their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages. Coral health and reproduction Hydrocarbon concentration in corals, reproductive state and settlement indices are not statistically different from the baseline state (where baseline data exists) or from comparable non-impacted assemblages.
Receptor impact	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.

<table>
<tr><th colspan="2">SMP6 - Benthic Habitats</th></tr>
<tr><td>Methodological approach</td><td>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.</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>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.</td></tr>
</table>

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

<table>
<tr><th colspan="2">SMP7 - Seabirds and Shorebirds</th></tr>
<tr><td>Rationale</td><td>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.</td></tr>
<tr><td>Aim</td><td>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.</td></tr>
<tr><td>Baseline</td><td>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.</td></tr>
<tr><td>Initiation criteria</td><td>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.</td></tr>
<tr><td>Termination criteria</td><td>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).</td></tr>
</table>

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.
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).

SMP8 - Marine Megafauna	
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.
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.

SMP9 - Marine Reptiles	
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.
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.
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).

SMP10 - Seafood Quality	
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.
Termination criteria	The following termination criteria will be adopted in consultation with WA DPIRD-Fisheries, DAWR – Fisheries, AFMA and Department of Health. 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.

SMP10 - Seafood Quality	
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	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).

SMP11- Fish, Fisheries and Aquaculture	
Receptor impact	Impact to fish, fisheries and aquaculture from pressures including hydrocarbon concentrations is measured through change in: • Species diversity • Abundance of indicator taxa • Assemblage structure • Health. Other pressures to these states are: • Accidental chemical spillage • Over fishing • Introduction of marine pests • Habitat disturbance • Climate change.
Methodological approach	Fish assemblages will be assessed using the stereo-baited remote underwater videos (BRUVs) following Shortis et al. (2009). 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.
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.

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 within Biologically Important Areas (BIAs) at the Ningaloo Coast and north Western Australian coastline.

Baseline	Baseline monitoring information of whale sharks includes: 1) Aerial survey. Monthly surveys funded by Woodside Energy were completed from 2000 to 2002. 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

1.1 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.

1.2 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.

1.3 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 (Ningaloo)(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 1 (Barrow/ Montbello/ Lowendal Islands), and Astron’s actual capability. Scenario 1 was used to demonstrate capability as it requires the most personnel simultaneously to undertake priority baseline surveys. When determining actual team capability, personnel were only allocated to a single SMP team.

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 1 capability assessment for rapid sampling of Montebello/Barrow/Lowendal Islands area within seven days.

Receptors	Priority Protection Areas			Required capability for rapid response (per Priority Protection Area)	Actual Team Capability
	Montebello Islands	Barrow Island	Lowendal Islands		
Water Quality (SMP1)	Priority survey	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	Priority survey		
Sandy Beaches/Rocky Shorelines (SMP3)	Priority survey	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	Priority survey		
Mangroves (SMP4)	Survey	Survey	Survey	Not required[3]	Not required
Benthic Habitats (SMP6)	Priority survey	Survey	Priority survey	1 teams of 2 personnel • at least one team member with experience in benthic habitat assessment • ROV operator or divers	2 teams of 2 personnel
Seabirds/ shorebirds (SMP7)	Priority survey	Survey	Survey	1 ground-based survey team of 2 personnel[2] • at least one member be experienced ornithologist	4 teams of 2 available
Marine megafauna (SMP8)	Survey	Survey	Priority survey	1 aerial survey team of 2 personnel[1] • both to be experienced wildlife observers 1 vessel-based survey team of 2 personnel[1] both to be experienced wildlife observers	2 teams of 2 available (aerial) 2 teams of 2 available (vessel)

Receptors	Priority Protection Areas			Required capability for rapid response (per Priority Protection Area)	Actual Team Capability
	Montebello Islands	Barrow Island	Lowendal Islands		
Marine reptiles (SMP9)	Priority survey	Survey	Survey	1 aerial survey team of two personnel[1] • both to be experienced wildlife observers 1 vessel-based survey team of two personnel[1] • both to be experienced wildlife observers 1 ground-based survey team of 2 personnel[2] • at least one member with experience in turtle survey techniques	2 teams of 2 available (aerial)[4] 3 teams of 2 available (vessel)[4] 3 teams of 2 available (ground-based)[5]
Seafood Quality (SMP10)	Priority survey	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
Fish, Fisheries & Aquaculture (SMP11)	Priority survey	Priority survey	Priority survey		
Whale sharks (Ningaloo)(SMP12)	Not applicable	Not applicable	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]Ground based surveys for shorebirds/seabirds and marine reptiles at Montebello Islands could be conducted by the same survey team.

[3]Remote sensing data would be collected for mangroves, with no field team required to be mobilised.

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

[5]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 surveys