EA-60-RI-00186.02

Santos

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	Functional Endorser
	Senior Oil Spill Response Coordinator	Environmental Approvals Team Lead Oil Spill and Emergency Response Coordinator	Manager – HSE Offshore WA	Crisis, Emergency, Response and Security
15				p.p.

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

Rev	Rev Date	Amendment
15	15/01/2024	'Halyard Infill Project' renamed to 'Halyard-2 Drilling and Completion project'.
	01/11/2023	'Spar-Halyard Infill Project' re-named to 'Halyard Infill Project' throughout. Table 4-7: Spill Responder Personnel Resources - Added clarification note to Santos OSR Team; added TRG; updated latest AMOSC Core Group numbers. Added clarification sentence to Appendix J – IMT Resourcing. Section 9.4 – Amended reference to ASTM F2067-22 for oil spill modelling, as per feedback from DoT. Reference to SHP-MEE updated to latest 2022 reference throughout, as per feedback from DoT. Table 8-10: Dispersant supply stock locations and volumes – Updated latest OSRL numbers. Minor changes to Santos OSR equipment locations (oil sampling kits, containment and recovery, and shoreline protection & deflection).
14	10/07/2023	Revised to incorporate Campbell MDO release scenario as per the Campbell Bridging Document to the VI Hub Asset Removal Operations EP (Doc. No. 7935-650-EIS-0001) (refer to table below for further info.) [note: internal version Rev 13 E] (State waters activity).
	27/06/2023	Revised to incorporate responses to further DMIRS comments received on 22/03/2023 (EARS-EP-116162; EARS-EP-116163) and DoT comments received on 8 March 2023 [note: internal version Rev 13 D].
	31/03/2023 – 07/06/2023	Revised to incorporate Halyard Infill Project (Commonwealth waters activity) and minor updates to align with Santos latest content requirements (refer to table below for further info.) [note: internal versions Rev 13 A, B & C].
13	10/01/2023	Changes made in response to DMIRS letter 16th November 2022 (ref.: EARS-EP-87720; EARS-REPORTABLE-4048)
12	14/03/2022	DoT comments on Rev 11 addressed
11	10/01/2022	Revised to incorporate Spartan Development infrastructure and updated to latest OPEP Template (refer to table below for further info.)
10.1	26/05/2021	Updated to address the changes described in MoC-241: Changes to the IMT structure and roles, the exercise requirement and the alignment with DoT requirements are considered an administrative change, with the changes further described below are assessed in this MOC.
	08/11/2021	Updated to address MoC-244: Port of Varanus Island handover to Pilbara Ports Authority. Addition of Pilbara Ports Authority to: Jurisdictional Authorities and Control Agencies; integration with other organisations; interface with external plans; regulatory notification and reporting; references.
10	20/07/2020	Revised to incorporate DMIRS comments Minor updates for revised DoT Industry Guidance Note, AMOSC oiled wildlife State-board and information on DISER
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

Rev	Rev Date	Amendment
7	31/07/2019	5-year revision to NOPSEMA
6	14/06/2017	Revised to incorporate DMIRS comments
5	17/03/2017	Regulatory revision to DMIRS
4	03/09/2014	Revised to incorporate NOPSEMA Request for Further Written Information (refer MOC-63) and DMIRS comments
3	10/07/2014	Submitted to DMIRS (03/09/2014)
2	16/06/2014	Revised activity description for State waters.
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.

Section	Summary of Changes
Rev 13 to Rev 14 Changes	
Changes in response to DMIRS call-in revision - EARS-EP-116162; EARS-EP-116163, and DoT comments provided on 8 March 2023.	
Refer to separate document (Response Table for DMIRS (VI Hub Operations EP Rev 10_OPEP Rev 13)), submitted to DMIRS on 14th August 2023. Refer to separate document (Response to DoT Comment_VI Hub OPEP Rev 13), submitted to DoT on 10th July 2023.	
Addition of Campbell MDO release scenario as per the Bridging Document for the Campbell ARO	
Quick reference information	Campbell Asset Removal Operation (ARO) activity and scenario added to Quick Reference Information.
Section 2.1, 2.4	Reference to Campbell ARO activity and cross refences to Bridging Document and EP added to Section 2.1 and 2.4.
Section 5.2	Campbell ARO activity spill scenario added to Section 5.1, Table 5-2.
Section 5.4.2	Campbell ARO activity spill modelling results added to Section 5.4.2.4.
Appendix A	Added cross reference to Campbell ARO activity documents under Marine Diesel Oil.
Addition of Halyard Infill Project	
General overview	The OPEP/OSCP (Rev 13) has been updated to incorporate: + Halyard Infill activities (drilling, installation, pre-commissioning and operations). Note, the inclusion of Halyard Infill activities has not changed the worst-case spill scenarios for response planning purposes. + Minor amendments throughout the OPEP/OSCP to align with Santos' latest content requirements.
Quick Reference Information	Halyard Infill Project particulars have been included.
Section 1: Initial Response (First Strike Activations)	Section 1.2 updated to include first strike for Halyard Infill drilling. Note, there is no difference in first strike notifications between Spartan Development drilling and Halyard Infill drilling.
Section 2: Oil Pollution Emergency Plan Overview	Updated to include Halyard Infill activities.
Section 3: Oil Spill Response Framework	Minor text amendment to align with latest Santos OPEP content requirements.
Section 4: Santos Incident Management	Text amendments to align with latest Santos OPEP content requirements.
Section 5: Response Strategy Selection	Updated to include Halyard Infill Project spill scenarios. capping stack and subsea dispersant injection (SSDI) included as secondary strategies for Halyard Infill drilling.
Section 6: External Notification and Reporting Procedures	Minor amendments to align with latest Santos OPEP content requirements.
Section 7: Incident Action Plan (IAP)	Minor amendments to align with latest Santos OPEP content requirements.
Section 8: Source Control	Updated to include source control for Halyard Infill drilling. Halyard Infill drilling included in Section 8.3.2 Relief well drilling (nothing different from Spartan Development drilling or operations scenarios). Following sections have been included specifically for Halyard Infill drilling:

Section	Summary of Changes
	Section 8.3.4 Subsea first response toolkit Section 8.3.5 capping stack Section 8.3.6 Subsea dispersant injection Section 8.3.7 Implementation guidance: subsea first response toolkit, capping stack and subsea dispersant injection In Section 8.7 Source Control Environmental Performance, the following tables have been included: Table 8-14 Environmental performance- source control VI Operations and Spartan Development drilling (existing information from the current, accepted Rev 13 of the OPEP) Table 8-19: Environmental performance – source control and SSDI for Halyard Infill Project
Section 9 to Section 17	Section 9 to 17 Selected response strategies remain unchanged. Inclusion of Halyard Infill Project worst-case scenarios did not change the worst-case scenarios for response planning (HFO and crude oil spills in State waters). Changes and updates have been made throughout these sections to align with latest Santos' response arrangements and OPEP content requirements.
Appendices	Appendix A: has been updated to include latest Halyard condensate information. Appendix B: Oil Spill Response ALARP Framework & Assessment. Changes to the structure of this appendix have been made to clearly separate VI Hub Operations and Spartan Development source control (previously accepted and remain current in Rev 14) from Halyard source control (including capping stack, SFRT and SSDI, new additions to Rev 14), including: Table B-2: ALARP Assessment Summary – Source Control and SSDI Halyard Infill Project (new information for Rev 14). Table B-3: ALARP Assessment Summary – Operations and Spartan Development Source Control (Table B-2 in Rev 13, existing information). Table B-4: ALARP Assessment Summary – Monitor and Evaluate, Containment and Recovery, Mechanical Dispersion, Protect and Deflect, Shoreline Clean-up, Oiled Wildlife, Waste and Scientific Monitoring (Table B-2 in Rev 13, existing information) Table B-5: Detailed ALARP Assessment Worksheets –Halyard Infill Project Source Control and SSDI (new information for Rev 14) Table B-6: Detailed ALARP Assessment Worksheets – VI Operations and Spartan Development drilling Source Control (Table B-3 in Rev 13, existing information) Table B-7: Detailed ALARP Assessment Worksheets - Monitor and Evaluate, Containment and Recovery, Mechanical Dispersion, Protect and Deflect, Shoreline Clean-up, Oiled Wildlife, Waste and Scientific Monitoring (Table B-3 in Rev 13, existing information) Changes and updates have been made throughout appendices as required to align with latest Santos' response arrangements and OPEP content requirements.
Rev 12 to Rev 13 changes in response to DMIRS call-in revision - EARS-EP-87720; EARS-REPORTABLE-4048	
Refer to separate spreadsheet, submitted to DMIRS on 25th January 2023	

Section	Summary of Changes
Rev 11 to Rev 12 changes (in response to DoT comments on addition of Spartan development)	
Section 3.2.2 and Section 4.2.3	DoT HMA changed to the DoT Chief Executive Officer (or Proxy).
Section 3.2.2 Section 20	Reference to State Hazard Plan: Marine Environmental Emergencies (MEE) updated throughout to most current (December 2021) version.
Section 4.2.3	Santos personnel designated to serve in DoT's FOB to arrive no later than 24 hours after receipt of formal request from the SMPC.
Section 4.2.3	Clarify that DoT only has jurisdictional/control agency authority within State waters.
Rev 10 to Rev 11 changes (addition of Spartan development)	
General overview	The accepted OPEP (Rev 10) has been updated to incorporate: + Spartan Development activities (drilling, installation, pre-commissioning and operations). Note, the inclusion of Spartan activities has not changed the worst-case spill scenarios for response planning purposes. + Re-structure of the OPEP to align with Santos' latest OPEP template and content requirements.
Quick Reference Information	Included to provide initial information required in the event of a spill – activity type, location, worst-case spill scenarios for planning purposes, where to find specific hydrocarbon information and protection priorities in this OPEP.
Section 1: Initial Response (First Strike Activations)	Section 5 in Rev 10 OPEP. Updated to include MODU first strike for Spartan development drilling.
Section 2: Oil Pollution Emergency Plan Overview	Section 1 of the Rev 10 OPEP. Updated to include Spartan activities.
Section 3: Oil Spill Response Framework	Section 2 of the Rev 10 OPEP. Santos Incident Management, interface with plans, integration with other organisations and cost recovery moved to Section 4.
Section 4: Santos Incident Management	New Section in Rev 11 OPEP. Describes Santos' incident management structure. Outlines regulatory arrangements and external support arrangements. Includes interface with external plans, cost recovery, training and testing arrangements.
Section 5: Response Strategy Selection	Section 3 and 4 of Rev 10 OPEP. Updated to include Spartan Development spill scenarios. Includes information from Rev 10 Section 3. Demonstration of ALARP moved to Appendix B to align with Santos latest ALARP Assessment structure and content.
Section 6: External Notification and Reporting Procedures	Section 6 of Rev 10 OPEP. Updated to reflect current OPEP structure, notification and reporting processes, and required environmental performance.
Section 7: Incident Action Plan (IAP)	Section 7 of Rev 10 OPEP. Updated to reflect current process and includes environmental performance.
Section 8: Source Control	Section 8 of Rev 10 OPEP Updated to include loss of well control (LOWC) source control updates.
Section 9 to Section 17	Section 9 to 17 of Rev 10 OPEP

Section	Summary of Changes
	Selected response strategies remain unchanged. Inclusion of Spartan worst-case scenarios did not change the worst-case scenarios for response planning (HFO and crude oil spills in State waters). Changes and updates have been made throughout these sections to align with Santos' current approach to demonstrate worst-case and first strike resourcing requirements. Additional Control Measures have also been included in some instances. The Performance Standards have also been updated to ensure that they are specific and measurable.
Appendices	**Removed appendices that were in the Rev 10 OPEP:** Appendix L: Oiled Wildlife Response Personnel and Equipment **Updated Appendices for Rev 11 OPEP:** Appendix A: has been updated to include Spartan Condensate information. Appendix O: Scientific Monitoring Plans Appendix Q: Scientific Monitoring Capability **New Appendices for Rev 11 OPEP:** Appendix B: Oil Spill Response ALARP Framework & Assessment for Rev 11 OPEP. This details the Santos approach to demonstrate that the oil spill response control measures are reducing risk to a level that is ALARP. Appendix J: IMT Resourcing. Appendix K: Testing Arrangements Plan Appendix R: Forward Operations Guidance. This appendix replaces Section 18 of the Rev 10 OPEP and aligns with Santos' current Forward Operations planning and requirements. Appendix S: Response Capability Assessment

Distribution	.pdf
Intranet – Emergency Preparedness – both Oil Spill Tile and SO ER Documentation	●
General Manager – Gas Assets	link
Varanus Island Offshore Installation Manager (OIM) / Varanus Island Control Room / email revision copy to Offshore.varanus.admin@Santos.com	link
Manager - HSE	link
Team Leader - Security & ER	link
Senior Spill Response Advisor	link
AMOSC	●
DoT	●
AMSA	●
OSRL	●
Pilbara Ports Authority	●
DEMIRS	●

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List of Acronyms

Abbreviation	Description
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre Pty Ltd
AMP	Australian Marine Park
AMSA	Australian Marine Safety Authority
APASA	Asia-Pacific Applied Sciences Associates
API	American Petroleum Institute
APPEA	Australian Petroleum Production & Exploration Association
BAOAC	Bonn Agreement Oil Appearance Codes
BRUV	Baited Remote Underwater Video
C&R	containment and recovery
CHARM	chemical hazard and risk management
CMT	Crisis Management Team
CSR	company site representative
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DFAT	Department of Foreign Affairs and Trade
DISR	Department of Industry, Science and Resources
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DoE	(Australian) Department of the Environment (now Department of the Environment and Energy)
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environment Regulation
EMBA	environment that may be affected
EP	Environment Plan
ER	emergency response
ESC	Environmental Scientific Coordinator
FOB	forward operating base
GIS	geographic information system
GPS	global positioning system
HMA	Hazard Management Agency
HR	human resources
IAP	Incident Action Plan
ICC	Santos Incident Coordination Centre / DoT Fremantle Incident Control Centre

Abbreviation	Description
IMP	Incident Management Plan
IMT	Incident Management Team
IR	industrial relations
IUCN	International Union for Conservation of Nature
LAT	lowest astronomical tide
LOWC	loss of well control
MARPOL	International Convention for the Prevention of Pollution from Ships
MEECC	Maritime Environmental Emergency Coordination Centre
MEER	Maritime Environmental Emergency Response
MNES	matters of national environmental significance
MODU	mobile offshore drilling unit
MoU	Memorandum of Understanding
MP	marine park
MSA	Master Services Agreement
MSP	monitoring service providers
N	North
NEBA	net environmental benefit analysis
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NW	North-west
OPEP	Oil Pollution Emergency Plan
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSC	on-scene commander
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response
PPA	Priority Protection Area
PS	people services
RCC	Rescue Coordination Centre
ROV	Remotely Operated Vehicle
S	South
SCAT	Shoreline Clean-Up Assessment Technique
SCP	Source Control Plan
SFRT	Subsea First Response Toolkit
SHP-MEE	State Hazard Plan for Maritime Environmental Emergencies
SIMA	spill impact mitigation assessment
SLA	Service Level Agreement

Abbreviation	Description
SMP	Scientific Monitoring Plan
SMPC	State Marine Pollution Coordinator
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plans
SSDI	Subsea Dispersant Injection
SW	South-west
TRP	Tactical Response Plan
UAV	unmanned aerial vehicle
VI	Varanus Island
VOC	volatile organic compound
VOO	vessels of opportunity
VPO	Vice President Offshore Upstream WA
W	West
WA	Western Australia
WAOWRP	Western Australian Oiled Wildlife Response Plan
WOMP	Well Operation Management Plan
WSP	waste service provider
WWC	Wild Well Control
ZPI	Zone of Potential Influence

Quick Reference Information

Parameter	Description	Further Information
Petroleum Activities and Operational Areas	Varanus Island (VI) Hub Operations (Commonwealth Waters): The operational area is defined as: + 500 m radius around the John Brookes WHP; + 250 m buffer either side of all subsea infrastructure; and + 500 m radius buffer surrounding the temporarily plugged and abandoned Rosella-1 wellhead.	Section 2 of the VI Hub Operations Environment Plan (EP) (EA-60-RI-10003)
	VI Hub Operations (State Waters): The VI Hub is located on the North West Shelf of Western Australia, in the Shire of Ashburton, off the Pilbara Coast.	Section 2 of the VI Hub Operations EP (State Waters) (EA-60-RI-00186)
	Spartan Development Activities (drilling, installation and pre-commissioning): + 2 km x 2 km square around the planned well location to allow for re-spudding contingency; + a 250m corridor around the Spartan flexible flowline lay route; and + 500 m radius around the John Brookes (JB) Wellhead Platform (WHP).	Section 2 of the Spartan Development EP Addendum (EA-60-RI-10003.02)
	Halyard-2 Drilling and Completion Project (drilling, installation, and pre-commissioning): + a 2,500 m radius around the Halyard-2 well location	Section 2 of the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001)
	Asset Removal Operation (ARO) for the Campbell facility: + 500 m exclusion zone (petroleum safety zone) surrounding the Campbell facility	Section 5.1 of the Campbell Bridging Document (BD) to the VI Hub Asset Removal Operations (ARO) EP (7935-650-EIS-0001)
Location	VI Hub Operations (Commonwealth Waters)	Table 2-1 of the VI Hub Operations Environment Plan (EP) (EA-60-RI-10003)
	Spartan Development Activities (drilling, installation and pre-commissioning)	Table 2-1 of the Spartan Development EP Addendum (EA-60-RI-10003.02)
	Halyard-2 Drilling and Completion Project (drilling, installation, and pre-commissioning)	Table 2-1 of the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001)

<table>
<tr><th>Parameter</th><th colspan="3">Description</th><th>Further Information</th></tr>
<tr><td></td><td colspan="3">Campbell facility ARO</td><td>Table 5-1 of the Campbell BD to the VI Hub ARO EP (7935-650-EIS-0001)</td></tr>
<tr><td rowspan="2">Petroleum Title/s (Blocks)</td><td colspan="3">Commonwealth Waters:
+ Production licences WA-13-L, WA-63-L, WA-29-L and WA-30-L, permit area WA-214-P and pipeline licence WA-11-PL,</td><td>Section 2.1 of the VI Hub Operations Environment Plan (EP) (EA-60-RI-10003)
Section 2.1.1 of the Spartan Development EP Addendum (EA-60-RI-10003.02)
Section 1.5 of the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001)</td></tr>
<tr><td colspan="3">State Waters:
+ Offshore: Production permits TL/1, 2, 5, 6, 8 and 9, Access Authorities ADW 12/91-2 and ADW 10/92-3.
Onshore: Onshore pipeline licences PL 12, PL 14, PL 29 and PL 30</td><td>Table 1.1 of the VI Hub Operations EP (State Waters) (EA-60-RI-00186)
Table 5-1 of the Campbell BD to the VI Hub ARO EP (7935-650-EIS-0001)</td></tr>
<tr><td>Water Depth</td><td colspan="3">40 to 115 m</td><td>N/A</td></tr>
<tr><td rowspan="12">Worst-case Spill Scenarios</td><td colspan="3">VI Hub Operations (Commonwealth Waters)</td><td rowspan="12">Section 5.1</td></tr>
<tr><td>Scenario</td><td>Hydrocarbon</td><td>Worst-case volume (m³)</td></tr>
<tr><td>Loss of well control (LOWC) John Brookes wellheads (surface release)</td><td>John Brookes Condensate</td><td>39,011</td></tr>
<tr><td>Subsea pipeline release (John Brookes 18” pipeline</td><td>John Brookes Condensate</td><td>210</td></tr>
<tr><td>Surface diesel release (surface spill)</td><td>Marine Diesel Oil (MDO)</td><td>329</td></tr>
<tr><td colspan="3">VI Hub Operations (State Waters)</td></tr>
<tr><td>Scenario</td><td>Hydrocarbon</td><td>Worst-case volume (m³)</td></tr>
<tr><td>Release from offtake tanker due to vessel collision/grounding</td><td>Heavy fuel oil (HFO)</td><td>1,900</td></tr>
<tr><td>Release from offtake tanker due to vessel collision/grounding</td><td>Varanus Island Crude Blend</td><td>8,629</td></tr>
<tr><td>Subsea release from Tanker Oil Load Out Line (30” rigid / 16” flexible)</td><td>Varanus Island Crude Blend</td><td>2,742</td></tr>
<tr><td>Surface diesel release (surface spill)</td><td>Marine Diesel Oil (MDO)</td><td>329</td></tr>
<tr><td colspan="3">Spartan Development (drilling, installation and pre-commissioning) (Commonwealth waters)</td></tr>
</table>

Parameter	Description			Further Information
	Scenario	Hydrocarbon	Worst-case volume (m^3)	
	LOWC during development well drilling – subsea release	Spartan Condensate	53,811	
	LOWC during development well drilling – surface release	Spartan Condensate	53,291	
	Surface diesel release (surface spill)	Marine Diesel Oil (MDO)	329	
	Halyard-2 Drilling and Completion Project (development drilling, installation and pre-commissioning) (Commonwealth waters)			
	Scenario	Hydrocarbon	Worst-case volume (m^3)	
	LOWC during development well drilling – subsea release	Halyard Condensate	173,755	
	LOWC during development well drilling – surface release	Halyard Condensate	170,576	
	Surface diesel release (surface spill)	Marine Diesel Oil (MDO)	329	
	ARO for the Campbell facility (State waters)			
	Scenario	Hydrocarbon	Worst-case volume (m^3)	
	Surface diesel release (surface spill)	Marine Diesel Oil (MDO)	998	
Hydrocarbon Properties	The hydrocarbon characteristics, including weathering and behaviour is described in **Appendix A**			**Appendix A**
Weathering Potential	The weathering characteristics of the hydrocarbons is described in **Appendix A**			**Appendix A**
Protection Priorities	Protection Priorities for offshore and onshore spills are described in **Section 5.7**			**Section 5.7**

1 Initial Response (First Strike Activations)

1.1 Varanus Island Hub Operations

The initial response actions to major incidents at VI Hub facilities are outlined within the Varanus Hub Incident Response Plan (SO-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 Emergency Shutdown (ESD) of facility infrastructure. The Varanus Hub Incident Response Plan (SO-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 associated with the Varanus Island Hub Operations, the Varanus Island On-scene Commander (VI Offshore Installation Manager (OIM)) is to contact the Incident Commander (in Perth via the on-call Duty Manager (**Table 1-1**)).

Table 1-1: Initial contact requirements for spills associated with VI Hub Operations

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	Duty Manager Incident Commander

First strike activations required for the credible oil spill incidents identified for Varanus Island Hub operations are outlined in **Section 1.1.1** to **Section 1.1.4** below. The Varanus Island First Strike Response Plan (located on the Santos ER SharePoint) should be referred to alongside the first strike activations tables below.

1.1.1 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 in **Table 1-2**.

Low flow well leak incidents identified from subsea inspection activities of plugged and abandoned wells are included in **Table 1-2**, given worst-case credible releases are relatively low in volume and considered not to require a Level 2/3 spill response. Nevertheless, these releases would need operational monitoring to assess the potential environmental consequence (refer **Section 17**) and following evaluation of operational monitoring information may be reassessed as a Level 2 spill requiring scientific monitoring to be initiated.

Table 1-2: 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 8**	Offshore Platform Designated Person / Vessel Master
Immediate	Report incident to Varanus Island Central Control Room (CCR)	Offshore Platform Designated Person / Vessel Master

When	Actions	Who
30 minutes	Report incidents where spill has reached marine environment to Santos Offshore Duty Manager	On-Scene Commander (OIM)
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 9**)	Offshore Platform Designated Person / Vessel Master On-Scene Commander (OIM)
60 minutes	Initiate regulatory notifications as per Notifications Plan (refer **Section 6**)	Offshore Platform Designated Person / Vessel Master On-Scene Commander (OIM) Incident Management Team (IMT) Planning Section Chief
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 (OIM)
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)

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

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 2/3 spills from offshore petroleum facilities (petroleum activity spills) the Control Agency is Santos (Commonwealth waters), DoT (State waters) or both Santos and DoT (spill crossing between Commonwealth and State waters). Santos 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 in **Table 1-3**.

Table 1-3: 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 (OIM) 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 8**	Offshore Platform Designated Person
30 minutes	Assess the situation and undertake response as per Varanus Hub Incident Response Plan	On-Scene Commander (OIM)
30 minutes	Notify IMT	On-Scene Commander (OIM)

When	Actions	Who
IMT Actions (0-48 hours)		
Within 90 minutes from IMT call out	Gain situational awareness by initiating Operational Monitoring. Refer to the Monitor and Evaluate Plan (**Section 9**).	IMT Planning Section Chief
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 Planning Section Chief
Activate on Day 1 as applicable to the incident	Prepare for use of offsite source control resources as applicable. Refer to the Source Control Plan – go to **Section 8**	IMT Operations Section Chief IMT Source Control Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Prepare for use of Offshore Containment and Recovery- go to **Section 11**	IMT Operations Section Chief IMT Offshore Response Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Use mechanical dispersion (vessel) as applicable. Refer to Mechanical Dispersion Plan – go to **Section 10**	IMT Operations Section Chief IMT Offshore Response Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Prepare for use of Shoreline Protection and Deflection – go to **Section 12**	IMT Environment Unit Leader IMT Operations Section Chief IMT Shoreline Clean-up Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Prepare for Oiled Wildlife Response – go to **Section 15**	IMT Environment Unit Leader IMT Oiled Wildlife Response Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Prepare for scientific monitoring as per Scientific Monitoring Plans where applicable – go to **Section 17**	IMT Environment Unit Leader IMT Monitoring Branch Director Logistics Section Chief Supply Unit Leader
If/when initiated	Prepare for initiation of Shoreline Clean-up Plan – go to **Section 13**	IMT Operations Section Chief IMT Shoreline Clean-up Branch Director Logistics Section Chief Supply Unit Leader

When	Actions	Who
Day 1	Prepare for proactive phase by completing the first Operational NEBA and beginning Incident Action Planning for those activities where Santos has command responsibilities as the single Control Agency or Lead IMT (for where Santos and DoT are Control Agencies): + Develop IAPs (including Operational NEBA) for subsequent operational periods + Arrange personnel roster to extend the IMT coverage + Begin set-up and mobilisation of personnel to forward operating base (FOB) as required + Undertake arrangements for supplying IMT personnel to DoT as applicable.	IMT Environment Unit Lead IMT Planning Section Chief
1 day	Initiate the development of a Safety Management Plan/s for activities under the command of Santos. Refer Oil Spill Recovery Safety Management Plan (SO-91-RF-10016)	IMT Safety Officer
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 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 will provide available response equipment and personnel (operational and IMT support) as outlined within the following plans: + Monitor and Evaluate Plan (refer **Section 9**) + 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**) **Commonwealth to State water spills** Santos will maintain control for those activities in Commonwealth waters, for which it is the designated Control Agency/ Lead IMT. For spills crossing from Commonwealth to State waters (cross-jurisdiction), both Santos and DoT will be Control Agencies. DoT will assume control of primarily State water activities as Lead IMT. Santos will be Lead IMT for: + Monitor and Evaluate Plan (refer **Section 9**) + Mechanical Dispersion Plan (refer **Section 10**)	Santos to provide the following roles to DoT MEECC/ IMT: + Crisis Management Team (CMT) Liaison Officer + Deputy Incident Controller + Deputy Intelligence Officer + Deputy Planning Officer + Environment Support Officer + Deputy Public Information Officer + Deputy Logistics Officer + Deputy Waste Management Coordinator + Deputy Finance officer + Deputy Operations Officer + Deputy Division Commander (FOB)

When	Actions	Who
	+ Offshore Containment and Recovery (**Section 11**) Santos will provide available response equipment and personnel (operational and IMT support) as outlined within the following plans for which DoT will be Lead IMT: + 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**)	

1.1.3 Level 2 offshore vessel-based Spills

Level 2 activations are based on spills that cannot be controlled by the 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 will provide first strike response and then support DoT or AMSA in their role as Control Agencies through provision of resources. First strike activations for a level 2 offshore vessel-based spill are found in **Table 1-4**.

Table 1-4: 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 6** Including notifications to relevant Control Agency (DoT or AMSA)	Vessel Master/ Company Site Representative
Immediate	Continue source control as required Activate the suitable Source Control Plan - go to **Section 8** Control the source using available vessel resources. Refer to the Source Control Plan - go to **Section 8**	Vessel Master
As soon as practical	Prepare a POLREP/SITREP (go to **Appendices C and D**) and provide as much information to the IMT and Control Agency as soon as possible	IMT Incident Commander IMT Planning Section Chief
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 Section Chief IMT Environment Unit 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 Section Chief

When	Actions	Who
		IMT Source Control Branch Director
If/when initiated	Prepare for use of Offshore Containment and Recovery – go to **Section 11**	IMT Operations Section Chief IMT Offshore Response Branch Director
If/when initiated	Use mechanical dispersion (vessel) as applicable. Refer to Mechanical Dispersion Plan – go to **Section 10**	IMT Operations Section Chief IMT Offshore Response Branch Director
If/when initiated	Prepare for initiation of Shoreline Protection and Deflection - go to **Section 12**	IMT Environment Unit Leader IMT Operations Section Chief IMT Shoreline Clean-up Branch Director
If/when initiated	Prepare for initiation Oiled Wildlife Response as applicable – go to **Section 15**	IMT Environment Unit Leader IMT Oiled Wildlife Response Branch Director
If/when initiated	Prepare for initiation of scientific monitoring as per Scientific Monitoring Plans where applicable – go to **Section 17**	IMT Environment Unit Leader IMT Monitoring Branch Director
If/when initiated	Prepare for initiation Shoreline Clean-up Plan - go to **Section 13.4**	IMT Operations Section Chief IMT Shoreline Clean-up Branch Director
Day 1	Initiate the development of a Safety Management Plan/s Refer Oil Spill Recovery Safety Management Plan (SO-91-RF-10016)	IMT Safety Officer
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. Santos will provide resources as a Support Agency as outlined within the following plans: + Source Control Plan (refer **Section 8**) + Monitor and Evaluate Plan (refer **Section 9**) + 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**)	CMT Liaison Officer Deputy Incident Controller Deputy Intelligence Officer Deputy Planning Officer Environment Support Officer Deputy Public Information Officer Deputy Logistics Officer Deputy Waste Management Coordinator Deputy Finance officer Deputy Operations Officer Deputy Division Commander (FOB)

1.1.4 Onshore spills

For response to a hydrocarbon leak from the onshore pipelines, tanks and process equipment at Varanus Island Santos 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 1-5**.

Table 1-5: First Strike Activations for Onshore 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 (OIM) via Central Control Room (CCR).	Onsite personnel
Immediate	Control the source. Refer to the Source Control Plan - go to **Section 8**	On-scene Commander (OIM)
As soon as practical	Report incident to the Perth based Incident Commander (IMT Leader)	On-scene Commander (OIM)
As soon as practical	Initiate notifications to regulatory agencies, service providers and stakeholders – go to **Section 6**	IMT Incident Commander IMT Planning Section Chief
2 hours	Prepare for initiating Onshore Response as per Onshore Response Plan - go to **Section 14**	On-scene Commander IMT Incident Commander IMT Operations Section Chief IMT Logistics Section Chief
Ongoing	Coordination of monitoring and remediation as required under Contaminated Sites legislation as directed by DWER	Designated Santos personnel and subcontractors

1.2 Spartan Development and Halyard-2 Drilling and Completion Project Drilling, Installation and Pre-commissioning Activities

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

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

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

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

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

Response information contained within this Oil Pollution Emergency Plan is concerned primarily with a large scale (Level 2/3) hydrocarbon spill where the Perth-based IMT and Santos Crisis Management Team (CMT) are engaged for support and implementation of response strategies. Level 1 spills are managed through on-site response and IMT is available to assist with regulatory requirements/notifications and support as required. Therefore, the immediate response actions listed in **Table 1-6** are relevant for any spill. Once sufficient information is known about the spill, the Incident Commander will classify the level of the spill. If the spill is classified as a Level 1 spill, then the actions related to Level 2/3 spills do not apply, unless specified by the Incident Commander.

Table 1-6: Spartan Development and Halyard-2 Drilling and Completion Project Activities First Strike Activations

When (indicative)	Activations		Who
	Objective	Action	
All spills			
Immediate	Manage the safety of personnel	Implement site incident response procedures (MODU Operator's Emergency Response Plan and Santos MODU Operator Emergency Response Bridging document) or vessel-specific procedures, as applicable	On-Scene Commander/Vessel Master
Immediate	Control the source using site resources, where possible	Control the source using available onsite resources (MODU/vessel) Refer to source control plan – **Section 8**	On-Scene Commander/Vessel Master
30 minutes of incident being identified	Notify Santos Offshore Duty Manager	Verbal communication to Offshore Duty Manager's duty phone	On-Scene Commander via the Company Site Representative (CSR)
As soon as practicable	Obtain as much information about the spill as possible	Provide as much information to the IMT (Incident Commander or delegate) as soon as possible	On-Scene Commander via CSR
60 minutes	Gain situational awareness and begin onsite spill surveillance	If spill reaches marine waters gain further situational awareness by undertaking surveillance of the spill from vessel or MODU Refer to Monitor and Evaluate Plan – **Section 9**	On-Scene Commander via CSR Incident Commander
Refer timeframes Go to **Section 6**	Make regulatory notifications within regulatory timeframes	Activate the External Notifications and Reporting Procedures – **Section 6**	Initial notifications by Planning Section Chief – **Table 6-1**
Level 2/3 spills (in addition to actions above)			
Immediately once notified of spill (to Incident Commander)	Activate IMT, if required	Notify IMT	Duty Manager Incident Commander

When (indicative)	Activations		Who
	Objective	**Action**	
IMT actions (0 to 48 hours)			
Within 90 minutes from IMT callout	Set-up IMT room	Refer to IMT tools and checklists for room and incident log set-up	Incident Commander IMT Data Manager
	Gain situational awareness and set incident objectives, strategies and tasks	Begin reactive Incident Action Planning process Go to **Section 7** Review First Strike Activations (this table)	Incident Commander Planning Section Chief
Refer timeframes **Section 6**	Make regulatory notifications as required Notify and mobilise/put on standby external oil spill response organisations and support organisations, as required	Go to **Section 6**	Initial notifications by Environment/ Safety Officer Oil Spill Response Organisations (Australian Marine Oil Spill Centre [AMOSC] and Oil Spill Response Ltd. [OSRL]) activation by designated call-out authorities (Incident Commanders/Duty Managers)
Refer timeframes **Section 9**	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making	Vessel Surveillance (**Section 9.1**) Aerial Surveillance (**Section 9.2**) Tracking Buoys (**Section 9.3**) Oil Spill Trajectory Modelling (**Section 0**) Initial Oil Characterisation (**Section 9.6**) Operational Water Quality Monitoring (**Section 9.7**) Shoreline Clean-up Assessment (**Section 9.9**)	IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader IMT Environment Unit Leader
Activate on Day 1 as applicable to the incident	Source control support to stop the release of hydrocarbons into the marine environment. **Degree of IMT support will be scenario-dependent**	Go to **Section 8**	IMT Operations Section Chief (IMT Drilling Team Leader as appropriate to scenario) IMT Logistics Section Chief / Supply Unit Leader

When (indicative)	Activations		Who
	Objective	**Action**	
Activate on Day 1 as applicable to the incident Refer **Section 17**	Assess and monitor impacts from spill and response	Activate the Scientific Monitoring Plan Go to **Section 17**	IMT Environment Unit Leader IMT Logistics Section Chief / Supply Unit Leader IMT Operations Section Chief
Day 1	Identify environmental sensitivities at risk and conduct Net Environmental Benefit Analysis (NEBA)	Review situational awareness and spill trajectory modelling Review strategic NEBA and begin operational NEBA (**Section 5.8**)	IMT Environment Unit Leader
Day 1	Develop forward operational base/s to support forward operations	Begin planning for forward operations base as per Forward Operations Plan. **Appendix R**	IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader
Day 1	Ensure the health and safety of spill responders	Identify relevant hazards controls and develop hazard register Begin preparation Site Health and Safety Management requirements Refer Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016)	IMT Safety Officer
If/when initiated Refer **Section 12**	Protect identified shoreline protection priorities	Activate the Shoreline Protection and Deflection Plan Go to **Section 12**	IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader IMT Environment Unit Leader
If/when initiated Refer **Section 15**	Prevent or reduce impacts to wildlife	Activate the Oiled Wildlife Response Plan Go to **Section 15**	IMT Environment Unit Leader IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader

When (indicative)	Activations		Who
	Objective	Action	
If/when initiated	Clean-up oiled shorelines	Activate Shoreline Clean-Up resources Go to **Section 13**	IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader
If/when initiated	Safely transfer, transport and dispose of waste collected from response activities.	Activate the Waste Management Plan. Go to **Section 16**	IMT Operations Section Chief IMT Logistics Section Chief / Supply Unit Leader
IMT Actions (48+ hours)			
Ongoing	For ongoing incident management – indicatively 48 + hours – a formal incident action planning process is to be adopted to continue with spill response strategies identified above. An Incident Action Plan (IAP) is to be developed for each successive operational period. Santos will maintain control for those activities for which it is the designated Control Agency/Lead IMT. Depending on the specifics of the spill, Australian Maritime Safety Authority (AMSA) and/or Western Australia (WA) Department of Transport (DoT) may be relevant Control Agencies (refer **Section 3.2**). Where another Control Agency has taken control of aspects of the response, Santos will provide support to that Control Agency. Santos' support to DoT for a State waters response is detailed in **Section 4.2.3**.		Control Agency IMT Santos to provide the following roles to DoT MEECC/IMT for State waters response: + CMT Liaison Officer + Deputy Incident Controller + Deputy Intelligence Officer + Deputy Planning Officer + Environment Support Officer + Deputy Public Information Officer + Deputy Logistics Officer + Deputy Waste Management Coordinator + Deputy Finance Officer + Deputy Operations Officer + Deputy Division Commander (Forward Operating Base [FOB])

2 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-60-RI-10003), the Spartan Development EP Addendum (EA-60-RI-10003.02) and the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001) 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), required by the Petroleum (Submerged Lands) (Environment) Regulations 2012.

2.1 Description of Varanus Island Hub Operations

Varanus Island (VI) is the central gathering and processing hub for Santos'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:

+ Spartan Development well drilling;
+ Spartan subsea infrastructure installation and pre-commissioning;
+ Halyard development well drilling;
+ Halyard subsea infrastructure installation and pre-commissioning;
+ 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 2-1 shows a schematic layout of the VI Hub facilities and **Figure 2-2** 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 2-1**.

VI currently receives produced hydrocarbons from the following offshore facilities:

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

VI will also receive hydrocarbons from the Spartan subsea well via the John Brookes platform (estimated Q3 2023) and the Halyard-2 well via Halyard subsea installation (estimated Q3/Q4 2024).

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, Spar-2 and Halyard-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-60-RI-10003) provide further detail on the operational activities at VI Hub and further detail on the onshore and offshore facilities.

Activities associated with the Spartan Development (development drilling, installation and pre-commissioning) are detailed in the Spartan Development EP Addendum (EA-60-RI-10003.02) to the Varanus Island Hub Operations Environment Plan for Commonwealth Waters.

Activities associated with the Halyard-2 Drilling and Completion Project (development drilling, installation and pre-commissioning) are detailed in the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001).

Activities associated with the Campbell facility ARO are described in the Campbell Bridging Document (BD) to the VI Hub Asset Removal Operations (ARO) EP (7935-650-EIS-0001) and within the VI Hub ARO EP (QE-02-BI-20001).

Table 2-1: Offshore Facilities that Connect to the VI Hub

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[2]	Field/s	Reservoir	Produced hydrocarbon
State waters							
Harriet Alpha platform	Not producing/ suspended	N[1]	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	N	Agincourt Artreus Zephyrus	Double Island Sandstone	N

[1] N = None

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[2]	Field/s	Reservoir	Produced hydrocarbon
			Jane-1 ST2				
Wonnich platform	Not producing	N	Wonnich-1 Wonnich Deep-1H	N	Wonnich	Flag Sandstone	N
Sinbad monopod (removed 2021)	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[2]	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
Commonwealth waters							
John Brookes platform	Gas/condensate Production	Spartan-2 (online Q3/Q4 2022) John Brookes-2 John Brookes-3 ST1	N	N	John Brookes	Top Barrow 'A' and Upper Barrow Sandstone	Spartan – gas/condensate John Brookes gas/ condensate

Facility	Hydrocarbon Production / Status	Producing wells	Inactive/ Suspended wells	Plugged and Abandoned wells[2]	Field/s	Reservoir	Produced hydrocarbon
		John Brookes-5 John Brookes-6 ST1					
Open Water	Exploration – Temporarily abandoned	N	Rosella-1	N	John Brookes		N
Halyard subsea	Gas/condensate Production	Halyard-1 Halyard-2 (planned)	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

[2]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 2.1.

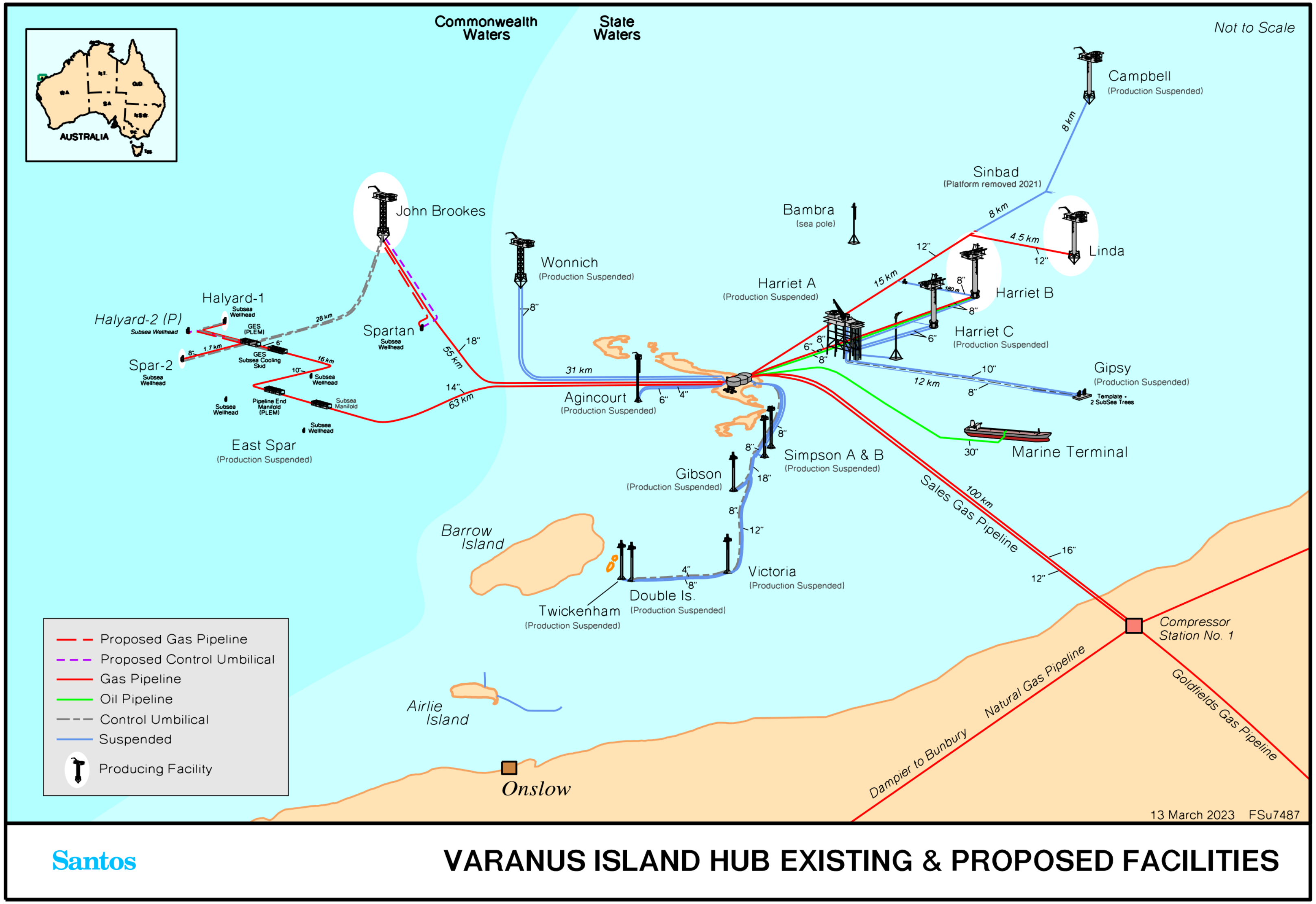


Figure 2-1: Schematic of the Varanus Island Hub facilities including proposed Halyard-2 well

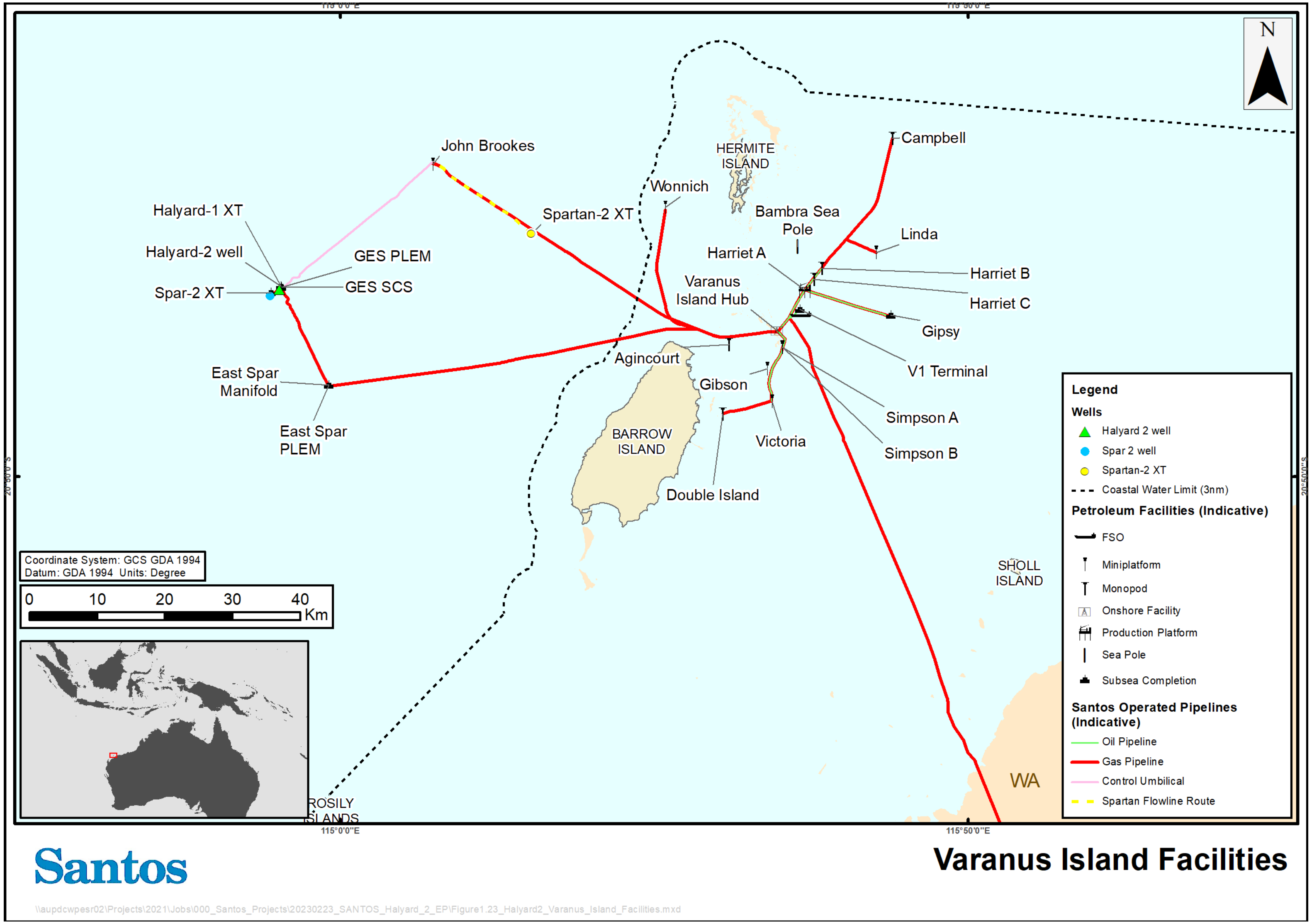


Figure 2-2: Location of the VI Hub facilities covered by this OPEP

2.2 Purpose and Scope of OPEP

The purpose of this OPEP is to describe Santos' 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 plugged 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 (DEMIRS), 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 (National Plan) managed by the Australian Maritime Safety Authority (AMSA) and the WA State Hazard Plan: Maritime Environmental Emergencies (MEE).

2.3 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). This will be achieved through the implementation of the various strategies and spill response mechanisms presented throughout this OPEP. Through their implementation, Santos will:

+ initiate spill response immediately following a spill;
+ establish source control as soon as reasonably practicable to minimise the amount of oil being spilt into the environment;
+ assess the spill characteristics and understand its fate in order to be able to make informed and clear response decisions;
+ monitor the spill to identify the primary marine and coastal resources requiring protection;
+ remove as much oil as possible from the marine environment while keeping environmental impacts from the removal methods to ALARP;
+ reduce the impacts of the remaining floating and stranded oil to ALARP;
+ respond to the spill using efficient response strategies that do not damage the environment themselves;
+ comply with all relevant environmental legislation when implementing this OPEP;
+ conduct all responses safely without causing harm to participants;
+ monitor the impacts from a spill until impacted habitats have returned to baseline conditions;

- remain in a state of 'Readiness' at all times for implementation of this OPEP by keeping resources ready for deployment, staff fully trained and completing response exercises as scheduled; and
- keep stakeholders informed of the status of the hydrocarbon spill response to aid in the reduction of social and economic impacts.

2.4 Interface with Internal Documents

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

- Varanus Island First Strike Response Plan
- Values and Sensitivities of the Marine and Coastal Environment (EA-00-RI-10062);
- Incident Management Plan – Upstream Offshore (SO-00-ZF-00025);
- Santos Incident Management Handbook;
- Santos Crisis Management Plan (SMS-HSS-OS05-PD03);
- 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);
- Campbell Bridging Document to the VI Hub Asset Removal Operations EP (7935-650-EIS-0001);
- VI Hub Asset Removal Operations EP (QE-02-BI-20001);
- Emergency Response Plan - Varanus Island (SO-00-ZF-00044);
- Environment Incident Notification Guideline and Matrices (QE-91-HF-10003);
- SMS-MS11 Incident and Crisis Standard;
- ST02 Incident Reporting and Investigation Procedure;
- Environmental Management Standards for Operations Support Vessels (EA-91-ZI-10002);
- Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200)
- Varanus Island Fire and Petroleum Spillage Management Plan (SO-91-RI-10001);
- Source Control Planning and Response Guideline (DR-00-OZ-20001);
- 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 (SO-91-IG-00007)
- Start up and Shutdown of Suck Back Pump (VI-91-IP-10197);
- NWA Waste Management Plan – Oil Spill Response Support (7715-650-ERP-0001);
- Detailed Site Investigation Varanus Island (EA-60-RI-10062);
- Varanus Island Remedial Action Plan (VI-10-RG-10023);
- Santos Environmental Monitoring Program (EA-00-RI-10058).

- MODU Operator's Emergency Response Plan
- Santos-MODU Operator Emergency Response Bridging Document
- Incident Response Telephone Directory (SO-00-ZF-00025. 20)
- Refuelling and Chemical Transfer Management Standard (SO-91-IQ-00098)
- Source Control Planning and Response Guideline (DR-00-OZ-20001)
- Well-Specific or Campaign Source Control Plan
- Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016)
- Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017)
- Santos Oiled Wildlife Sample Collection Protocol
- Oil Spill Scientific Monitoring Plan (EA-00-RI-10099)
- Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)
- Oil Spill Scientific Monitoring Baseline Data Review (SO-91-RF-20022)
- Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001)
- Santos Offshore Division Oil Spill Response Readiness Guideline (SO-91-OI-20001)
- Santos Offshore - Vessel Requirements for Oil Spill Response (7710-650-ERP-0001)
- Santos Offshore - Oil and Water Sampling Procedures (7710-650-PRO-0008)
- Santos Oil Spill Response - Forward Operating Base Guideline (SO-91-IF-20017).

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

3 Oil Spill Response Framework

3.1 Spill Response Levels

Santos 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. Spill Response Levels help to identify the severity of an oil spill incident and the level of response required to manage the incident and mitigate environmental impacts. Incident Response levels are outlined within the Santos Incident Management Plan – Upstream Offshore (SO-00-ZF-00025) and further detailed in **Table 3-1** below for hydrocarbon spills.

Table 3-1: Santos Oil Spill Response Levels

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

3.2 Jurisdictional Authorities and Control Agencies

The responsibility for an oil spill is dependent on location and spill origin. The National Plan for Maritime Environmental Emergencies (AMSA, 2020) sets out the divisions of responsibility for an oil spill response. Definitions of Control Agency and Jurisdictional Authority are as follows:

Control Agency: the organisation assigned by legislation, administrative arrangements or within the relevant contingency plan, to control response activities to a maritime environmental emergency. Control Agencies have the operational responsibility of response activities but may have arrangements in place with other parties to provide response assistance under their direction.

Jurisdictional Authority: the agency which has responsibility to verify that an adequate spill response plan is prepared and, in the event of an incident, that a satisfactory response is implemented. The Jurisdictional Authority is also responsible for initiating prosecutions and the recovery of clean-up costs on behalf of all participating agencies.

With respect to a hydrocarbon spill from 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 3-2**).

Table 3-2: Jurisdictional Authorities and Control Agencies for Varanus Island Hub oil spill response

<table>
<tr><th rowspan="2">Role</th><th rowspan="2">Spill Level</th><th colspan="2">State waters</th><th colspan="2">State waters within Pilbara Ports Authority Limits[1]</th><th colspan="2">Commonwealth waters</th><th>International waters[2]</th><th rowspan="2">Onshore</th></tr>
<tr><th>Facility [3]</th><th>Vessel [4]</th><th>Facility</th><th>Vessel</th><th>Facility</th><th>Vessel</th><th>All activities</th></tr>
<tr><td rowspan="2">Control Agency</td><td>1</td><td>Petroleum Titleholder (Santos)</td><td>DoT</td><td>Petroleum Titleholder (Santos)</td><td>Pilbara Ports Authority[5]</td><td>Petroleum Titleholder (Santos)</td><td>AMSA</td><td rowspan="2">Santos will liaise with the Australian Government Department of Foreign Affairs and Trade (DFAT) in the event that an oil spill may enter international waters. Santos will work with DFAT and the respective governments to support response operations.</td><td>Petroleum Titleholder (Santos)</td></tr>
<tr><td>2/3</td><td>DoT</td><td>DoT</td><td>DoT</td><td>Pilbara Ports Authority/ DoT[6]</td><td>Petroleum Titleholder (Santos)</td><td>AMSA</td><td>Petroleum Titleholder (Santos)</td></tr>
<tr><td>Jurisdictional Authority</td><td>1/2/3</td><td>DoT</td><td>DoT</td><td>DoT</td><td>DoT</td><td>NOPSEMA</td><td>AMSA</td><td>Relevant foreign authority</td><td>DFES/ DWER</td></tr>
</table>

[1] The Varanus Island port limits are defined in section 4 of the Port of Varanus Island Port Handbook (Pilbara Ports Authority, 2021a).

[2] As per AMSA (2017a), Coordination of International Incidents: Notification Arrangements Guidance NP-GUI-007.

[3] 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 OPGGS Act 2006.

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

[5] DoT and the Pilbara Ports Authority may assign, through IMPs/OSCPs/OPEPs, emergency response functions to a Port Operator or Port Facility Operator for spills originating from their activities, however the role of Control Agency will remain with the nominated agency or organisation as per Table 3-2 above (Pilbara Ports Authority, 2021a).

[6] In the event of a Level 2/3 incident in Pilbara Ports Authority waters, the role of Control Agency may fall with the Pilbara Ports Authority or DoT and will be determined by the Hazard Management Agency (HMA) in consultation with the Pilbara Ports Authority. The Control Agency will be the agency deemed most capable of performing the role of Control Agency (Pilbara Ports Authority, 2021b).

3.2.1 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) is responsible for responding to an oil spill incident as the Control Agency in Commonwealth waters, in accordance with its OPEP.

3.2.2 Petroleum Activity Spill in State Waters

If a Marine Oil Pollution Incident occurs within State waters, the DoT is the Hazard Management Agency (HMA) (DoT Chief Executive Officer or proxy). The Assistant Executive Director (or proxy) has been nominated by the HMA to perform the role of State Marine Pollution Coordinator (SMPC) (as prescribed in Section 1.3 of the SHP – MEE [WA DoT, 2022]). Under the SHP-MEE, the Control Agency for Level 1 Petroleum Activity spills in State waters is the Petroleum Titleholder (Santos) with the Control Agency for Level 2/3 spills nominated as DoT. The SMPC will provide strategic management of the incident response on behalf of the HMA.

While Santos is not the Control Agency for Level 2/3 Petroleum Activity spills in State waters, Santos 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 DEMIRS:

+ *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 will provide all necessary resources to assist DoT. The framework under which Santos will provide support to DoT for an oil response within State waters is detailed in **Section 4.2.3**.

3.2.3 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), unless otherwise appointed through agreement between the HMA / Jurisdictional Authority of both waters. Where a Level 2/3 spill originating in Commonwealth waters moves into State waters, two Control Agencies will exist: DoT and the Petroleum Titleholder (Santos), each with its own IMT and Lead IMT responsibilities.

The arrangements between DoT and Santos for sharing resources and coordinating a response across both Commonwealth and State waters are further detailed in **Section 4.2.3**.

3.2.4 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 National Plan 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 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.

In all circumstances, the Vessel Master is responsible for implementing source control arrangements detailed in the vessel-specific SOPEP.

Once initial notifications to the Control Agency are made, Santos shall maintain direct contact with the Control Agency and act as a supporting agency throughout the response. This includes providing essential services, personnel, materials or advice in support of the Control Agency. In addition, Santos will be required to implement monitoring activities as outlined in the Monitor and Evaluate Plan (**Section 9**) and Scientific Monitoring Plan (**Section 17**).

3.2.5 Vessel Spills in State Waters

For Level 1 vessel spills within the Port of VI limits, the Control Agency is Pilbara Ports Authority. In this instance, Pilbara Ports Authority and DoT may assign, through existing Incident Management Plans (IMPs)/OSCPs/OPEPs, emergency response functions to a Port Operator or Port Facility Operator (i.e. Santos) for spills originating from their activities, however the role of Control Agency will remain with the Pilbara Ports Authority.

For Level 2/3 vessel spills within the Port of VI limits, the Control Agency is either Pilbara Ports Authority or DoT. The role of Control Agency may fall with the Pilbara Ports Authority or DoT and will be determined by the HMA in consultation with Pilbara Ports Authority. The Control Agency will be the agency deemed most capable of performing the role of Control Agency.

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 is required to have adequate preparedness arrangements for spills from vessels undertaking Petroleum Activities within State Petroleum legislation administered by DEMIRS.

Santos will be responsible for coordinating a first-strike response to all vessel-based spills 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 would provide all necessary resources (including personnel and equipment) as a Supporting Agency.

3.2.6 Cross-jurisdictional Vessel Spills

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

AMSA may request that DoT manage a vessel incident in Australian Commonwealth waters (WA DoT, 2022).

3.2.7 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 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 will ensure clean-up and remediation of any onshore spill is completed to the satisfaction of the Department of Water and Environmental Regulation (DWER) as the relevant Jurisdictional Authority for the clean-up of onshore oil spill pollution and management of contaminated sites.

4 Santos Incident Management

The Santos IMT (Perth) and Crisis Management Team (CMT) will be activated in the event of a Level 2/3 hydrocarbon spill regardless of the type of spill or jurisdiction. Santos maintains internal resources (trained personnel and equipment) across its activities that provide first strike response capability and to also support an ongoing response. Should an incident occur, the IMT Duty Manager would be notified immediately. This rostered role is on-call, filled by trained Incident Commanders and available 24 hours/day and 7 days/week. The IMT Duty Manager would then activate the IMT via an automated call-out system. Documentation required in a response is accessed via the Santos Emergency Response (ER) intranet site.

As outlined above, control of the response may be taken over by the relevant Control Agency as the incident progresses. The Santos response structure to a major emergency incident is detailed in the Incident Management Plan – Upstream Offshore (SO-00-ZF-00025) and the Santos Incident Management Handbook. The Incident Management Plan – Upstream Offshore and Santos Incident Management Handbook describes response planning and incident management that would operate under emergency conditions – describing how the Santos IMT operates and interfaces with the CMT and external parties.

The first priority of an escalating oil spill response to a Level 2/3 spill is the formation of an IMT and establishment of an Incident Coordination Centre (ICC)[1]. The ongoing involvement of the IMT and CMT will be dependent on the severity and type of spill and the obligations of Santos and other agencies/authorities in the coordinated spill response.

Santos's incident response structure relevant to a VI incident includes:

+ Varanus Island-based ERT;
+ Santos IMT – Perth based ICC to coordinate and execute responses to an oil spill incident;
+ CMT - to coordinate and manage threats to the company's reputation and to handle Santos' corporate requirements in conjunction with the Perth based Santos –Vice President Offshore Upstream WA;
+ Other field-based command, response and monitoring teams for implementing strategies outlined within the OPEP.

The Santos incident response organisational structure is defined in the Incident Management Plan – Upstream Offshore (SO-00-ZF-00025) and Santos Incident Management Handbook, and in **Figure 4-1**. The Santos IMT roles and field-based teams are scalable; roles can be activated and mobilised according to the nature and scale of the incident response.

If the incident involves a LOWC, the Santos Source Control Branch would also be included in the incident response structure (**Figure 4-1**). This team would be comprised of the following sub-teams, according to the applicable source control strategies:

+ Relief Well Team
+ Well Intervention Team

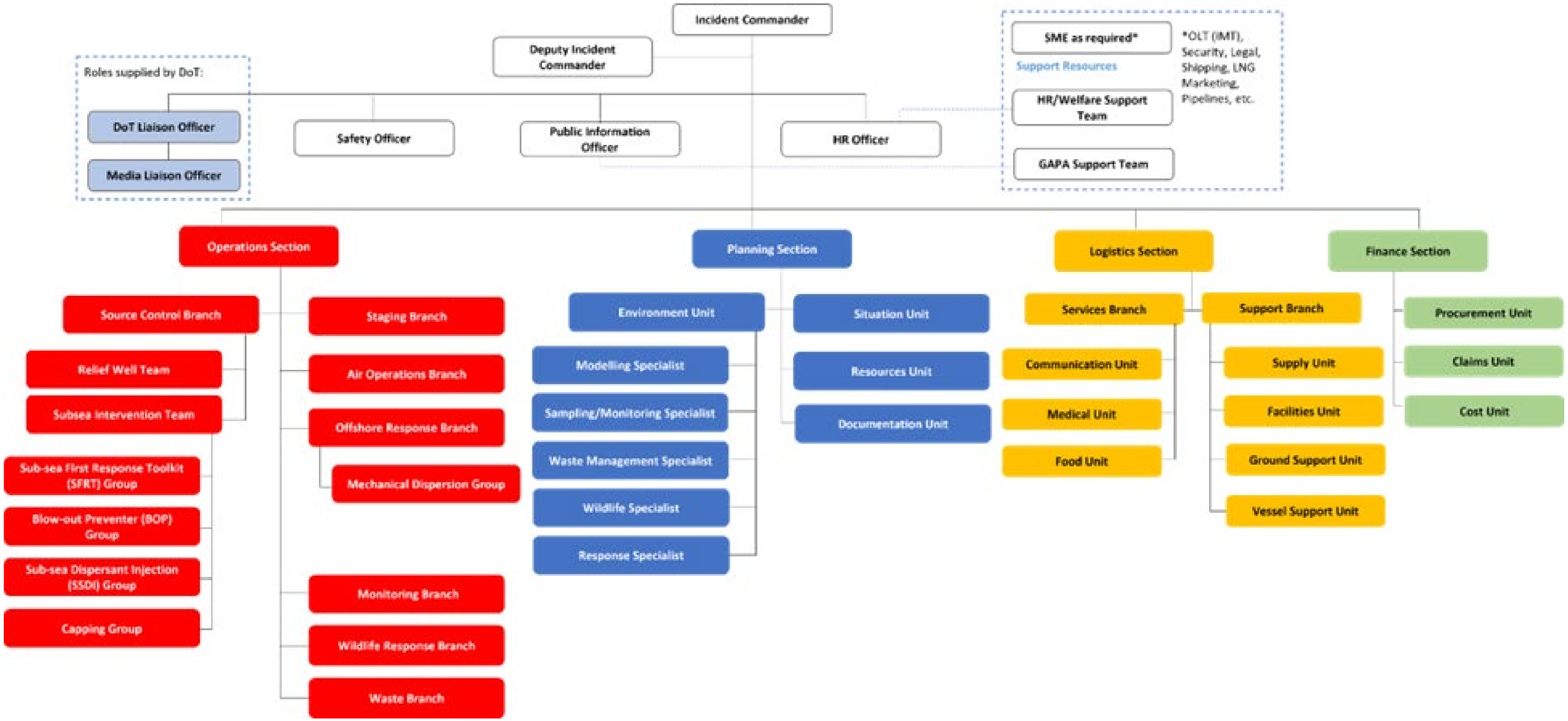
The Santos Source Control Branch would report directly to the Operations Section Chief and would be responsible for:

+ coordinating engineering safety and operational activities;
+ managing source control technical personnel from third parties (e.g. Wild Well Control);
+ developing task-specific plans and procedures;
+ identifying and sourcing required tools and equipment; and

[1] The Santos ICC is located in the Santos WA Perth office.

- approving source control components of IAPs.

In the event of a Level 2 or 3 spill event, Santos will review the relevant persons identification process described in Section 4.2 of the Varanus Island Hub Operations Environment Plan (State Waters) (EA-60-RI-00186), and in Section 4.2 of the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (EA-60-RI-10003). Relevant persons, whose functions, interests or activities that may be affected by the spill event or response arrangements will be identified and engaged in accordance with the Santos incident management process, noting notification and communications requests made by Relevant Persons during Environment Plan consultation with respect to emergency situations.



Note: For a Level 2/3 Petroleum Activity spills whereby DoT is involved as a Control agency, either within a single jurisdiction (State water only spills) or cross-jurisdictional (spills from Commonwealth to State waters), Santos will work in coordination with the DoT in providing spill response capability. Santos' expanded organisational structure for these situations is detailed in **Section 4.2.3**.

Note: For the Spartan development activities, the Blowout Preventer Group, Subsea Intervention Team, Subsea Dispersant Injection (SSDI) Group and Capping Group is not expected to be activated.

Figure 4-1: Santos Incident Response Organisational Structure

4.1 Roles and Responsibilities

The following tables provide an overview of the responsibilities of the Santos CMT (**Table 4-1**), IMT (**Table 4-2**), and ERT in responding to an incident (**Table 4-3**). Not all of the roles listed in **Table 4-2** are shown in **Figure 4-1**, as some of the roles in **Table 4-2** are support roles or specific to a particular response strategy. Full responsibilities checklists/job cards of each role are described in the Incident Management Plan – Upstream Offshore (SO-00-ZF-00025), Santos Incident Management Handbook and Santos Crisis Management Plan (SMS-HSS-OS05-PD03) to support the incident action planning process. The IMT and ERT are scalable to the nature and scale of the response i.e. one person can take on multiple roles or one role can be filled by multiple people, where circumstances permit.

Also provided are the roles and responsibilities of Santos personnel required to work within DoT's organisational structure (**Table 4-4**), where DoT has responsibilities for spill response as a Control Agency, as per *DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements*.

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

The details on IMT resourcing for roles identified in **Table 4-2** are provided in **Appendix J**.

Table 4-1: Roles and Responsibilities in the Santos Crisis Management Team

Santos CMT Role	Main Responsibilities
Crisis Management Chair (CEO)	The CM Chair (Santos Chief Executive Officer) is responsible for the following: + Leads crisis management direction + Provides governance and oversight of CMT operations. + Provides enterprise and strategic direction to the CMT for the resolution of the crisis event. + Delegates the CM Lead role and accountability to the appropriate ExCom designee. + Engage with the CM Lead to endorse the crisis resolution plan. + Liaise with the Santos Board and strategic stakeholders. + Provide the full extent of the company's resources to bring about a resolution and recovery from the crisis impact.
CMT Lead/ Duty Manager	The CMT Lead is responsible for: + Determine the need for establishing a Level 3 response and for activating the CMT. + Determine which / if any Crisis Management Support Teams (CMST) are mobilised. + Leading the crisis resolution process. + Ensures internal and external notifications to key stakeholders. + Uses the crisis resolution process to determine enterprise level impacts (potential or actual) and strategic objectives. + Ensures a crisis resolution plan is developed and direct the CMT functions to implement strategies, action plans and tasks. + Determines when it is appropriate to conclude the crisis response and stand down all or a portion of the CMT.

Santos CMT Role	Main Responsibilities
CMT Information Management	The CMT Information Managers directly support the CMT as follows: + Support the CMT during crisis management operations. + Sets up the crisis management room, assist with set-up of communications, video conferences and information transfer within the CMT. + Advises on CMT operating processes and available resources. + Assisting with reserving break out rooms for the CMT functions and CMSTs. + Ensuring CMT crisis resolution forms are used and displayed on the monitors. + Provides incident action plan information when an IMT is established. + Monitoring and managing the welfare needs of the CMT.
Crisis Management Advisor	The Crisis Management Advisor is responsible for the following: + Provides CMT process guidance and advice to CMT Lead, Function Leaders, and CMST. + Supports and facilitates the crisis resolution planning process. + Acts as the liaison between the CMT and IMT. + Work with CMT Information Managers to manage roster and handovers for extended CMT operations. + Schedules and facilitates post crisis debriefs and after-action reviews.: + The Crisis Management Advisor will support the CMT Lead as follows: + Facilitates CMT activation requirements with the CMT Lead. + Assists the CMT Lead in maintaining an ongoing assessment of incident potential and analysis of stakeholder impacts. + Advises the CMT Lead on CMT structure and requirements for CMST engagement. + Coordinates tasks delegated by CMT Lead. + Provide tools to the CMT Lead for review and crisis assessment meetings.

Santos CMT Role	Main Responsibilities
CMT Function Leads	CMT Function Leaders include Leaders for the following areas: + Legal Counsel and Risk, + Environment Health Safety and Security, + Operating Unit VP, + People, + Government and Public Affairs (GAPA), + Media and Communications + The CMT Function Leads are responsible for the following: + Participate and contribute to the crisis resolution planning process. + Each Function Leader shall determine critical communications pertaining to their area. + Mobilize and coordinate activities of the function CMST. + Advise the CMT Lead on strategic impacts, threats and mitigation created by the crisis event. + Develop and execute strategies to meet objectives endorsed by the CM Chair. + Provide support and resources via the CMST to divisional IMTs. + Ensures critical actions, decisions or points of strategic criticality are included in the CMT log. + Participates in the crisis management debrief and after-action reviews.

Table 4-2: Roles and Responsibilities in the Santos Incident Management Team

Santos Management/ IMT Role	Main Responsibilities
Vice President Offshore (VPO) Upstream WA	+ Depending on the level of the incident, the VPO (and/or their delegate) will act as the primary liaison to the CMT Duty Manager. + On the activation of the IMT, the VP is advised by the IMT Duty Manager.
Incident Commander	+ Incident Commander is responsible for the overall management of the incident. Will set response objectives and strategic directions and oversee the development and implementation of Incident Action Plans
Safety Officer	+ Safety Officer is responsible to develop and recommend measure for assuring personnel safety and to assess and/or anticipate hazardous and unsafe situations. Safety Officer may have specialists as necessary.
Public Information Officer	+ Public Information Officer is responsible for developing and releasing information about the incident to media, incident personnel and to appropriate agencies and organisations
Human Resources Officer	+ HR Officer is responsible for advising and assisting the Incident Commander, Command Staff and Section Chiefs on any HR related aspects of an incident.

Santos Management/ IMT Role	Main Responsibilities
Operations Section Chief	+ The Operation Section Chief leads the Operations Section within the IMT and is responsible for the management of all tactical operations directly applicable to the primary assignments. The Operations Section Chief activates and supervises operational elements in accordance with the IAP and directs its execution.
Source Control Branch Director	+ The Source Control Branch Director will be responsible for the implementation of the Source Control Plan (Source Control Planning and Response Guideline - DR-00-OZ-20001). The Source Control Branch Director will activate and supervise source control elements in accordance with the Incident Action Plan and direct its execution.
Relief Well Team Leader	+ The Relief Well Team Leader is responsible for the management and coordination of relief well design and operations. The Relief Well Team Leader coordinates the development of the drilling plans and procedures, secures resources and manages relief well operations to ensure the relief well reaches its target + Create groups as required to acquire relief well MODU, equipment and services and perform detailed relief well planning
Well Intervention Team Leader	+ The Well Intervention Team Leader is responsible for intervention activities including initial site survey, debris clearance and direct BOP intervention
SFRT Group Leader	+ The SFRT Group Leader is responsible for the activation of the SFRT via the AMOSC Duty Officer and mobilisation to site. Mobilisation includes sourcing two vessels for SFRT deployment according to vessel criterion in Santos Source Control Planning and Response Guideline. The Group Leader manages and coordinates SFRT functions including debris clearance survey and operations.
BOP Group Leader	+ The BOP Group Leader is responsible for the management and coordination of an intervention on the BOP of the incident well. Based on the initial subsea survey results, the group assess the situation and develops the BOP intervention plans and procedures, secures resources and manages BOP intervention operations with the objective of closing the BOP *(Note: Due to the use of a jack-up MODU and the surface location of the BOP, this Group is not expected to be activated for the Spartan development activity).*
SSDI Group Leader	+ SSDI Group Leader The SSDI Group Leader is responsible for the management and coordination of subsea dispersant operations at or near the source at seabed. The group coordinates application and monitoring plans, prepares procedures, secures resources and approvals, and oversees the application and efficacy of subsea dispersant operations. *(Note: Due to the use of a jack-up MODU this Group is not expected to be activated for the Spartan development activity).*
Capping stack Group Leader	+ The Capping Group Leader responsible for the management and coordination of overall capping stack staging, installation plan, and operations. The group begins its task early in the process and continues to operate concurrently with all other source control efforts until the well is secured. *(Note: Due to the use of a jack-up MODU this Group will not be activated for the Spartan development activity).*

Santos Management/ IMT Role	Main Responsibilities
Staging Branch Director	+ The Staging Branch Director is responsible for supervising the Staging Area Managers as well as coordinating their activities including assigning Staging Area Managers, receiving, maintaining, checking in/out, storing and distributing resources
Air Operations Branch Director	+ The Air Operations Branch Director is ground-based and is primarily responsible for the coordination of the air operations section (ICS 220) of the IAP and for providing logistical support to incident aircraft
Offshore Response Branch Director	+ The Offshore Response Branch Director is responsible for leading the offshore response activities including protection and containment and recovery activities on water. Depending on the size and nature of the incident, various, groups, teams and task forces will be implemented including Recovery & Protection Group etc. + The Recovery & Protection Group is responsible for the deployment of containment and diversion/protection booming and managing on water recovery operations in the designated locations in compliance with the IAP.
Monitoring Branch Director	+ Working closely with the Environmental Unit, the Monitoring Branch Director will be responsible for implementing the operational and scientific monitoring plans required based on the nature and scale of the incident.
Oiled Wildlife Response Branch Director	+ Working with relevant state authorities, the Oiled Wildlife Response Branch Director will be responsible for implementing the OWR plan for the incident including the deployment of equipment and personnel required.
Shoreline Clean-up Branch Director	+ The Shoreline Clean-up Branch Director is responsible for leading all shoreline response activities working closely with the Shoreline Response Program Manager and shoreline clean-up supervisors and various locations
Waste Branch Director	+ The Waste Branch Director is responsible for coordinating the on-site activities of personnel engaged in collecting, storing, transporting and disposing of waste materials, in compliance with the IAP.
Planning Section Chief	+ Planning Section Chief will lead the Planning Section within the IMT and is responsible for the collection, evaluation, dissemination and use of incident information and maintaining status of assigned resources.
Situation Unit Lead	+ The Situation Unit Leader is responsible for collecting, processing, and organizing incident information relating to escalation, mitigation or intelligence activities taking place in an incident. The Situation Unit will be responsible for preparing future projections of incident growth, maps, and intelligence information.
Resources Unit Lead	+ The Resource Unit Leader is responsible for maintaining the status of all assigned tactical resources and personnel at an incident. The Resource Unit will oversee the check-in of all tactical resources and personnel, maintaining a status-keeping system indicating current location and status of all the resources.
Documentation Unit Lead	+ The Documentation Unit Lead us responsible for maintenance of accurate, up-to-date incident files including Incident Action Plans. Incident reports, communication logs, situation status reports etc.

Santos Management/ IMT Role	Main Responsibilities
Environment Unit Lead	+ The Environment Unit Leader is responsible for environmental matters associated with the response, including strategic assessment, modelling, surveillance and environmental monitoring and permitting.
Technical Specialists	+ Certain incidents may require the use of Technical Specialists who have specialized knowledge or expertise. Technical Specialists may function within the Planning Section or be assigned wherever their services are required. Santos will activate Technical Specialists, based on the requirements of the incident, through a range of arrangements and this may include, Modelling Specialist, Operational/Scientific Monitoring Specialist, Response Technology Specialist, Waste Management Specialist etc.
Shoreline Response Programme (SRP) Manager	+ The SRP Manager reports to the Environment Unit Leader and is responsible for managing shoreline response + Provides input to Planning and Operations Section Chiefs on shoreline response program to minimize shoreline impacts and Shoreline Clean-up Assessment Technique (SCAT) program
SCAT Programme Coordinator	+ SCAT Program Coordinator is the primary point of contact, through SRP Manager, within the IMT for all SCAT activities + SCAT Program Coordinator act as the project manager for SCAT program and will design and direct the SCAT program for any incidents + SCAT Program Coordinator will implement and manage the day-today activities for the SCAT program including establishing good management practices and safety protocols for the field teams, chairing SCAT Field Survey Team briefings and debriefings and producing daily and weekly summaries of field reports
SCAT Field Coordinator	+ SCAT Field Coordinator works with SCAT Program Coordinator to develop daily missions and rolling strategy for the field teams and to provide the necessary logistics and equipment support as required
SCAT Data Manager	+ SCAT Data Manager reports to the SCAT Program Coordinator and is responsible for processing field data, quality assurance, data storage and dissemination within the IMT, and for providing the SCAT Field Survey Teams with the maps and data required to conduct their missions.

Santos Management/ IMT Role	Main Responsibilities
Shoreline Treatment Recommendations (STR) Manager	+ The STR Manager is responsible for the preparation of the Shoreline Treatment Recommendations (STRs) + STR Manager will work with the Environment Unit to obtain reconnaissance information to assess priority areas for initial SCAT surveys and gain approval for land access where appropriate + STR Manager ensures all approvals are obtained (e.g. concerning any endangered species, cultural, historical resources etc.) prior to undertaking shoreline activities + STR Manager will work with the Environment Unit's Technical Specialists, subject matter experts and stakeholders to ensure that their requirements and constraints are incorporated into shoreline treatment recommendations + STR Manager will work with the Operations Section to obtain advice on the feasibility, practicality and effectiveness of potential treatment strategies and tactics + STR Manager will track the progress of approved STRs to generate and update progress reports
Logistics Section Chief	+ Logistics Section Chief is responsible for providing facilities, services and materials in support of the incident. The Logistics Section Chief participates in the development and implementation of the Logistics Section of the IAP.
Services Branch Director	+ Service Branch Director, when activated is under the supervision of the Logistics Section Chief and is responsible for the management of all service activities for the incident including the operations of the Communications, Medical and Food Units
Support Branch Director	+ Support Branch Director, when activated, is under the supervision of Logistics Section Chief and is responsible for the development and implementation of logistics plan in support of the IAP. The Support Branch supervises the operations of the Supply, Facilities, Ground Support and Vessel Support Units.
Finance Section Chief	+ Finance Section Chief is responsible for all the financial, administrative and cost analysis aspects of the incident and for supervising members of the Finance Section
Procurement Unit Lead	+ Procurement Unit Leader us responsible for administering all financial matters pertaining to vendor contracts and leases. The Procurement Unit Leader will execute all procurements in accordance with the policies and procedures of Santos
Claims Unit Lead	+ The Claims Unit Leader is responsible for the management and direction of all administrative matters pertaining to compensation and claims related matters for any incident
Cost Unit Lead	+ The Cost Unit Leader is responsible for collecting all cost data and providing cost estimated and any cost saving recommendations for the incident

Table 4-3: Roles and Responsibilities in the Field-based Response Team

Field-Based Position	Main Responsibilities
On-Scene Commander (MODU during Spartan or Halyard-2 drilling)	+ Assess facility-based situations. + Be single point of communications between facility/site and IMT. + Communicate the incident response actions and delegates actions to the Incident Commander. + Manage the incidents in accordance with MODU Emergency Response Plan. + Coordinate medical evacuations as required. + Refer to the MODU Emergency Response Plan for detailed descriptions of roles and responsibilities.
Company Site Representative (MODU during Spartan or Halyard-2 drilling)	+ Notify the Perth based Incident Commander of oil spills. + Coordinate onsite monitoring of oil spill and ongoing communication with Incident Commander.
Medical Evacuation Team	+ Manage all medical and transportation requirements related to injured personnel to an appropriate medical facility + Refer to the Medical Evacuation Procedure (SO-91-IF-00020) for detailed descriptions of roles and responsibilities within the Medical Evacuation Team
Varanus Island On-Scene Commander (OIM)	+ Commands the onsite response to Varanus Island Hub incidents, including oil spills, using onsite resources, including the Facility ERT + 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 Emergency Response Team (ERT)	+ Respond to incidents under the instruction of an Incident Response Team Leader in accordance with actions developed by the VI On Scene Commander.
Emergency Commander / Division Commander	+ Coordinates the field response as outlined in the First Strike Response Plan and/or Incident Action Plan developed by the IMT + Commands a Forward Operating Base (FOB) for the coordination of resources mobilised to site
Oil Spill Response Teams	+ Undertake oil spill response activities as defined in Incident Action Plans and Oil Pollution Emergency Plans.
Source Control Branch	+ Respond to incidents involving well loss of containment to stop the flow of oil to sea + Refer to the Source Control Planning and Response Guideline (DR-00-OZ-20001) for detailed descriptions of roles and responsibilities within the Source Control Team
Wildlife Response Branch	+ Respond to oiled wildlife incidents to minimise the impacts to wildlife + Refer to the Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) for a description of the wildlife response branch, and the Santos Incident Management Handbook for detailed descriptions of roles and responsibilities within the Oiled Wildlife Response Team

Field-Based Position	Main Responsibilities
Monitoring Branch	+ 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 4-4: Santos Personnel Roles Embedded within the State Maritime Environmental Emergency Coordination Centre (MEECC) / Department of Transport (DoT) Incident Management Team (IMT) / Forward Operations Base

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
CMT Liaison Officer[9]	+ Provide a direct liaison between the Santos CMT and the State MEECC. + Facilitate effective communications and coordination between the Santos CMT Lead and the SMPC. + Offer advice to SMPC on matters pertaining to Santos crisis management policies and procedures
Deputy Incident Controller	+ Provide a direct liaison between the DoT IMT and the Santos IMT. + Facilitate effective communications and coordination between the Santos Incident Commander and the DoT Incident Controller. + Offer advice to the DoT Incident Controller on matters pertaining to the Santos incident response policies and procedures. + Offer advice to the Safety Coordinator on matters pertaining to Santos safety policies and procedures particularly as they relate to Santos employees or contractors operating under the control of the DoT IMT.
Deputy Intelligence Officer	+ As part of the DoT Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. + Facilitate the provision of relevant modelling and predications from the Santos IMT. + Assist in the interpretation of modelling and predictions originating from the Santos IMT. + Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Santos IMT. + Facilitate the provision of relevant mapping from the Santos IMT. + Assist in the interpretation of mapping originating from the Santos IMT. + Facilitate the provision of relevant mapping originating from the Santos IMT.

[9] The role described as the *Santos Offshore Liaison Officer* in **Figure 4-2**.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Planning Officer	+ As part of the DoT Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub-plans + Facilitate the provision of relevant IAP and sub-plans from the Santos IMT. + Assist in the interpretation of the Santos OPEP from Santos. + Assist in the interpretation of the Santos IAP and sub-plans from the Santos IMT. + Facilitate the provision of relevant IAP and sub-plans originating from the DoT IMT to the Santos IMT. + Assist in the interpretation of Santos' existing resource plans. + Facilitate the provision of relevant components of the resource sub-plan originating from the DoT IMT to the Santos IMT. (Note this individual must have intimate knowledge of the relevant Santos OPEP and planning processes).
Environment Support Officer	+ As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process + Assist in the interpretation of the Santos OPEP and relevant Tactical Response Plan (TRPs). + Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the Santos IMT. + Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Santos IMT.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Public Information Officer[10]	+ As part of the Public Information Team, provide a direct liaison between the Santos Media team and DoT IMT Media team. + Facilitate effective communications and coordination between Santos and DoT media teams[11]. + Assist in the release of joint media statements and conduct of joint media briefings. + Assist in the release of joint information and warnings through the DoT Information & Warnings team. + Offer advice to the DoT Media Coordinator on matters pertaining to Santos media policies and procedures. + Facilitate effective communications and coordination between Santos and DoT Community Liaison teams. + Assist in the conduct of joint community briefings and events. + Offer advice to the DoT Community Liaison Coordinator on matters pertaining to Santos community liaison policies and procedures. + Facilitate the effective transfer of relevant information obtained from the Contact Centre to the Santos IMT.
Deputy Logistics Officer	+ As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. + Facilitate the acquisition of appropriate supplies through Santos' existing OSRL, AMOSC and private contract arrangements. + Collects Request Forms from DoT to action via the Santos IMT. + (Note this individual must have intimate knowledge of the relevant Santos logistics processes and contracts).
Deputy Waste Management Coordinator	+ As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. + Facilitate the acquisition of appropriate services and supplies through Santos' existing private contract arrangements related to waste management; + Collects Waste Collection Request Forms from DoT to action via the Santos IMT.

[10] In the event of an incident, Santos can provide the DoT IMT with a list of agencies, organisations, representative bodies, and other stakeholders that were consulted in the development of the Environment Plan to assist DoT with the management and provision of public information.

[11] In the event DoT assumes the role of Control Agency in State Waters, Santos acknowledges that the DoT IMT will be the lead IMT for public information and warnings and community liaison. In such circumstances, Santos retains the right to manage its own media interests, but acknowledges the strong preference for DoT and Santos to issue joint media statements and conduct joint media conferences and the importance of close liaison between the respective Media Teams.

Santos roles embedded within the State MEECC/ DoT IMT	Main Responsibilities
Deputy Finance Officer	+ As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Santos' existing OSRL, AMOSC and private contract arrangements. + Facilitate the communication of financial monitoring information to Santos to allow them to track the overall cost of the response. + Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Santos.
Deputy Operations Officer	+ As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. + Facilitate effective communications and coordination between the Santos Operations Section and the DoT Operations Section. + Offer advice to the DoT Operations Officer on matters pertaining to Santos incident response procedures and requirements. + Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of Santos and DoT response efforts.
Deputy Division Commander (FOB)	+ As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. + Provide a direct liaison between Santos' Forward Operations Base/s (FOB/s) and the DoT FOB. + Facilitate effective communications and coordination between Santos FOB Operations Commander and the DoT FOB Operations Commander. + Offer advice to the DoT FOB Operations Commander on matters pertaining to Santos incident response policies and procedures. + Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to Santos employees or contractors. + Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to Santos safety policies and procedures.

Table 4-5: Department of Transport Roles Embedded within Santos' CMT / IMT

DoT roles embedded within Santos' CMT/IMT	Main Responsibilities
DoT Liaison Officer (prior to DoT assuming role of Control agency) Deputy Incident Controller – State Waters (after DoT	+ Provide a direct liaison between the Santos IMT and the State MEECC. + Facilitate effective communications between DoT's State Marine Pollution Coordinator (SMPC) the Incident Controller and Santos' appointed CMT Lead/Incident Commander.

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

4.2 Regulatory arrangements and external support

4.2.1 Australian Marine Oil Spill Centre (AMOSC)

Santos is a Participating Member of AMOSC and as such has access to AMOSC equipment and personnel as outlined in the AMOSPlan (AMOSC, 2021).

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

The mutual aid arrangements that AMOSC operates under are collaborated under the AMOSPlan and are activated via the AMOSC Duty Officer. 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, Chevron, Woodside and Jadestone have signed a Memorandum of Understanding (MOU) that defines the group's mutual aid arrangements. Under this MoU, Santos, Chevron, Jadestone and Woodside have agreed to use their reasonable endeavours to assist in the provision of emergency response services, personnel, consumables and equipment.

4.2.2 Australian Maritime Safety Authority (AMSA)

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

Upon notification of an incident involving a ship, AMSA will assume control of the incident and response in accordance with the National Plan (AMSA, 2020). AMSA is to be notified immediately of all ship-source incidents through its Rescue Coordination Centre (RCC) Australia (Santos Incident Response Telephone Directory (SO 00 ZF 00025.020)).

AMSA manages the National Plan, Australia's key maritime emergency contingency and response plan (AMSA, 2020). AMSA fulfils its obligations under the National Plan for non-ship source pollution incidents on the formal request from the respective Offshore Petroleum Incident Controller/s (AMSA, 2021a). AMSA also has a range of National Plan supporting documents containing related policies, guidance and advisory information.

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

4.2.3 WA Department of Transport (DoT)

For Level 2/3 spills entering or within WA State waters/shorelines, DoT as the Control Agency is the ultimate decision maker regarding identification and selection of protection priorities. DoT will utilise their internal processes which typically includes the following:

+ evaluation of situational awareness information, including all surveillance, monitoring and visualisation data provided by the Titleholder;
+ evaluation of resources at risk including use of the WA Oil Spill Response Atlas and any other relevant WA/Commonwealth government databases or other information sources;
+ evaluate shoreline types, habitat types and seasonality of environmental, socio-economic and cultural values and sensitivities;
+ consultation with the State Environmental Scientific Coordinator and other relevant State and Federal government departments with environmental responsibilities;
+ consultation with other relevant oil spill agencies, including the AMSA Environment, Science and Technology network or any other experts as necessary;
+ all information is utilised in a NEBA/SIMA type process, to determine protection priorities and response strategies.

DoT will adjust/amend their internal processes to suit the spill situation at the time.

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

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

Santos will conduct initial response actions in State waters as necessary in accordance with its OPEP and continue to manage those operations until formal handover of incident control is completed. Appendix 1 within DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements provides a checklist for formal handover. Beyond formal handover, Santos will continue to provide all necessary resources, including personnel and equipment, to assist the DoT in performing duties as the Control Agency for State Waters.

For a cross-jurisdictional response, there will be a Lead IMT (DoT or Santos) for each spill response activity, noting that DoT only has jurisdictional/control agency authority within State waters.

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

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

For a cross jurisdictional response Santos will be responsible for ensuring adequate resources are provided to DoT as Control Agency, initially 11 personnel to fill roles in the DoT IMT or FOB **(refer Section 4.2.3)** and operational personnel to assist with those response strategies where DoT is the Lead IMT. Concurrently DoT will also provide two of their personnel to the Santos IMT as described in **Table 4-5.** Santos' CMT Liaison Officer and the Deputy Incident Controller are to attend the DoT Fremantle Incident Control Centre (ICC) as soon as possible after the formal request has been made by the SMPC. It is an expectation that the remaining initial cohort will attend the DoT Fremantle ICC no later than 8am on the day following the request being formally made to Santos by the SMPC. Santos personnel designated to serve in DoT's FOB will arrive no later than 24 hours after receipt of formal request from the SMPC.

Figure 4-2 shows the organisational structure of Santos incident management personnel within Santos IMT and embedded within DoT's MEECC/IMT.

Figure 4-3 shows the overall cross jurisdictional organisational structure referenced from the SHP-MEE.

Santos

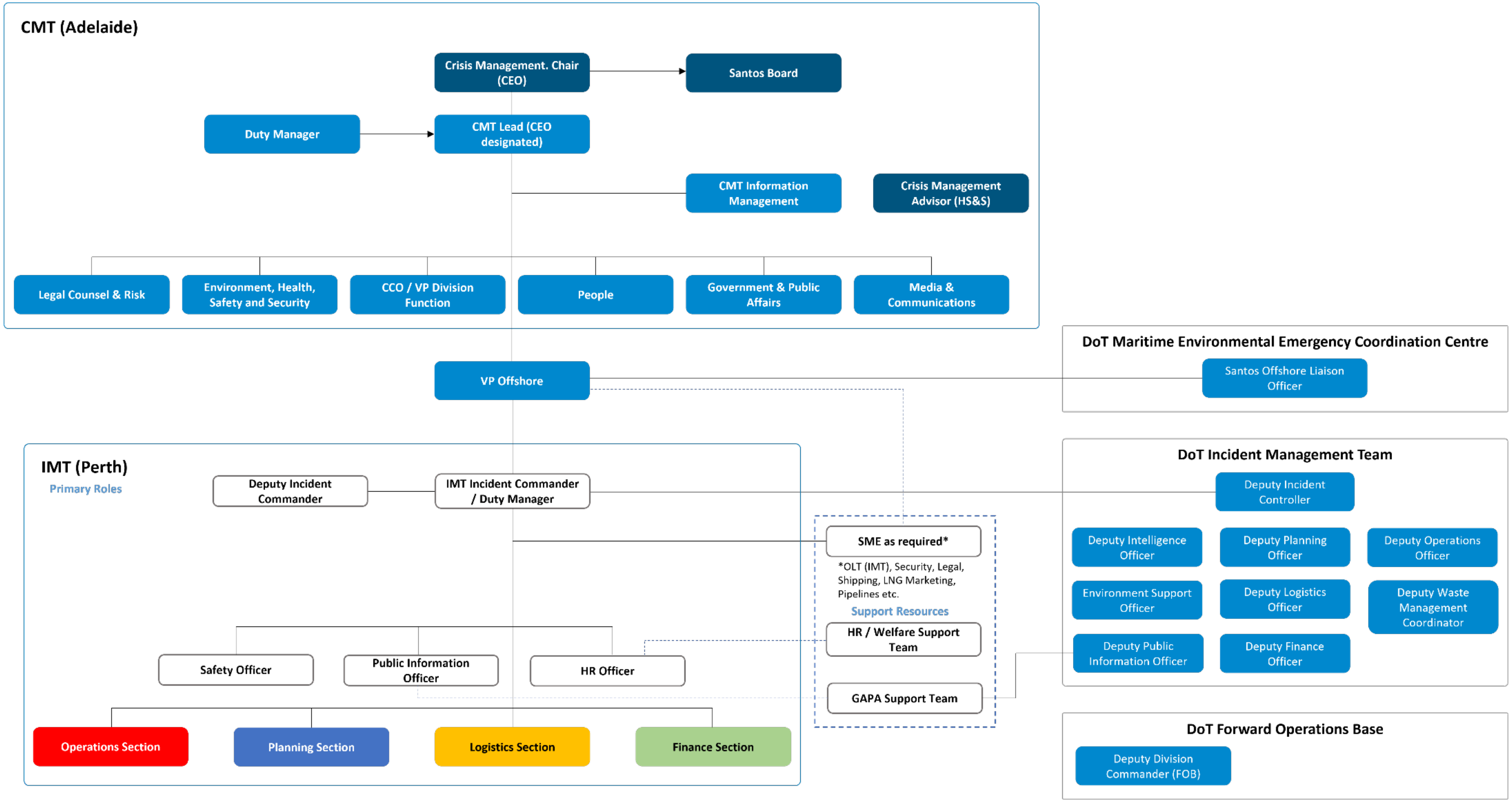


Figure 4-2: Santos cross jurisdictional incident management structure for Level 2/3 facility oil pollution incident originating within or entering State waters

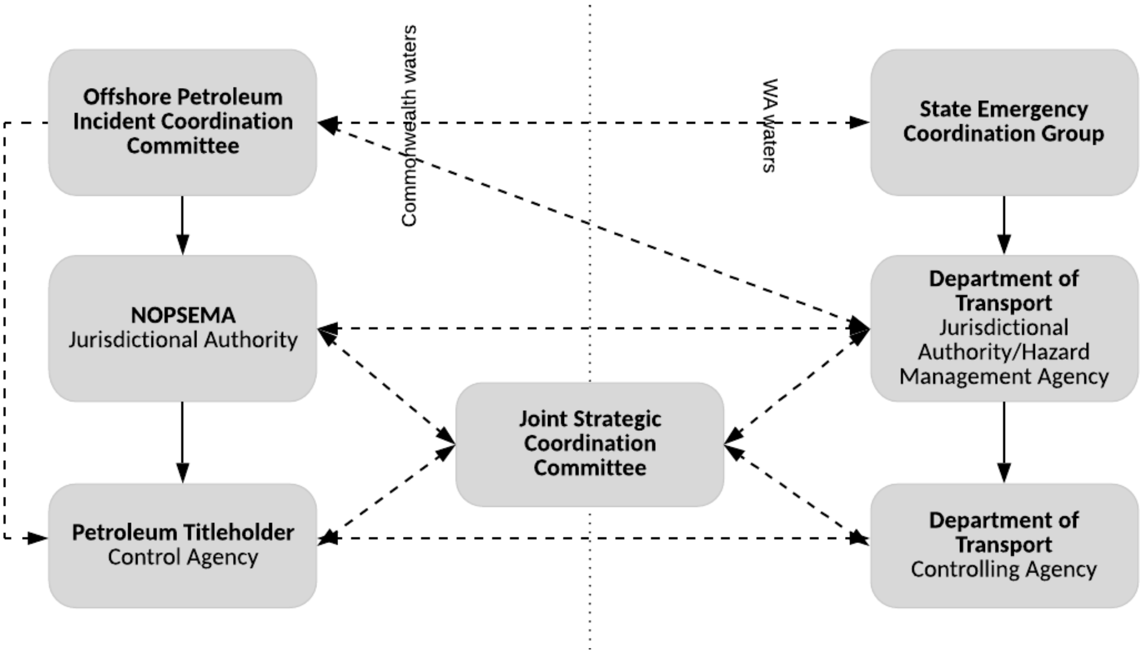


Figure 4-3: Overall control and coordination structure for offshore petroleum cross-jurisdiction incident

4.2.3.1 Notification of dispersant use in adjacent Commonwealth waters

The use of dispersant in Commonwealth waters does not require the consent of DoT. However, where the use of dispersant in Commonwealth waters may impact State waters, the DoT requests early notification.

NOPSEMA's assessment of the OPEP prior to a petroleum activity commencing provides preapproval of dispersant use, where appropriate, and where it avoids any delay which might otherwise limit the window of opportunity available for an effective dispersant strategy (NOPSEMA, 2018).

4.2.4 Port of Varanus Island, Pilbara Ports Authority

The Port of Varanus Island (VI) transitioned to Pilbara Ports Authority on 01st July 2021. The VI Port limits are defined in section 4 of the Port of VI Handbook and are shown in **Figure 4-4**. Santos is the port operator of the Port of VI and provides the necessary services required to conduct safe operation of the facilities under Santos control. The Port of VI is governed by Pilbara Ports Authority under the *Port Authorities Act 1999* (WA) (Pilbara Ports Authority, 2021a).

Any marine oil pollution incident (irrespective of quantity) within the Port limits should be verbally reported within 4 hours to the Harbour Master via VI Port Control. A follow up report must be made within 48 hours through the Pilbara Ports Authority Hazard and Incident Reporting Form (refer to **Table 6-1**). Pilbara Ports Authority also expects a POLREP to be submitted to WA DoT (refer to Appendix C) (PPA, 2021a). Pollution reporting requirements are provided in **Section 6.1**.

Pilbara Ports Authority has established an overarching Marine Pollution Contingency Plan (MPCP) for Pilbara Ports (Pilbara Ports Authority, 2021b), which covers all Pilbara Ports West waters, including the Port of VI. The MPCP is a source of information for those individuals and agencies that are responsible for developing and managing oil spill response capabilities within Pilbara Ports West port limits.

First strike response and spill response resources are provided by Santos, covered by this OPEP.

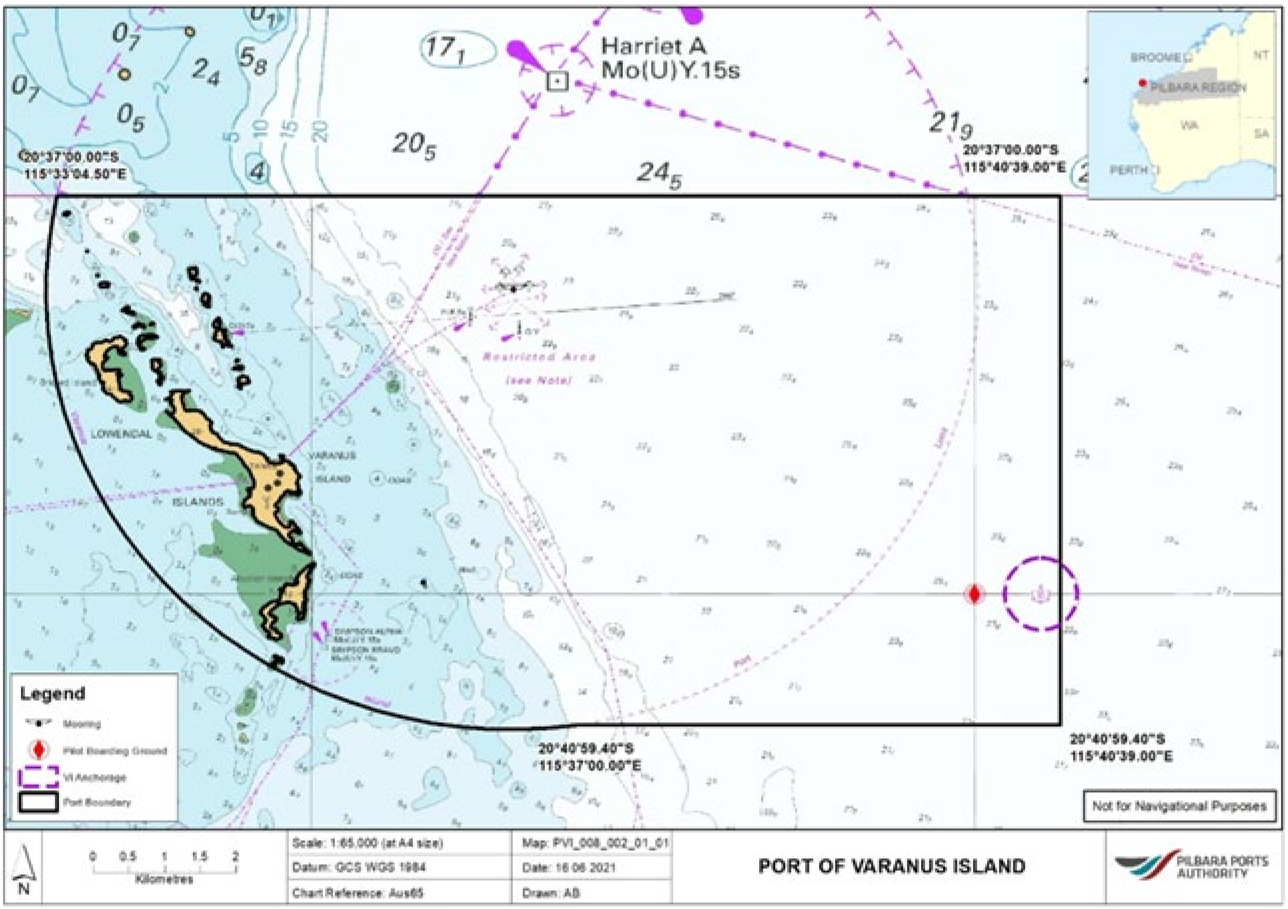


Figure 4-4: Pilbara Ports Authority Port of Varanus Island Port Limits (Pilbara Ports Authority, 2021a)

4.2.5 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) (DBCA, 2022a).

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

Any deterrence, displacement or rescue activity involving wildlife in WA (living or dead) constitutes “disturbance” or “taking” of wildlife under the *Biodiversity Conservation Act 2016* and will require authorisation through DBCA unless undertaken by licensed personnel. The DBCA OWA will expedite the process of granting interim licences or other authorities to undertake approved activities. No action specifically targeted at wildlife should occur without this authority. Deceased animals disposal will be managed in accordance with the DBCA’s WAOWRP which describes the process for disposal of dead animals/carcasses. Initially, the granting of authority to take deceased wildlife is likely to be via a direction from a DBCA wildlife officer while the appropriate licences or licence holder/s that the animals can be held by are identified and organised.

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.

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

4.2.7 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). 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 is currently classified as Contaminated Sites and have ongoing monitoring and remediation activities in place as described in Section 2.5.9 of the Varanus Island Hub Operations EP (State Waters) (EA-60-RI-00186).

4.2.8 Oil Spill Response Limited (OSRL)

Through an associate membership, Santos 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 could access OSRL's international personnel and equipment 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).

4.2.9 The Response Group

The Response Group (TRG) is an international provider of crisis management and emergency response services including oil spill response. TRG are available 24/7 and can provide personnel for emergency response support.

4.2.10 Wild Well Control

Santos maintains a contract with Wild Well Control Inc. (WWCI) for well control specialist services including relief well drilling and Capping Stack deployment. WWCI maintains well control response teams on standby at all times to ensure a rapid response to a well control event anywhere in the world. WWCI maintains an inventory of well control, firefighting, and specialist services equipment at its Houston headquarters and at other locations in the US and internationally.

4.2.11 Department of Foreign Affairs and Trade (DFAT)

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

4.2.12 Department of Industry, Science and Resources (DISR)

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

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

4.3 External Plans

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

+ AMOSPlan – Australian Industry Cooperative Spill Response Arrangements:
    - Details the cooperative arrangements for response to oil spills by Australian oil and associated industries.
+ 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.
+ Offshore Petroleum Incident Coordination Framework – provides overarching guidance on the Commonwealth Government's role and responsibilities in the event of an offshore petroleum incident in Commonwealth waters
+ 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/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf
+ 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):
  - Establishes the framework for responding to potential or actual wildlife impacts in WA waters, within the framework of an overall maritime environmental emergency
  - Outlines risk reduction strategies, preparedness for, response to and initiation of recovery arrangements for wildlife impacts during a marine oil pollution incident. The Pilbara Region and Kimberley Region Oiled Wildlife Response Plans are also relevant regional plans for OWR associated with worst-case spills from Varanus Island Hub operations.
- Western Australia Oiled Wildlife Response Manual:
  - A companion document to the Western Australia Oiled Wildlife Response Plan for Maritime Environmental Emergencies, designed to standardise operating procedures, protocols and processes for wildlife response.
- 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.
- Pilbara Ports Authority Port of VI Handbook (port-of-varanus-island-port-handbook (pilbaraports.com.au))
  - Defines the requirements for marine oil pollution reporting within the Port of VI limits.
- Pilbara Ports West Marine Pollution Contingency Plan (MPCP) (https://www.pilbaraports.com.au/about-ppa/publications/forms-and-publications/forms-publications/form/2021/july/pilbara-ports-west-marine-pollution-contingency-pl)
  - Provides a source of information for individuals and agencies responsible for developing and managing oil spill response capabilities within Pilbara Ports West port limits.

4.4 Cost Recovery

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

4.5 Training and Exercises

In order to refresh IMT roles and responsibilities and provide familiarisation with OPEP processes and arrangements, IMT workshops are conducted as per the Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001).

To familiarise the IMT with functions and processes, an OPEP Desktop and Activation Exercise is undertaken as per the Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001). Exercise planning takes into consideration virtual/remote access requirements. All workshops and exercises undertaken are recorded in the Santos EHS Toolbox, with the key recommendations recorded and tracked.

4.5.1 Incident management team training and exercises

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

Competency is maintained through participation in regular response exercises and workshops. Exercise and training requirements for Santos' IMT members are summarised in **Table 4-6**.

Table 4-6: Training and exercise requirements for incident management team positions

IMT Role	Exercise	Training
Incident Commander	One Level 3 exercise annually <u>or</u> two Level 2 desktop exercises annually[12]	+ PMAOMIR418 + AMOSC – IMO3 equiv. Oil Spill Response Command & Control
Operations Section Chief / Source Control Branch Director		+ PMAOMIR322 + AMOSC – IMO3 equiv. Oil Spill Response Command & Control
Planning Section Chief Logistics Section Chief Environment Unit Leader		+ PMAOMIR322 + AMOSC – IMO2 equiv. Oil Spill Response Management
Safety Officer Supply Unit Leader GIS Team Leader Data Manager[13] HR Officer Situation Unit Leader Documentation Unit Leader IMT Log & Situation		+ PMAOMIR322 + AMOSC – Oil Spill Response Familiarisation Training
Relief Well Team Leader Well Intervention Team Leader		+ Drilling Well Control accredited training through International Well Control Forum (IWCF) + IWCF Level 4 (Well Site Supervisor Training)

[12] All IMT members are required to participate in at least one Level 3 exercise every two years.

[13] Data Manager is an administrative support role, not an IMT role, but is included here for completeness

4.5.1.1 Oil Spill Responder training

Santos has an internal capability of trained oil spill responders who can be deployed in the field in a spill response and has access to external, trained spill responder resources (**Table 4-7**).

Table 4-7: Spill Responder Personnel Resources

Responder	Role	Training	Available Number
Santos AMOSC Core Group Responders	Santos personnel trained and competency assessed by AMOSC as the AMOSC Core Group. Deployed by IMT for spill response operations.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 equiv. Oil Spill Response Operations	12
Santos Facility Emergency Response Teams	Present at Devil Creek, Varanus Island and Ningaloo Vision Facilities for first strike response to incidents.	Internal Santos training and exercises as defined in each facility's Emergency Response Plan OSC to have AMOSC – Oil Spill Response Familiarisation Training.	One Emergency Response (ER) team per operational facility per shift
Santos Aerial Observers	Undertake aerial surveillance of spill. Deployed by IMT in the aerial surveillance aircrafts.	AMOSC – Aerial Surveillance Course (refresher training undertaken triennially).	7
Santos Oil Spill Response Team	Provides a pool of Santos employees trained to perform leadership roles in an IMT or in the field during an oil spill response.	As per the Santos OSR training matrix	140 Note: The number of members in this pool is not directly related to the number of people required in the IMT or field at any one time. Rather it is a resource pool able to be called upon to fill roles in the IMT and field. Santos has arrangements in place to meet any shortfalls during an incident response as detailed in **Section 4.2.9**.
AMOSC Core Group Oil Spill Responders	Industry personnel as the AMOSC Core Group, available to Santos under the AMOSPlan. For providing incident management (IMT) and operations (field response) assistance.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 equiv. Oil Spill Response Operations and/or IMO2 equiv. Oil Spill Response Management	As defined in Core Group Member Reports [14] Target to maintain at least 84 members (Ref: AMOSC Core Group Program and Policies)

[14] An average of 54 personnel available as of October 2023 (AMOSC Member's website), plus 16 AMOSC staff members (AMOSPlan, 2021).

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 responders guaranteed
TRG Response Personnel	Emergency response personnel provided by arrangement with Santos	As per TRG training and competency matrix	60
AMOSC Staff	Professionals, providing technical, incident management and operational advice and assistance available under Santos-AMOSC contract.	As per AMOSC training and competency matrix.	16[15]
Santos Source Control Personnel	Management and coordination of source control strategies including relief well drilling and subsea intervention	Internal Santos training and exercises. IWCF Level 4 certification	60[16]
Oiled Wildlife Response Roles	Refer **Section 14** and **Appendix T**.		
Monitoring Service Provider: Monitoring Coordination Team (MCT) and Scientific Monitoring Plan Teams	Monitoring Coordination Team (MCT) Scientific Monitoring Plan Teams: Technical Advisers Field Team Leader Field Team Member	As defined in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Capability defined in Monthly Capability Reports. MCT – five personnel Scientific Monitoring Plan Teams 12+ per team
Level 1 Oiled Wildlife Responders (Workforce Hire)	Provide oiled wildlife support activities under supervision.	No previous training required; on the job training provided.	Nominally over 1,000
Shoreline clean-up personnel (Workforce Hire)	Manual clean-up activities under supervision.		

[15] AMOSC has a permanent staff of 16 available on a 24/7 basis (AMOSC Plan, 2021), 12 of which are available for field response, and 4 for admin/management support roles.

[16] Made up of D&C staff that are members of the Santos OSR Team, and other D&C staff.

In addition to **Table 4-7**, the following resources are available for spill response and may be activated by the relevant Control 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 the relevant Control Agency. The NRT is trained and managed in accordance with the National Response Team Policy, approved by the National Plan Strategic Coordination Committee (AMSA, 2021b); and
- The State Hazard: MEE: State Response Team (SRT) – Oil pollution response teams available to assist under the jurisdiction of the DoT. SRT members remain trained and accredited in line with the State Hazard Plan: MEE (WA DoT, 2022).

In the event of a spill the trained spill responders outlined in **Table 4-7** would be required to undertake various roles in key spill response operations including operational monitoring, shoreline protection, shoreline clean-up, oiled wildlife response and scientific monitoring.

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

4.6 Response testing arrangements and audits

Santos has oil spill response testing arrangements in place in accordance with the Santos Offshore Oil Spill Response Readiness Guideline (SO-91-OI-20001) which provides a process for continual monitoring of OSRO capability. This also includes regular oil spill response equipment inventory checks from the various sources. Testing of key response provider arrangements may be done as part of larger exercises or as standalone tests where the capability and availability of resources through the response provider are assessed against the performance requirement.

4.6.1 Testing arrangements

Not all spill preparedness and response arrangements will be tested simultaneously. The frequency of testing will relate to the potential spill level, spill risk and complexity of response.

Santos employs a range of tests to ensure that the various response arrangements function as required. These tests include;

- Contract / Plan Review
- Audit
- Notification/ Communication Check
- Desktop Exercise
- Deployment Exercise
- Level 2/3 IMT Exercise

The above objectives are set for each of the tests identified for various response arrangements and the effectiveness of the response arrangements against these objectives are examined using pre-identified Key Performance Indicators (KPI). The objectives and KPIs for testing the response arrangements specified in this OPEP are detailed in **Appendix K**. All testing activities are documented, and corrective actions or recommendations are tracked to closure. This is achieved through the Santos EHS Toolbox system. Once completed, records of testing arrangements are entered into Santos EHS Toolbox and any actions or recommendations identified are assigned a responsible party for completion and tracked to closure. The status of completion is tracked through the 'Action module' in the EHS Toolbox and communicated widely through monthly EHS KPI reporting.

Source control testing arrangements have been formulated with reference to recent industry guidelines including the APPEA Offshore Titleholders Source Control Guideline (June 2021) and the NOPSEMA Information Paper: Source Control Planning and Procedures IP1979 (June 2021).

Source control objectives and KPIs are developed in order to test the response arrangements specified in this OPEP and the Source Control Planning and Response Guideline (DR-00-OZ-20001). In addition to objectives and KPIs, test frequency and type of test are also detailed in **Appendix K**.

For each source control exercise, a copy of the exercise materials is recorded in the EHS toolbox. Action items identified are tracked in EHS toolbox to completion. Lessons learnt are incorporated into Santos guidelines and procedures as part of a process of continual improvement.

4.6.2 Audits

Oil spill response audits will follow the Santos Assurance Management Standard (SMS-MS15.1) and are scheduled as per the Santos Annual Assurance Schedule. Audits will assist in identifying and addressing any deficiencies in systems and procedures. At the conclusion of the audit, any opportunities for improvement and/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.

Multiple oil spill response organisations are engaged by Santos. These organisations are responsible for the audit and maintenance of their own capacity. The Santos Emergency Response Coordinator (Oil Spill) maintains oversight of the audit and maintenance programs of its service providers through regular reporting requirements and any third-party assurance activities. These include:

+ The deployment readiness and capability of AMOSC's oil spill response equipment and resources in Geelong, Fremantle, Exmouth and Broome are audited every two years under the direction of AMOSC's participating members. The intent of this audit is to provide assurances to Santos and associated members about AMOSC's ability to respond to an oil spill incident as per the methods and responsibilities defined in OPEPs and AMOSC's Service Level Statement.
+ The deployment readiness and capability of OSRL's oil spill response equipment and personnel are audited every two years by the Emergency & Oil Spill Response Coordinator. The intent of this audit is to provide assurances to Santos of OSRL's ability to respond to an oil spill incident as per the methods and responsibilities defined in Santos' OPEPs and OSRL's SLA.

5 Response Strategy Selection

5.1 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-60-RI-10003); the Spartan Development EP Addendum to the VI Hub Operations EP for Commonwealth Waters (EA-60-RI-10003.02), the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001) and the Generic Well Suspension and Well Abandonment Environment Plan (EA-00-RI-10027).

Note that the inclusion of Spartan Development scenarios (included in Rev 11 updates, **Section 5.4.3.2** of this document) and Halyard-2 Drilling and Completion Project scenarios (Rev 13, **Section 5.4.3.3**) did not change the worst-case scenarios that the resource requirements for the response strategies in **Section 9** to **Section 17** are based on.

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, Spartan development activities and Halyard-2 Drilling and Completion Project (drilling, installation and pre-commissioning);
+ they represent maximum credible release volumes;
+ those scenarios that represent the greatest spatial extent from a response perspective based on surface oil and shoreline accumulation as these are the key factors contributing to response; and
+ proximity to sensitive receptors, shorelines, State/Commonwealth boundaries etc.

The worst-case credible spill risks that occur in Commonwealth waters, State waters and onshore selected to inform this OPEP are presented in **Table 5-1**, **Table 5-2** and **Table 5-3** 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 5-1: VI Hub Commonwealth Waters Worst-Case Spill Scenario Summary (grey shading indicates worst-case spill scenario)

Worst-case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)
During Halyard-2 Drilling and Completion Project Activities		
Loss of well control during Halyard-2 well drilling leading to a subsea release of condensate and gas at the Halyard-2 well location.	Halyard Condensate (Group I)	173,755 m^3 subsea release at 140 m depth over 77 days Note: results presented in **Table 5-13**
Loss of well control during Halyard-2 well drilling leading to a surface release condensate and gas at the Halyard-2 well location.	Halyard Condensate (Group I)	170,576 m^3 surface release over 77 days Note: results presented in **Table 5-14**
Vessel 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
During Spartan Development Activities		
Loss of well control during Spartan development well drilling leading to a subsea release of condensate and gas at the Spartan well location.	Spartan Condensate (Group I)	53,811 m^3 subsea release at 60 m depth over 77 days Note: results presented in **Table 5-10**
Loss of well control during Spartan development well drilling leading to a surface release condensate and gas at the Spartan well location.	Spartan Condensate (Group I)	53,291 m^3 surface release over 77 days Note: results presented in **Table 5-11**
Vessel spill – Release of marine diesel from support/ supply vessel fuel tank (due to vessel collision/dropped object)	Marine Diesel (Group II)	329 m^3 surface release over a 1-hour period Note: results presented in **Table 5-12**
During Operations		
Loss of well control/damage to infrastructure causing a subsea release of condensate and gas release for the Halyard-2 well during operations	Halyard Condensate (Group I)	**1,269 m^3**
Loss of well control/damage to infrastructure causing a subsea release of condensate and gas release for the Spartan well during operations	Spartan Condensate (Group I)	1,269 m^3
Vessel spill – Release of marine diesel from support/ supply vessel fuel tank (due to vessel collision/dropped object)	Marine Diesel (Group II)	329 m^3 surface release over a 1-hour period
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 Note – results presented in **Table 5-5**
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

Table 5-2: VI Hub State Waters Worst-Case Spill Scenario Summary (grey shading indicates worst-case spill scenario)

Worst-case credible spill scenario	Hydrocarbon type	Maximum credible volume released (m^3)
During Operations		
Vessel spill – release from support/ supply vessel fuel tank (due to vessel collision or lifting operations) at the Wonnich Platform	Marine Diesel (Group II)	329 m^3 surface release over a 1-hour period Note: results presented in **Table 5-7**
Vessel 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 Note: results presented in **Table 5-8**
Vessel 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 Note: results presented in **Table 5-9**
Well leak on Linda platform	Linda condensate	521 m^3 surface leak over 120 days
Well leak on Wonnich platform	Wonnich condensate	270 m^3 surface leak over 120 days
Well leak on Harriet Alpha platform	Harriet crude oil	121 m^3 surface leak over 30 days
Well leak on Gibson/ South Plato platforms	Simpson crude oil	41 m^3 surface leak over 30 days
Well leak on Agincourt platform	Agincourt crude oil	109 m^3 surface leak over 30 days
Well leak on Double Island/ Victoria platform	Double Island crude oil	46 m^3 surface leak over 30 days
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
Loss of integrity / Impact damage causing condensate with gas release from the John Brookes 18" Pipeline	John Brookes Condensate (Group I)	210 m^3 over a 5.4-hour period Note – results presented in **Table 5-6**
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 condensate with gas release from the Linda Pipeline	Linda Condensate (Group 1)	36 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
Loss of integrity / Impact damage causing crude oil release from the Tanker Oil Load Out Line (30" rigid / 16" flexible)	Varanus Island Crude Blend (Group 1)	2,742 m^3 over a 0-to-24-hour period
During Campbell facility Asset Removal Operations		
Vessel spill – release from ARO field support vessel fuel tank (due to collision) at the Campbell location	Marine Diesel (Group II)	998 m^3 over a 6-hour period

Table 5-3: 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 II)	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)	210 m^3 over a 5.4-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 condensate with gas release from the Linda Pipeline	Linda Condensate (Group 1)	36 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 the Tanker Oil Load Out Line (30" rigid / 16" flexible)	Varanus Island Crude Blend (Group 1)	2,742 m^3 over a 0-to-24-hour period

5.2 Response Planning Thresholds

Environmental impact assessment thresholds are addressed in Section 7.5.4 of the EP. In addition to the environmental impact assessment thresholds, response thresholds have been developed for response planning to determine the conditions that response strategies would be effective. These are shown in **Table 5-4**. These thresholds are provided as a guide for response planning based on case studies that have demonstrated some response strategies require certain oil spill thicknesses and conditions to be effective.

Table 5-4: Surface hydrocarbon thresholds for response planning

Hydrocarbon concentration (g/m^2)	Description
>1	Estimated minimum threshold for commencing some scientific monitoring components (refer to **Appendix O**)
>50	Estimated minimum floating hydrocarbon threshold for containment and recovery
>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.

5.3 Hydrocarbon Characteristics and Behaviour

The hydrocarbon characteristics, including weathering and behaviour is further described in **Appendix A**.

5.4 Offshore Spills (State and Commonwealth Waters)

5.4.1 Stochastic modelling

Selected oil spill scenarios have been modelled using a stochastic approach involving the running of multiple simulations across all seasons using a number of unique environmental conditions sampled from historical metocean data. Further detail on the spill modelling undertaken is provided in Section 7.5 of the Varanus Island Hub Operations EP (State Waters) (EA-60-RI-00186), Varanus Island Hub Operations Environment Plan (EP) for Commonwealth Waters (EA-60-RI-10003), Section 7.5 Spartan Development Addendum (EA-60-RI-10003.02) to the Varanus Island Hub Operations Environment Plan (EP) for Commonwealth Waters for scenarios during the Spartan Development, and Section 7.5 of the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001).

The spill modelling uses a number of hydrocarbon exposure values to inform the impact assessments presented in these EPs.

5.4.2 Modelling Results

5.4.2.1 Operations scenarios

Modelling for selected worst-case credible spill scenarios (as indicated by the shading in **Table 5-1** and **Table 5-2**) during operations in State and Commonwealth waters (based on spill volume and the different hydrocarbon types) have been presented in **Table 5-5** to **Table 5-9**. Modelling results in these tables were provided by RPS in 2019 as reprocessing of original modelling carried out in 2013/2014 (APASA, 2013c; RPS APASA, 2014b). The John Brookes pipeline leak scenario (**Table 5-6**) was completely remodelled in 2019 (RPS, 2019). Floating oil results for concentrations of >1 g/m^2 and >25/m^2 are presented together with accumulated shoreline hydrocarbon results above 100 g/m^2. While 50 g/m^2 is generally considered to be the limit for offshore containment and recovery for applicable oils – modelling results for 50 g/m^2 were not determined and thus 25 g/m^2 is considered a highly conservative proxy for concentrations for offshore containment and recovery. These results focus on Protection Priority Areas (PPAs) 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.

Modelling results for dissolved and entrained oil for the worst-case scenarios are presented within the Commonwealth EP (EA-60-RI-10003), the Spartan Development Addendum to the Commonwealth EP (EA-60-RI-10003.02) and State EP (EA-60-RI-00186), and are considered when defining the Environment that May be Affected (EMBA) by worst-case hydrocarbon spills and the area within which oil spill scientific monitoring may be required.

Table 5-5: 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 ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Montebello Islands	5	155 (6 days)	<1	13	171 (7 days)	33	43
Barrow Island	1	393 (16 days)	<1	8	105 (4 days)	20	61
Lowendal Island	1	349 (14 days)	<1	NC	NC	NC	NC
Barrow-Montebello surrounds[1]	11	48 (2 days)	<1	8	104 (4 days)	7	NC

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

NC = No Contact

Table 5-6: Predicted shoreline contact for a short-term (5.4 hours) pipeline leak of condensate (210 m^3) from the John Brookes Pipeline at the State waters boundary (summer)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m2
Lowendal Islands	8	6 (0.2 days)	1	7	21 (0.8 days)	5	4
Montebello Islands	8	9 (0.4 days)	<1	7	16 (0.6 days)	8	37

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m2
Barrow Island	10	3 (0.1 days)	<1	2	16 (0.6 days)	18	44
Barrow-Montebello surrounds[1]	71	1 (0.04 days)	26	NC	NC	NC	NC
Montebello Marine Park	91	1 (0.04 days)	65	NC	NC	NC	NC

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

NC = No Contact

Table 5-7: 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 ≥1 g/m2	Minimum time for floating oil arriving at shoreline at concentrations ≥1g/m2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m2	Probability (%) of shoreline accumulation at concentrations ≥100 g/m2	Minimum time for shoreline accumulation at concentrations ≥100 g/m2 (hours)	Maximum accumulated volumes for shoreline accumulation (m3) at concentrations ≥100 g/m2	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Montebello Islands	34.5	3 (0.1 days)	13	28.5	5 (0.2 days)	168	34
Lowendal Islands	2.5	6 (0.2 days)	<0.5	2.5	17 (0.7 days)	40	11
Barrow Island	1	41 (1.7 days)	<0.5	1	100 (4 days)	14	23
Barrow-Montebello Surrounds[1]	100	1 (0.04 days)	100	21.5	3 (0.1 days)	115	NC
Montebello Marine Park	28.5	2 (0.08 days)	18.5	NC	NC	NC	NC

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

Table 5-8: 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 ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m2
Barrow Island	44	6 (0.2 days)	12	19.5	11 (0.4 days)	1,183	65
Lowendal Islands	100	1 (0.04 days)	93.5	49.5	2 (0.08 days)	1,324	11
Montebello Islands	32	10 (0.4 days)	9.5	30	12 (0.5 days)	1,480	67
Barrow-Montebello Surrounds[1]	50.5	3 (0.1 days)	20.5	35	13 (0.5 days)	468	NC
Montebello Marine Park	32	11 (0.4 days)	8.5	NC	NC	NC	NC

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

NC = No Contact

Table 5-9: 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 ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Barrow Island	37.5	6 (0.2 days)	15	21.5	11 (0.4 days)	613	86
Lowendal Islands	100	1 (0.04 days)	95	51.5	2 (0.08 days)	521	11
Montebello Islands	24	7 (0.2 days)	4	23	10 (0.4 days)	636	69

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥25 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Barrow-Montebello Surrounds	44	3 (0.1 days)	19	29	4 (0.1 days)	177	NC
Montebello Marine Park	26.5	9 (0.3 days)	6.5	NC	NC	NC	NC

NC = No Contact

5.4.2.2 Spartan Development scenarios

Modelling for worst-case credible spill scenarios during the Spartan Development activities in Commonwealth waters (based on spill volume and the different hydrocarbon types) have been presented in **Table 5-10** to **Table 5-12**. Note, Spartan Development activities will not occur in State waters. Modelling results in these tables were provided by RPS (RPS, 2021). Floating oil results for concentrations of ≥1 g/m^2 and 50 g/m^2 are presented together with accumulated shoreline hydrocarbon results above 100 g/m^2. These results focus on PPAs 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 (refer to Section 7.5.5 of the Spartan Development Addendum to the Varanus Island Hub Operations EP [EA-60-RI-10003.02]).

Modelling results for dissolved and entrained oil for the worst-case scenarios are presented within the Spartan Development EP Addendum (EA-60-RI-10003.02) and are considered when defining the EMBA by worst-case hydrocarbon spills and the area within which oil spill scientific monitoring may be required.

Table 5-10: Predicted shoreline contact for a 77-day subsea release of Spartan condensate (53,881 m^3) from a loss of well control during development well drilling at the Spartan well location (Commonwealth Waters)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Ningaloo – Outer Coast North*	10	394 (16 days)	NC	NC	NC	NC	NC
Barrow-Montebello surrounds*	4	551 (22 days)	NC	NC	NC	NC	NC
Barrow Island	8	873 (36 days)	NC	22	425	60	6
Ningaloo – Outer NW*	8	473 (19 days)	NC	NC	NC	NC	NC
Montebello AMP*	100	2 (0.08 days)	NC	NC	NC	NC	NC
Ningaloo -Offshore*	20	187 (7 days)	NC	NC	NC	NC	NC
Muiron Islands	8	527 (21 days)	NC	44	215 (8 days)	18	5
Ningaloo North Coast	10	429 (17 days)	NC	20	274 (11 days)	54	16
Montebello Islands	2	157 (6 days)	NC	18	166 (6 days)	33	11
Lowendal Islands	NC	NC	NC	6	593 (24 days)	8	2
Southern Islands Coast	2	NC	NC	14	683 (28 days)	7	2

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC = No Contact

Table 5-11: Predicted shoreline contact for a 77-day surface release of Spartan condensate (53,291 m^3) from a loss of well control during development well drilling at the Spartan well location (Commonwealth Waters)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Ningaloo – Outer Coast North*	6	484 (20 days)	NC	NC	NC	NC	NC
Ningaloo Coast North	2	1,644 (68 days)	NC	8	753 (31 days)	23	6
Barrow-Montebello Surrounds*	6	143 (5 days)	NC	NC	NC	NC	NC
Barrow Island	2	140 (5 days)	NC	6	456 (19 days)	7	2
Ningaloo – Outer NW*	4	1207 (50 days)	NC	NC	NC	NC	NC
Montebello AMP*	100	1 (0.04 days)	NC	NC	NC	NC	NC
Muiron Islands	NC	NC	NC	26	216 (9 days)	9	3
Montebello Islands	NC	NC	NC	8	572 (23 days)	13	3

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC – No Contact

Table 5-12: Predicted shoreline contact for an instantaneous surface release of MDO (329 m^3) from a vessel at the Spartan well location (Commonwealth Waters)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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 (m3) at concentrations ≥100 g/m^2	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Barrow – Montebello Surrounds*	2	27 (1 day)	2	NC	NC	NC	NC
Barrow Island	2	39 (1 day)	NC	<2	NC	<1	NC
Montebello AMP*	28	1 (0.04 days)	26	NC	NC	NC	NC

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC = No Contact

5.4.2.3 Halyard-2 Drilling and Completion Project Scenarios

Modelling for worst-case credible spill scenarios during the Halyard-2 Drilling and Completion Project activities in Commonwealth waters (based on spill volume and the different hydrocarbon types) have been presented in **Table 5-13** and **Table 5-14**. MDO modelling results for the Halyard-2 Drilling and Completion Project have used the MDO results from the Spartan development due to the proximity to Barrow Island (refer to Section 7.5.2 of the Halyard-2 Drilling and Completion Project EP [9887-650-REP-0001]), the results of which are presented in **Table 5-12**). Note, Halyard-2 drilling and completion activities will not occur in State waters. Modelling results in these tables were provided by RPS (RPS, 2023). Floating oil results for concentrations of ≥1 g/m^2 and 50 g/m^2 are presented together with accumulated shoreline hydrocarbon results above 100 g/m^2. These results focus on PPAs 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 (refer to Section 7.5.5 of the Halyard-2 Drilling and Completion Project EP [9887-650-REP-0001]).

The stochastic modelling predicts submerged (entrained) oil contact ≥10 ppb (low threshold) with State waters at 65% probability and a minimum arrival time of 74 days for the subsea LOWC scenario, and 67% probability and a minimum arrival time of 39 days for the surface LOWC scenario (RPS, 2023).

Modelling results for dissolved and entrained oil for the worst-case scenarios are presented within the Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001) and are considered when defining the EMBA by worst-case hydrocarbon spills and the area within which oil spill scientific monitoring may be required.

Table 5-13: Predicted shoreline contact for a 77-day subsea release of Halyard condensate (173,755 m^3) from a loss of well control during development well drilling at the Halyard-2 well location (Commonwealth Waters)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Montebello AMP*	2.67	382 (15 days)	NC	NC	NC	NC	NC
Ningaloo – Offshore*	100	2	82.3	NC	NC	NC	NC
Ningaloo - Outer Coast North	0.33	837 (34 days)	NC	NC	NC	NC	NC
Ningaloo Coast North	0.67	402 (16 days)	NC	NC	NC	63	12
Southern Islands Coast	0.33	1,241 (51 days)	NC	NC	NC	11	1
Barrow Island	NC	NC	NC	NC	NC	29	3

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC = No Contact

Table 5-14: Predicted shoreline contact for a 77-day surface release of Halyard condensate (170,576 m^3) from a loss of well control during development well drilling at the Halyard-2 well location (Commonwealth Waters)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Montebello AMP*	0.33	96 (4 days)	NC	NC	NC	NC	NC
Ningaloo – Offshore*	100	2	NC	NC	NC	NC	NC
Ningaloo Coast North	NC	NC	NC	0.33	NC	24	4

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC – No Contact

5.4.2.4 Campbell Asset Removal Scenarios

Modelling results for the Campbell facility ARO worst-case credible spill scenario have been presented in **Table 5-15**. Modelling results in these tables were provided by RPS (RPS, 2022). Floating oil results for concentrations of ≥1 g/m^2 and 50 g/m^2 are presented together with accumulated shoreline hydrocarbon results ≥100 g/m^2. The modelling provided results seasonally (Summer [October to March], Transitional [April and September], and Winter [May to August]); the worst-case results for each receptor from these three seasonal periods have been presented in **Table 5-15**. These results focus on PPAs 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 (refer to Section 7.4 of the Campbell BD to the VI Hub ARO EP [7935-650-EIS-0001]).

Modelling results for dissolved and entrained oil for the worst-case scenarios are presented within the Campbell BD to the VI Hub ARO EP (7935-650-EIS-0001) in Section 7.4 and are considered when defining the EMBA by worst-case hydrocarbon spills and the area within which oil spill scientific monitoring may be required.

Table 5-15: Predicted shoreline contact for a surface release of MDO (998 m^3) over 6 hours from a vessel at the Campbell location (State Waters) (RPS, 2022)

Receptor contact	Probability (%) of floating oil arriving at shoreline at concentrations ≥1 g/m^2	Minimum time for floating oil arriving at shoreline at concentrations ≥1 g/m^2 (hours)	Probability (%) of floating oil arriving at shoreline at concentrations ≥50 g/m^2	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 (m3) at concentrations ≥100 g/m^2	Maximum length of oiled shoreline (km) at concentrations ≥100 g/m^2
Barrow Island	NC	NC	NC	1 (T)	8 days, 18 hrs (T)	1.8 (T)	0.5 (T)
Barrow – Montebello Surrounds*	63 (W)	4 hours (W)	19 (W)	NC	NC	NC	NC
Montebello Islands	NC	NC	NC	57 (W)	0.33 (S)	302.3 (W)	17.4 (W)
Montebello AMP*	80 (S)	3 hours	41 (T)	NC	NC	NC	NC

*Floating oil will not accumulate on submerged features and at open ocean locations.

NC = No Contact

S = Summer; T = Transitional; W = Winter

5.5 Onshore spills

As described in **Table 5-3**, 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); and
+ diesel storage/transfer system.

Figure 5-1 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); and the Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-60-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 5-1: Potential onshore spill sources, facility and surrounding sensitivities

5.5.1 Zone of Potential Influence (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 50 m) from the shoreline and are subsequently raised above ground towards the facility process area. The Harriet Bravo 8” and Tanker Load Out 30” pipelines northeast of the facility are mainly buried except for short a section (about 50 m) raised above ground.

The surface extent of the zone of potential influence (ZPI) for these pipelines has been estimated as a distance of 50 m from either side of the pipelines, as shown in **Figure 5-2** to **Figure 5-4**, 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 flow towards the coastline however there is expected to be considerable infiltration 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).

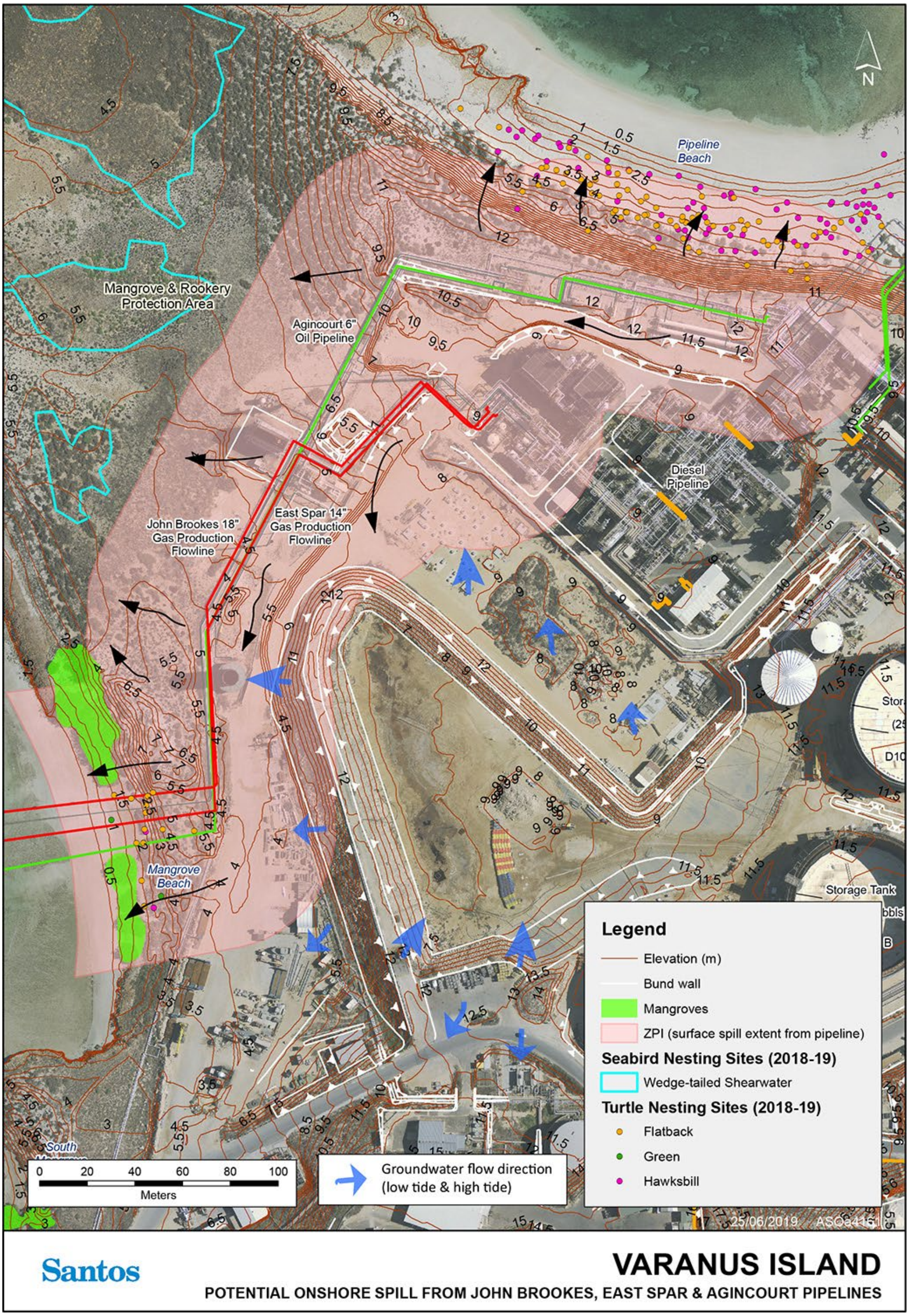


Figure 5-2: Onshore pipelines (John Brookes, East Spar, Agincourt) spill ZPI - surface

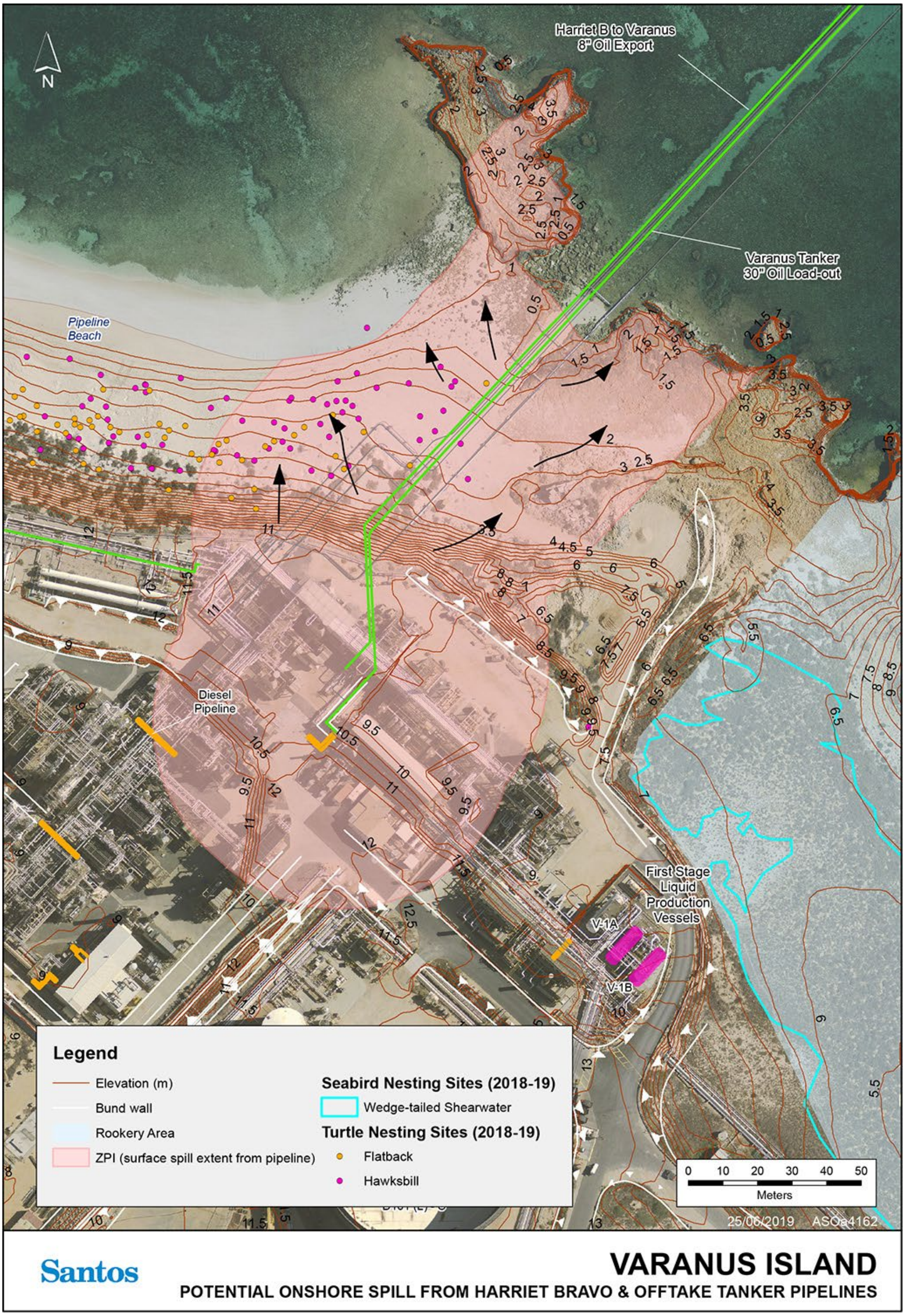


Figure 5-3: Onshore pipelines (Harriet Bravo, Tanker Load-out) spill ZPI - surface

Figure 5-4: Onshore pipelines (Diesel) spill ZPI - surface

5.5.2 Zone of Potential Influence (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 5-1**. 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 5-1** 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 5-5: Onshore pipelines spill subsurface ZPI

5.6 Evaluation of Applicable Response Strategies

Based on the nature and scale of the credible spill scenarios outlined in **Section 5.1**, the following spill response strategies have been assessed as potentially applicable for combatting a spill (**Table 5-16**). 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 5.1**. 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 5-16** has been developed by Santos for preparedness purposes. Santos may not be the Control Agency or Lead IMT for implementing a spill response. For example for Level 2/3 spills within or entering State waters, DoT will ultimately determine the strategies and controls implemented for most State water activities with Santos providing all necessary resources and planning assistance.

Table 5-16: Applicable Response Strategy Selection and 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 (ESD)	X	✔ 1	X	✔ 1	All pipelines and operational wells covered under this OPEP have ESD available (manual and/or automatic) to isolate hydrocarbon inventories and limit the volume of a spill.
	Well 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.
	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.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	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	✔ 2 (Halyard-2 Drilling and Completion Project Only)	X	X	**Halyard-2 Drilling and Completion Project**: A capping stack may be a viable option for controlling a subsea well drilled using a semi-submersible drilling rig. A capping stack installed onto a subsea wellhead can be used to divert the flow of hydrocarbons and potentially reduce the release rate of hydrocarbons prior to well kill via a relief well. Capping stack is a secondary response measure with deployment limited to appropriate conditions (e.g., blowout rates within safe operating limits, safe vertical access) and when operating conditions permit (wind speed, wave height, current and plume radius). Debris clearance using the Subsea First Response Toolkit (SFRT) would be implemented prior to capping stack installation. **Spartan Development Drilling**: If a LOWC were to occur from the Spartan well during development well drilling, a subsea capping stack response strategy is not applicable given the petroleum activity will take place from a jack-up MODU. A semi-submersible drilling unit is not suitable for the Spartan drilling activities given the water depths at the well top-hole locations (~50 m); this precludes the use of Dynamically Positioned (DP) drilling units (drill ships and DP semi-submersibles) and moored semi-submersible drilling units. Therefore, under a credible loss of well control event subsea there are no connection points for capping stack installation.
	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 Planning and Response Guideline (DR-00-OZ-20001).

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	Subsea dispersant injection (SSDI)	X	✔ 2 (Halyard-2 Drilling and Completion Project Only)	X	X	Considerations are detailed below in chemical dispersion discussion
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. 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.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						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. nighttime, cloud cover etc) Mobilisation restricted to image availability Requires processing May return false-positives
	Operational Water Quality Monitoring					Fluorometry surveys are used to determine the location and distribution of the entrained oil and dissolved aromatic hydrocarbon components of the spill and validate the spill fate modelling predictions.
	Shoreline Clean-up 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. Health & safety considerations. Requires trained observers. Constrained to daylight. Delayed response time.
Chemical dispersion	Vessel Application	X	X	X	X	
	Aerial Application	X	X	X	X	

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
	Subsea Application	X	✔ 2 (Halyard-2 Drilling and Completion Project Only)	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:** *Surface application* Condensates produced are not considered a persistent hydrocarbon and have 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. On the basis of the above, surface (vessel and/or aerial) chemical dispersant application is not recommended as an applicable strategy, the benefit of applying to condensate from an environmental perspective is considered minimal. *Subsea application* **Halyard-2 Drilling and Completion Project**: SSDI is known to reduce VOC levels at the sea surface and is shown to be effective at dispersing condensates when applied subsea (RPS, 2019), making conditions safer for responders and source control personnel. SSDI is shown to reduce surface concentrations of hydrocarbons, thereby reducing the exposure of seabirds and surfacing marine fauna to hydrocarbons. It also disperses hydrocarbons into a larger volume of water, reducing concentrations and enhances biodegradation (French McCay *et al.*, 2018).

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						A potential drawback of this response tactic is that it will result in smaller droplet sizes and entrainment of hydrocarbons into the water column, which may affect some oceanic and benthic organisms (e.g. fish, plankton). However, this is likely to be temporary and restricted to the top ~3 m of the water column whilst SSDI is being used (RPS, 2019). This increase in entrainment is partially offset by significant increases in biodegradation rates. SSDI is only suitable for subsea LOWC scenarios. Halyard condensate is considered a Group 1 oil (non-persistent) hydrocarbon that has rapid evaporation rates (85% within the first 24 hrs – refer to **Appendix A**). There is therefore little to no direct environmental benefit from SSDI and potential drawbacks associated with the enhancement of entrainment. However SSDI may be employed as a secondary strategy and only if it was necessary to attempt to reduce VOCs in the atmosphere, improving the safety of response personnel working close to the well site. In this case, SSDI may have an overall environmental benefit, as enabling source control personnel access to the site to bring the release under control (e.g. for BOP intervention and/or deployment of capping stack) will reduce the overall volume of hydrocarbons being released into the environment. The Halyard-2 well is located in deeper water depths (approximately 100-120 m) than the Spartan development well. At these deeper depths, SSDI may be more effective as there is more time in the water column to allow mixing and SSDI is more likely to have an effect on VOC reduction at the surface compared to shallow water deployment, and may aid in achieving safe conditions for capping stack deployment. The reduction in atmospheric VOC levels at the surface through executing SSDI would be closely monitored – if there was no reduction in VOCs being achieved, SSDI would cease. **Spartan Development** SSDI is not considered applicable for the Spartan development well given the shallow water depth (approximately 50 m). SSDI is unlikely to provide any benefit at such shallow depth, as there is very limited time in the water column to allow mixing. The shallow water depths also indicate that SSDI is highly unlikely to have any significant effect on VOC reduction at the surface (OSRL, 2019). Given that

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						capping stack application is not considered applicable for the credible loss of well control scenarios associated with the Spartan well, there is no benefit in SSDI for the purpose of facilitating this strategy for the Spartan development. **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 oil that spreads 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 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.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						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. It is better to keep HFO on the sea surface and attempt to 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.
Protection and Deflection	Booming in nearshore waters and at shorelines	✔ 2	✔ 2	✔ 1	✔ 1	Use of anchored boom or other barriers (e.g. sandbags, 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.

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						Note: *This strategy for marine diesel and condensate may not be executed in certain sensitive areas due to the propensity of hydrocarbons to evaporate and disperse naturally, and the risk of damage from spill responders entering these sensitive areas. Therefore, this strategy would only be carried out in these areas for these hydrocarbon types if operational NEBA shows a clear benefit.*
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. 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. Note: *This strategy for marine diesel and condensate may not be executed in certain sensitive areas due to the propensity of hydrocarbons to evaporate and disperse naturally, and the risk of damage from spill responders entering these*

OSR Strategy	Activities	Applicability and Designated Primary (1) or Secondary (2) Response Strategy				Considerations
		Marine Diesel	Condensate	HFO	Crude	
						sensitive areas. Therefore, this strategy would only be carried out in these areas for these hydrocarbon types if operational NEBA shows a clear benefit.
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, cleaning and rehabilitation.	✔ 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. 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)

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

5.7 Identify Priority Protection Areas

5.7.1 Offshore spills

Combined spill modelling results for Commonwealth water scenarios and State waters scenarios were used to predict the EMBA for Varanus Hub Operations, Spartan Development and Halyard-2 Drilling and Completion Project activities. Within the EMBA, Santos has determined Hot Spots (key areas of high ecological value that have the greatest potential to be impacted by an offshore spill) for which detailed oil spill risk assessment has been conducted. From these Hot Spot areas, PPAs for spill response have been identified. In the spill response preparedness strategy, it is not necessary for all Hot Spots to have detailed planning. For example, wholly submerged Hot Spots may only be contacted by entrained oil, and the response would be largely to implement scientific monitoring to determine impact and recovery. Hot Spots with features that are not wholly submerged (i.e. emergent features) are considered for Priority for Protection. This final determination of 'Priority for Protection' sites, for the oil spill response strategy, is based on the worst-case estimate of floating oil concentration, shoreline loading and minimum contact time at response threshold concentrations. **Table 5-17** details the hotspots and PPAs from the list of contacted receptors from both the subsea and surface LOWC scenarios; rationale is included when a hotspot is included as a PPA, or not.

Table 5-17: Determination and rationale for the priorities for protection

Hotspots	Type	HEV ranking	Hotspot	PPA	Rationale
Ningaloo- Outer Coast North	Intertidal	1	Y	N	No floating or accumulated hydrocarbon contact.
Muiron Islands	Emergent	2	Y	Y	Shoreline accumulation HEV rank 2
Ningaloo Coast North	Emergent	2	Y	Y	Shoreline accumulation HEV rank 2
Barrow-Montebello Surrounds	Intertidal	3	Y	Y	Shoreline accumulation HEV rank 3
Montebello Islands	Emergent	3	Y	Y	Shoreline accumulation HEV rank 3
Lowendal Islands	Emergent	3	Y	Y	Shoreline accumulation HEV rank 3
Barrow Island	Emergent	3	Y	Y	Shoreline accumulation HEV rank 3
Ningaloo- Outer NW	Submerged	3	Y	N	No floating or accumulated hydrocarbon contact.
Ningaloo Coast South	Emergent	3	Y	N	No floating or accumulated hydrocarbon contact (accumulation at low threshold).

Table 5-18 lists the key sensitivities and associated locations within the PPAs identified for both the worst-case loss of well control and HFO scenario. The ranking of these sensitivities (also referred to as receptors) are listed, which is consistent with the rankings in *Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara* (DoT, 2017). Using a combination of sensitivities, and their associated rankings; together with the modelled maximum total volumes ashore and minimum time to shoreline contact, an initial response priority is provided in **Table 5-18**. This information is

designed to aid decision making in the preliminary stages of the response operation, so that initial resources are used for best effect.

It should be noted that the implementation of scientific monitoring is dependent upon the initiation criteria described in the relevant scientific monitoring plans in **Appendix O** being met. In some cases, scientific monitoring will be triggered when aerial or visual observation reports submitted to the IMT show presence or likely presence of oil; or spill fate modelling predicts oil at sensitive receptors of ≥1g/m2 for surface oil, and ≥10 ppb for entrained and dissolved oil. This then activates the relevant Scientific Monitoring Plan (SMP), which determines if any impact has occurred based upon applicable exposure values.

Table 5-18: Initial response priorities – worst-case LOWC and HFO scenarios

<table>
<tr><th>Protection Priority Area</th><th>Key sensitivities</th><th>DoT Ranking (Floating oil)[17]</th><th>DoT Ranking (Dissolved oil)[19]</th><th>Key locations</th><th>Relevant key periods</th><th>Maximum total accumulated oil ashore (tonnes) ≥100 g/m²</th><th>Minimum arrival time accumulated oil ashore ≥100 g/m² (days)</th><th>Initial response priority - HFO</th><th>Initial response priority - LOWC</th></tr>
<tr><td rowspan="5">Ningaloo Coast North</td><td>World Heritage Area</td><td>5</td><td>5</td><td>N/A</td><td>N/A</td><td rowspan="5">Halyard-2 Drilling and Completion Project drilling subsea LOWC: 63

Halyard-2 Drilling and Completion Project drilling surface LOWC: 24

Spartan development drilling subsea LOWC: NC

Spartan development drilling surface LOWC: 23</td><td rowspan="5">Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC

Halyard-2 Drilling and Completion Project drilling surface LOWC: NC

Spartan development drilling subsea LOWC: 31.5 days

Spartan development drilling surface</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Mangroves</td><td>3</td><td>3</td><td>Mangrove Bay
Yardie Creek</td><td>N/A</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Turtles
Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density)</td><td>4</td><td>3</td><td>North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar</td><td>Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Marine mammals
Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)</td><td>3</td><td>2</td><td>N/A</td><td>Pygmy blue whale migration: Apr to Aug
Humpback whale migration: Jun to Jul</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Sharks and rays
Seasonal aggregations of whale sharks (Vulnerable) and manta rays</td><td>2</td><td>3</td><td>N/A</td><td>Whale sharks – Mar to Jul</td><td>Medium</td><td>Medium</td></tr>
</table>

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

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[17]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Birds 33 species seabirds and avifauna (Including Critically Endangered Eastern Curlew)	5	4	Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island	Nesting: Sep to Feb	State waters HFO release: 419	LOWC: 31.5 days State waters HFO release: 7 days	Medium	Low
	Coral and other subsea benthic primary producers	3	4	Largest fringing reef in Australia	Coral spawning: Mar & Oct			Medium	Medium
	Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	2	2	Numerous campsites and snorkelling sites along western Cape Range shorelines, Coral Bay, Waroora Station	Year-round			Medium	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	Halyard-2 Drilling and Completion Project drilling subsea LOWC: 29 Halyard-2 Drilling and Completion Project drilling surface LOWC: NC Spartan development drilling subsea LOWC: 17 Spartan development drilling surface LOWC: 7	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and Completion Project drilling surface LOWC: NC Spartan development drilling subsea LOWC: 17.7 days Spartan development drilling surface LOWC: 19 days	High	Medium
	Turtles Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerheads and hawksbill	4	3	Green turtles on the western side of Barrow Island and flatback turtle nesting on the eastern side. Turtle Bay north beach, North and west coasts and John Wayne Beach have loggerhead and hawksbill turtle nesting	Year round, peaking Oct to Jan			High	Medium
	Birds Migratory birds (important habitat); tenth of top 147 bird sites, highest population of migratory birds in Barrow Island Nature Reserve (south-southeast of island). Double Island has important bird nesting sites (shearwaters and sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sep to Feb			High	Low

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

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct	State waters HFO release: 1,184	State waters HFO release: 0.5 days	High	Medium
	Socio-economic Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations Petroleum Activities such as Barrow Island petroleum production	5	5	Reverse Osmosis plant and port on eastern side of island (Port of Barrow Island)	N/A			Medium	Low
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and Completion Project drilling	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and Completion Project drilling	High	Medium
	Turtles Loggerhead (Endangered) and green (Vulnerable) (significant rookeries); hawksbill (Vulnerable), flatback (Vulnerable) turtles	4	3	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			High	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) $\geq$100 g/m^2	Minimum arrival time accumulated oil ashore $\geq$100 g/m^2 (days)	Initial response priority - HFO	Initial response priority - LOWC
	Marine mammals Pygmy blue whale (Vulnerable) and humpback whale migration area Dugong (Vulnerable) foraging	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Aug	surface LOWC: NC Spartan development drilling subsea LOWC: 33 Spartan development drilling surface LOWC: 13 State waters HFO release: 1,482	surface LOWC: NC Spartan development drilling subsea LOWC: 6.9 days Spartan development drilling surface LOWC: 23.8 days	Medium	Medium
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sep to Feb			High	Low
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			High	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Socio-economic Pearling (inactive/pearling zones) Very significant for recreational fishing and charter boat tourism (Marine Management Area) Social amenities and other tourism Nominated place (national heritage)	3	2	Widespread	Year-round		State waters HFO release: 0.5 days	High	Medium
Barrow-Montebello Surrounds	As per Barrow Island and Montebello Island above					State waters HFO release: 468	State waters HFO release: 0.5 days	Medium	Low
Muiron Islands	Turtle nesting – major loggerhead (Endangered) site (South Island), significant Green turtle (Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence	4	3	Loggerhead – South Island	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and Completion Project drilling	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and Completion Project drilling	Medium	Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Seabird nesting Wedge-tailed shearwater nesting colony, birds forage at sea in large aggregations. Crested tern nesting colony.	2	1	Widespread	Nesting: Sept-Feb	surface LOWC: NC Spartan development drilling subsea LOWC: 18 Spartan development drilling surface LOWC: 9 State waters HFO release: 46	surface LOWC: NC Spartan development drilling subsea LOWC: 8.9 days Spartan development drilling surface LOWC: 9 days State waters HFO release: 7.3 days	Low	Low
	Humpback whale migration	3	2	N/A	Jun to Jul			Medium	Medium
	Exmouth gulf prawn fishery (Muiron is western boundary); significant for recreational fishing and charter boat tourism	1	2		Prawn fishery – April to November Tourism and recreation: year-round			Low	Low
Lowendal Island	Mangroves	3	3	Varanus Island, Bridled Island	N/A	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and	Halyard-2 Drilling and Completion Project drilling subsea LOWC: NC Halyard-2 Drilling and	High	Low
	Coral and other subsea benthic primary producers	3	4	Deep-water benthic (soft sediment) habitats Dugong Reef and Batman Reef (eastern side of Island)	Coral spawning: Mar and Oct			High	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Turtles Significant flatback turtle rookery, Important hawksbill, loggerhead and green turtle nesting	4	3	All beaches on Beacon, Bridled, Varanus, Abuitlon, Parakeelya Islands	Nesting all year, peak Oct to Jan Significant flatback rookery, nesting season for flatback turtles peaks Dec to Jan	Completion Project drilling surface LOWC: NC Spartan development drilling subsea LOWC: 8 Spartan development drilling surface LOWC: 3 State waters HFO release: 1,324	Completion Project drilling surface LOWC: NC Spartan development drilling subsea LOWC: 24.7 days Spartan development drilling surface LOWC: NC at ≥100 g/m² threshold State waters HFO release: 0.08 days (2 hours)	High	Low
	Birds Approximately 89 species of avifauna, 12 to 14 migratory and threatened seabirds Seabirds nesting: wedge-tailed shearwater, bridled tern, crested tern, lesser crested terns and silver gull Regularly supports 1% of the world population of crested and bridled terns	2	1	Abutilon, Beacon, Bridled, Parakeelya, Varanus islands	Year-round			High	Low
	Marine mammals Dugong foraging	3	2	Seagrass beds	N/A			High	Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[18]	DoT Ranking (Dissolved oil)[19]	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) ≥100 g/m²	Minimum arrival time accumulated oil ashore ≥100 g/m² (days)	Initial response priority - HFO	Initial response priority - LOWC
	Socio-economic and heritage Social amenities and other tourism, very significant for recreational fishing and charter boat tourism	2	2	Widespread	N/A			Medium	Low

5.7.1.1 Tactical Response Plans for Priority Protection Areas

Tactical Response Plans (TRPs) have been developed for selected receptors, identifying suitable response strategies, equipment requirements, relevant environmental information and access and permit requirements. Tactical Response Plans are referenced in both the activity/facility Oil Pollution First Strike Plan and Operational Plans. Tactical Response Plans are to be used by the IMT for first strike and ongoing activities and to assist in informing the appropriate responses for inclusion in an IAP.

Not all PPA's require tactical response plans in place. The requirement for a tactical response plan considers the time to contract to a PPA from accumulated or floating hydrocarbons in <10 days to contact (above the response planning thresholds in **Section 5.2**). The ten days allows two days to get services procured; six days to draft TRP; and two days to implement. The Sensitivity ranking (HEV and DoT) is also considered. A TRP will also be considered should the impact from hydrocarbon be considerable (high accumulation, large floating oil contact). Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA. Additionally, TRPS for contacted receptors will be sought from other operators where possible.

Table 5-19: Tactical Response Plans for Priority Protection Areas

PPA	TRP Evaluation	Existing TRP
Muiron Islands	Existing TRP in place for Muiron Islands	Yes
Ningaloo Coastline (North)	Existing TRPs in place for: + Jurabi to Lighthouse Bay beaches + Mangrove Bay + Muiron Islands + Turquoise Bay + Yardie Creek	Yes
Montebello Islands	Existing TRPs in place for: + Montebello 1: Claret Bay + Montebello 2: Sherry Lagoon entrance + Montebello 3: Hock Bay + Montebello 4: Stephenson Channel, north + Montebello 5: Hermite – Delta Island channel + Montebello 6: Champagne Bay – Chippendal Channel + Montebello 7: North Channel and Kelvin Channel	Yes

PPA	TRP Evaluation	Existing TRP
Barrow Island	+ NWS OSCP Volume 2: Environmental Resource Atlas-Barrow is covered + Chevron Australia TRPs for Barrow Island (Santos has an agreement with Chevron for use of these TRPs): – Wapet Landing – Double Islands – Mushroom Beach – Terminal Beach – MOF Basin and Seawater Intakes – Bivalve Beach – Inga Beach – Yacht Club – Little Bandicoot Bay – Turtle Bay – Whites Beach	Yes
Lowendal Islands	Existing TRP in place for Lowendal Islands Group: + Varanus Island + Bridled Island + Abutilon Island	Yes

5.7.2 Onshore spills

The existing sensitivities adjacent to onshore spill ZPIs are shown in **Figure 5-1** to **Figure 5-5**. A general description of the onshore environmental setting is provided **Table 5-20**.

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 5-21**) based on contact with hydrocarbons identified by the spill modelling.

Table 5-20: 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
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

Key Feature	Description of the feature
	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 5-21: 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

5.8 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's IMT, the Environment Unit Leader 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 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 5.4** apart from the HFO spill in State waters, and is represented in **Table 5-22.** 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 5-23.** Although not all spill response activities included in the strategic NEBA would be under the control of Santos 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 is applied to the current situation, or operationalised. To complete the NEBA:

+ 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; and
+ all persons involved and data inputs have been considered for the analysis.

The Operational NEBA 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 provides guidance to the IAPs and is revisited each Operational Period.

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Table 5-22: Impact of spill response strategies on the environmental values of the protection priorities following worst-case spill of John Brookes condensate/Spartan condensate/Halyard condensate/marine diesel/VI crude blend in Commonwealth or State waters

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protect'n & 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								
Humpback/ Pygmy blue whale migration	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec					N/A	N/A		
Socio-economic – pearling, fishing, tourism and national heritage	-								
Ningaloo Coast North									
World Heritage Area	-								
Mangroves	-							N/A	

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
(Mangrove Bay, Yardie Creek)									
Turtles Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density) (North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan								
Marine mammals Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul					N/A	N/A		
Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	Whale sharks – Mar to Jul					N/A	N/A		
Birds 33 species seabirds and avifauna (Including Critically Endangered Eastern Curlew) (Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the	Nesting: Sep to Feb								

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Mildura wreck site and Fraser Island)									
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct					N/A	N/A	N/A	
Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	Year-round								
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	
Seabird nesting - incl. Double Island	Sept-Feb								
Migratory shorebirds - particularly Bandicoot Bay	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec								

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
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	
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct					N/A	N/A	N/A	
Wedge-tailed shearwaters: Burrow excavation Egg laying Chick hatching Chick fledging	 Jul - Oct Nov Jan Apr								
Crested terns	Oct - Dec								
Bridled terns Egg laying Chick hatching	 Oct – Jan Dec - Mar								

Key environmental sensitivities	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
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 5-23: 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 Protect'n & 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									

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
	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									
Humpback/ Pygmy blue whale migration	Pygmy blue whale migration: Apr-Aug Humpback whale migration: May-Dec						N/A	N/A		
Socio-economic – pearling, fishing, tourism and national heritage	-									
Ningaloo Coast North										
World Heritage Area	-									
Mangroves (Mangrove Bay, Yardie Creek)	-								N/A	

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Turtles Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) (low density) (North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi Point, Gnarraloo Bay and Cape Farquhar)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan									
Marine mammals Pygmy blue whales (Endangered) foraging area. Dugongs (Marine/migratory) (breeding and foraging)	Pygmy blue whale migration: Apr to Aug Humpback whale migration: Jun to Jul						N/A	N/A		
Sharks and rays Seasonal aggregations of whale sharks (Vulnerable) and manta rays	Whale sharks – Mar to Jul						N/A	N/A		
Birds 33 species seabirds and avifauna (Including Critically	Nesting: Sep to Feb									

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Endangered Eastern Curlew) (Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island)										
Coral and other subsea benthic primary producers	Coral spawning: Mar & Oct						N/A	N/A	N/A	
Tourism – significant fishing/charter boat tourism, camping and use of nearshore sanctuary zones (fishing, snorkelling)	Year-round									
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									

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
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
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									

Priority for Protection Area	Relevant Key Sensitive Periods	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Shoreline Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
	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	
Wedge-tailed shearwaters: Burrow excavation Egg laying Chick hatching Chick fledging	 Jul - Oct Nov Jan Apr									
Crested terns	Oct - Dec									
Bridled terns Egg laying Chick hatching	 Oct – Jan Dec - Mar									
Migratory shorebirds	Sept-Feb									
Dugongs- Seagrass beds around the Lowendal islands	-						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 Protect'n & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
thought to provide valuable food source										
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

5.9 Resource Arrangements and Demonstration of ALARP

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

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

6 External Notifications and Reporting Procedures

For oil spills during operations, the Varanus Island Incident Response Plan (SO-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 (OIM).

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.

For oil spills during drilling of the Spartan development or Halyard-2 Drilling and Completion Project activities, the OSC (of the MODU or Company Site Representative) will notify the Perth-based IMT for delegation of further notifications to relevant Regulatory Authorities and for further spill response assistance for Level 2/3 spills.

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 Planning Section Chief.

Contact details for the Regulatory agencies outlined in **Table 6-1** and **Table 6-2** are provided within the Incident Response Telephone Directory (SO-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 oil spill reporting requirements associated with carrying out a Petroleum Activity in State and Commonwealth waters. There are also additional requirements for Vessel Masters to report oil spills from their vessels under relevant marine oil pollution legislation (e.g. MARPOL). This includes, where relevant, reporting oil spills to AMSA (Rescue Coordination Centre) and WA DoT (MEER unit).

Table 6-1: External Notification and Reporting Requirements (Commonwealth and State waters)

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
NOPSEMA Reporting Requirements for Commonwealth water spills					
NOPSEMA (Incident Notification Office)	Verbal notification within 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 Planning Section Chief (or delegate)	Incident reporting requirements: https://www.nopsema.gov.au/environmental-management/notification-and-reporting/
NOPTA (National Offshore Petroleum Titles Administrator) & DEMIRS (WA Department of Mines, Industry Regulation and Safety)	Written report to NOPTA and DEMIRS 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 Planning Section Chief (or delegate)	Provide same written report as provided to NOPSEMA
DEMIRS Reporting Requirements for State water spills					
WA Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)	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	Notification by IMT Planning Section Chief (or delegate)	Environmental and Reportable Incident/ Non-compliance Reporting Form http://www.dmp.wa.gov.au/Environment/Environment-reports-and-6133.aspx

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
			an environmental impact that is categorised as moderate or more serious than moderate[1]		
Energy Policy WA (part of DEMIRS)	Notification in the event of production disruption	-	Notification in the event of production disruption	Notification by IMT Planning Section Chief (or delegate)	None, however, provide copy of above Environmental and Reportable Incident/ Non-compliance Reporting Form for information.
Pilbara Ports Authority, AMSA and DoT spill reporting requirements					
Port of VI (Pilbara Ports Authority)	Verbal notification within 4 hours to Harbour Master via VI Port Control. Follow up report within 48 hours through the Pilbara Ports Authority Hazard and Incident Reporting Form: https://www.pilbaraports.com.au/safety-and-security/hazard-and-incident-reporting Follow up with POLREP to WA DoT	*Port Authorities Act 1999* Pilbara Ports Authority Port of VI Handbook	For all spills within Port of VI limits	Notification by Vessel Master, On-scene Commander (OSC), or Facility Emergency Response Team (ERT)	WA DoT POLREP: https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf
AMSA Rescue Coordination Centre (RCC)[2]	Verbal notification within 2 hours of incident Written POLREP form, within 24 hours on request from AMSA	MARPOL	Santos to notify AMSA of any marine pollution incident[1]	Notification by IMT Planning Section Chief (or delegate)	Not applicable
WA Department of Transport (WA DoT)[2] (Maritime Environmental Emergency Response	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 Act 2005* State Hazard Plan: Maritime Environmental Emergencies	Santos to notify of actual or impending Marine Pollution Incidents (MOP) that are in, or may impact, State waters.	Notification by IMT Planning Section Chief (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

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
(MEER) Duty Officer)		Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements	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].		
Protected areas, fauna and fisheries reporting requirements					
Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) (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 Planning Section Chief (or delegate)	Not applicable
Department of Biodiversity Conservation and Attractions	Verbal notification as soon as reasonably practicable	Western Australian Oiled Wildlife Response Plan	Santos to notify DBCA of any marine pollution incident[1] Notify if spill has the potential to impact or has impacted wildlife in	Notification by IMT Planning Section Chief (or delegate)	Not applicable

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
(Pilbara Regional Officer)			State waters (to activate the Oiled Wildlife Advisor)		
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 Planning Section Chief (or delegate)	Not applicable
Parks Australia (24-hour Marine Compliance Duty Officer)	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 Planning Section Chief (or delegate)	Not applicable, but the following information should be provided: • Titleholder's details • Time and location of the incident (including name of marine park likely to be affected) • Proposed response arrangements as per the OPEP • Confirmation of providing access to relevant monitoring and evaluation reports when available • 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 Planning Section Chief (or delegate)	Not applicable

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
Department of Water and Environmental Regulation (DWER)	Initial verbal or electronic notification of the discharge as soon as practicable. Written notification of the incident to the CEO of the DWER, copied to the local DWER Industry Regulation Office, as soon as practicable.	*Environmental Protection Act 1986* (Section 72) Environmental Protection (Unauthorised Discharge) Regulations 2004	Call DWER 24 hour Pollution Watch hotline Environmental Protection Act: Spill or discharge of hydrocarbons to the environment that has caused, or is likely to cause pollution, or material or serious environmental harm (Level 2 / 3 spills) Environmental Protection (Unauthorised Discharge) Regs.: Unauthorised discharge (where there is potential for significant impact or public interest) to environment of Schedule 1 material	Notification by Planning Section Chief (or delegate)	Reporting requirements: https://www.der.wa.gov.au/your-environment/51-reporting-pollution/110-reporting-a-life-threatening-incident-or-pollution-emergency
VI Contaminated Sites Auditor	Initial verbal or electronic notification followed by a report if confirmed contamination	*WA Contaminated Sites Act 2003*	Applies if there is shoreline contact that could cause land contamination on Varanus Island and/or Airlie Island	Notification by Planning Section Chief (or delegate)	NA

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
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 Planning Section Chief (or delegate)	Not applicable
If spill is heading towards international waters					
Department for Foreign Affairs and Trade (DFAT) (24-hour consular emergency centre)	Verbal phone call notification within 8 hours, if the spill is likely to extend into international waters Follow up with email outlining details of incident	NP–GUI–007: National Plan coordination of international incidents: notification arrangements guidance (AMSA, 2017a)	Notify DFAT that a spill has occurred and is likely to extend into international waters Inform DFAT of the measures being undertaken to manage the spill NOPSEMA, DISER and DFAT will form an inter-agency panel; the Australian Government Control Crisis Centre	Notification by IMT Planning Section Chief (or delegate)	Email details of incident to globalwatchoffice@dfat.gov.au

1 For clarity and consistency across Santos regulatory reporting requirements Santos 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's environmental impact and risk assessment process outlined in Section 5 of the EPs.

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

Table 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 Energy, Mines, Industry Regulation and Safety (DEMIRS)	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 Planning Section Chief (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 Planning Section Chief (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 Planning Section Chief (or delegate)	Not applicable
WA Department of Fire and	As determined by VI On-scene	Emergency Response Plan -	WA Department of Fire and Emergency Services (DFES)	As determined by VI On-scene	Emergency Response Plan -Varanus Island (SO-00-ZF-00044)

Agency or Authority	Type of Notification /Timing	Legislation/ Guidance	Reporting Requirements	Responsible Person/Group	Forms
Emergency Services (DFES)	Commander (OIM)	Varanus Island (SO-00-ZF-00044)		Commander (OIM)	

6.2 Activation of external oil spill response organisations and support agencies

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 in an oil spill response. It is not an exhaustive list of all providers that Santos may use for assisting an oil spill response. The Company Incident Response Telephone Directory (SO-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 Communi-cation	Resources Available	Activation instructions	Santos person responsible for activating
AMOSC AMOSC Duty Officer	As soon as possible but within two hours of incident having been identified	Verbal Service Contract	Santos is a Participating Member of 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. Only a Santos call-out authority (registered with AMOSC) can activate AMOSC, and will be required to supply their credentials to AMOSC. A signed contract note must also be completed by the Santos call out authority and returned to AMOSC prior to mobilisation	The IMT Planning Section Chief (or delegate) will notify AMOSC (upon approval from Incident Commander)
Aviation Service Provider	Within 2 hours of incident	Verbal	Helicopters/pilots available for aerial	Phone call	Logistics Section Chief (or delegate)

Organisation	Indicative Timeframe	Type of Communi-cation	Resources Available	Activation instructions	Santos person responsible for activating
	having been identified		surveillance. Contract in place.		
Duty Officers/ Incident Commanders (Woodside, Chevron, Jadestone)	Within 2 hours of incident having been identified	Verbal	Mutual aid resources (through AMOSC mutual Aid Arrangement)	Phone call	Incident Commander (or delegate)
Exmouth Freight & Logistics	Within two hours of incident having been identified	Verbal	Assistance with mobilising equipment and loading vessels	Phone call	Logistics Section Chief (or delegate)
North West Alliance – Waste	As required for offshore and shoreline clean-up activities	Verbal	Santos has contract arrangements in place with North West Alliance to take overall responsibility to transport and dispose of waste material generated through clean-up activities.	Phone call to the Primary Contact Person. In the event the Primary Contact Person is not available, the Secondary Contact Person will be contacted.	Logistics Section Chief (or delegate)
Monitoring Service Provider	Scientific Monitoring Plan initiation criteria are met (**Section 17**)	Verbal and written	Santos' Monitoring Service Provider has been contracted by Santos to provide Standby Services for Scientific Monitoring Scientific Monitoring Plans (SMPs) 1-11. This includes provision of	**Step 1.** Obtain approval from Incident Commander to activate Monitoring Service Provider for Scientific Monitoring **Step 2.** Verbally notify Monitoring Service Provider followed by the submission of an Activation Form (Environment Unit Leader Folder) via email **Step 3.** Provide additional details as requested by the Monitoring Service Provider Monitoring Coordinator on call-back	Planning Section Chief (or delegate)

Organisation	Indicative Timeframe	Type of Communi-cation	Resources Available	Activation instructions	Santos person responsible for activating
			personnel and equipment. The Monitoring Service Provider annually reviews the SMPs for continual improvement.	**Step 4.** Monitoring Service Provider initiates Scientific Monitoring Activation and Response Process	
Dispersant Operational Monitoring Provider	If and when SSDI is activated (**Section 8.3.6.2**)	Verbal and Activation Form	Santos' Dispersant Operational Monitoring Provider has been contracted to provide operational dispersant monitoring, including the provision of personnel and equipment.	Phone call to the Dispersant Operational Monitoring Provider – Operational Stand-by Response (refer to **Appendix P**: SMP and Operational Monitoring Activation Process)	Planning Section Chief (or delegate)
Intertek Geotech (WA) Environmental Services and Ecotoxicology	When characterisation of oil is activated (**Section 9.7**)	Verbal	Oil analysis including gas chromatography/ mass spectrometry fingerprinting	Phone call	Planning Section Chief (or delegate)
Oil Spill Response Limited (OSRL), OSRL Duty Manager	Within two hours of incident having been identified	Verbal OSRL Mobilisation Authorisation Form	Santos has a Service Level Agreement with OSRL, which includes the provision of support functions, equipment and personnel to meet a wide range of scenarios. Further	**Step 1.** Contact OSRL Duty Manager in Singapore and request assistance from OSRL **Step 2.** Send notification to OSRL as soon as possible after verbal notification **Step 3.** Upon completion of the OSRL incident notification form, OSRL will plan and place resources on standby.	Designated call-out authorities (including Incident Commanders and CMT Leads)

Organisation	Indicative Timeframe	Type of Communi-cation	Resources Available	Activation instructions	Santos person responsible for activating
			details available on the OSRL webpage.		
The Response Group	As soon as possible but within two hours of incident having been identified	Verbal and written	Santos has arrangements with TRG for the provision of trained field response personnel	Contact TRG Duty Officer	Designated call-out authorities (including Incident Commanders)
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	Planning Section Chief (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.	**As per Source Control Planning and Response Guideline (DR-00-OZ-20001):** **Step 1.** Following Santos management confirmation of a subsea loss of containment, the Santos Incident Command Team (IMT) Drilling	Drilling Representative

Organisation	Indicative Timeframe	Type of Communi-cation	Resources Available	Activation instructions	Santos person responsible for activating
	having been identified			Representative is to call the Wild Well Control 24-hour emergency hotline number to notify WWC of the incident. **Step 2.** As soon as practical after initial notification and once the scale of the subsea loss of containment is confirmed, an emergency mobilisation authorisation form must be filled out, signed off by the authorised Santos Manger and sent through to WWC. Obtain the most current emergency mobilisation form from the WWC emergency hotline attendant. The form shall be submitted as directed by WWC, as advised by the emergency hotline attendant.	

6.3 Environmental Performance

Table 6-4 lists the Environmental Performance Standards and Measurement Criteria for external notifications and reporting.

Table 6-4: Environmental performance – external notification and reporting

Environmental Performance Outcome	Make notifications and reports within regulatory and defined timeframes.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
External notifications and reporting plan	**Response Preparedness**		
	Incident Response Telephone Directory (SO-00-ZF-00025.02)	Incident Response Telephone Directory is revised every six months	Document revision history
	OPEP Communications Test	OPEP contact details for regulatory and service provider notifications are checked annually	Test records
	Response Implementation		
	External notifications and reporting tables	External notification and reporting undertaken as per **Table 6-1** and **Table 6-2**.	Incident Log

7 Incident Action Plan (IAP)

Santos 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 IMT will use the IAP process to determine and document the appropriate response priorities, objectives, strategies and tasks to guide the incident response which are reviewed and updated as more information becomes available. The IMT will use an IAP for each operational period following the initial first-strike assessments, notifications, and activations undertaken.

When acting as the support agency, Santos may be requested by the Control Agency to develop or support the development of an IAP to help guide the incident response.

The Santos IAP process is built on the phases described in **Figure 7-1**.

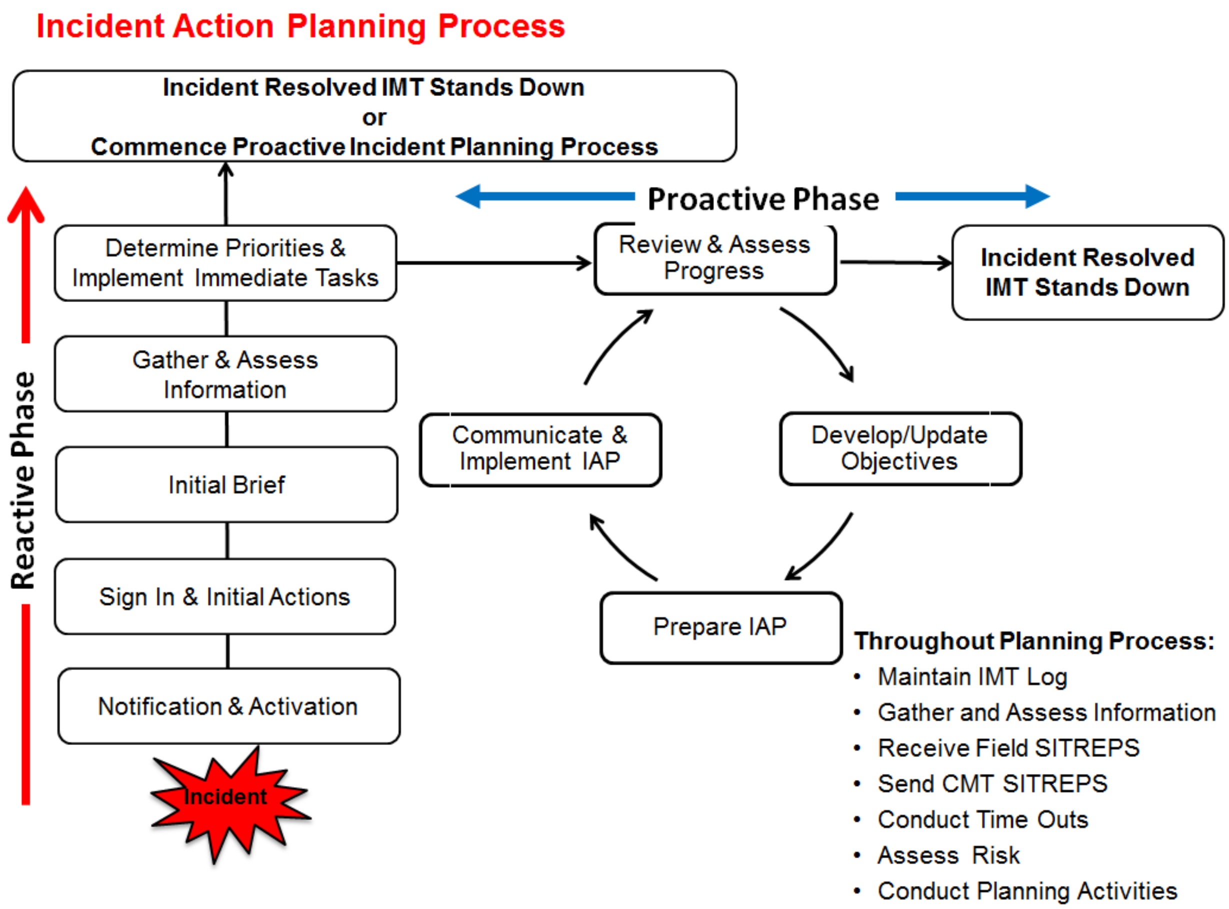

Figure 7-1: Incident Action Plan process

7.1 Reactive phase planning

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

First strike response actions are summarised in Initial Response, **Section 1** at the beginning of this document and provide links to relevant oil spill strategy sections within the OPEP which contain a more detailed list of implementation actions and considerations as well as statements of performance (performances standards) that must be followed to ensure the initial response meets regulatory requirements and environmental performance outcomes.

For each credible oil spill scenario covered by this OPEP the first strikes response actions, have been informed by a pre-assessment of applicable oil spill response strategies, priority response locations and a strategic NEBA also referred to as a SIMA. This pre-planning is included in **Section 5**. During the reactive phase the strategic NEBA is to be reviewed and, using the specific information gathered from the spill, operationalised into an operational NEBA (**Section 5.8**). This assessment helps verify that the response strategies pre-selected for each spill scenario are providing the best environmental outcome for the incident response.

7.2 Developing an Incident Action Plan

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

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

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

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

IAP forms and processes are documented in the Santos SharePoint Oil Spill Response Tile and in the SO ER Documentation SharePoint site. Access subfolders to display all forms required to conduct incident action planning. Each functional position within the IMT has subfolders carrying forms and processes unique to the functional position on the Oil Spill Tile.

7.3 Environmental Performance

Table 7-1 lists the Environmental Performance Standards and Measurement Criteria for incident action planning.

Table 7-1: Environmental performance – incident action planning

Environmental Performance Outcome	Manage incident via a systematic planning process		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Incident Action Planning	**Response Preparedness**		
	IMT Exercise and Training Plan	Incident Action Planning and NEBA is practiced by the IMT during exercises	Exercise records
	Incident Management Personnel	Incident Management personnel are trained and available as per **Appendix J.**	Manual compliance check on IMT and CMT Membership contracts with AMOSC and OSRL
	Response Implementation		
	Incident Action Plan	Incident Action Plan is completed for each operational period and approved by the Incident Commander	Incident Log Incident Action Plan/s
		Monitor effectiveness of response strategies being implemented and use information in the development of IAPs	Incident Log Incident Action Plan/s
	Tactical Response Plans	If operational monitoring shows that shoreline contact of Protection Priority Areas is likely, TRPs will be developed or sought from other titleholders/ regional industries prior to shoreline contact.	TRP
	NEBA	An operational NEBA will be undertaken for each operational period of the incident	NEBA Incident Action Plan
	IMT activation and de-escalation	IMT will be activated Immediately once notified of a level 2/3 spill (to Incident Commander).	Incident Action Plan
		The decision to de-escalate the IMT will be made in consultation with the relevant Control Agency/s, Jurisdictional Authorities and other Statutory Authorities that play an advisory role.	NEBA Incident Action Plan

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

Vessel and Platform Releases (hydrocarbon storage, handling and transfer)				
Activation time		Immediately upon notification of a vessel or platform release.		
Action		**Consideration**	**Responsibility**	**Complete**
Initial Actions	In the event of a loss of production hydrocarbons from platform topside production equipment, consult the Varanus Hub Incident Response Plan (SO-00-ZF-00044)		Offshore Platform Designated Person/ Facility On Scene Commander	❑

<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><td>Action</td><td>Consideration</td><td>Responsibility</td><td>Complete</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 Transfer Management Standard (SO-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;
Disposal of contaminated waste to licensed waste contractor; and
Isolation and repair of damaged, leaking equipment.</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>
<tr><td colspan="2">Resources</td><td colspan="2">Location</td></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>
</table>

Vessel and Platform Releases (hydrocarbon storage, handling and transfer)			
Activation time	Immediately upon notification of a vessel or platform release.		
Action	**Consideration**	**Responsibility**	**Complete**
Personnel	Refer to vessel, platform and activity specific procedures for details of personnel.	Refer to vessel, platform and activity specific procedures for details of personnel.	
Maintenance of response	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.		

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

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

<table>
<tr><th colspan="5">Vessel Tank Rupture</th></tr>
<tr><td colspan="2">Activation time</td><td colspan="3">Immediately upon notification of a vessel tank rupture.</td></tr>
<tr><td colspan="2">Action</td><td>Consideration</td><td>Responsibility</td><td>Complete</td></tr>
<tr><td>Initial Actions</td><td>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</td><td>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 fuel 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 fuel loss;
+ If the affected tank is not easily identified, reduce the level of the fuel in the tanks in the vicinity of the suspected area if stability of the vessel will not be compromised;
+ Evaluate the transfer of fuel 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</td><td>Vessel Master</td><td>❑</td></tr>
<tr><td colspan="3">Resources</td><td colspan="2">Location</td></tr>
<tr><td colspan="2">Equipment</td><td>Refer to vessel specific procedures for details of equipment available.</td><td colspan="2">Refer to vessel specific procedures for details of equipment locations.</td></tr>
<tr><td colspan="2">Personnel</td><td>Refer to vessel specific procedures for details of personnel.</td><td colspan="2">Refer to vessel specific procedures for details of personnel.</td></tr>
<tr><td colspan="2">Maintenance of response</td><td colspan="3">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</td></tr>
</table>

Vessel Tank Rupture	
Activation time	Immediately upon notification of a vessel tank rupture.
	Potential resources (e.g. support vessels with capacity to store liquids) available through VI Hub operations.

8.3 Loss of Well Control

Table 8-5 provides the environmental performance outcome, initiation criteria and termination criteria for controlling the source of a loss of well control.

Table 8-5: Loss of well control – source environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment					
Initiation criteria	LOWC					
Applicable hydrocarbons	Spartan Condensate	John Brookes Condensate	Crude oil	Lube oil/hydraulic fluids	MDO	HFO
	✔	✔	✔	✗	✗	✗
Termination criteria	The primary well is contained and killed to prevent any further release of hydrocarbon to the environment					

Santos identified the worst-case credible loss of well control (LOWC) oil spill scenarios for assessment as:

+ during operations:
  – LOWC/damage to infrastructure causing a release of 39,011 m^3 of condensate John Brookes wellheads at surface, released over 100 days;
+ during Spartan development drilling:
  – LOWC during Spartan development well drilling leading to a subsea release of 53,811 m^3 of condensate at the Spartan well location at 60 m depth over 77 days; and
  – LOWC during Spartan development well drilling leading to a surface release of 53,291 m^3 of condensate at the Spartan well location over 77 days;
+ during Halyard-2 Drilling and Completion Project drilling:
  – LOWC during Halyard-2 well drilling leading to a subsea release of 173,755 m^3 of condensate at the Halyard-2 well location at 140 m depth over 77 days; and
  – LOWC during Halyard-2 well drilling well drilling leading to a surface release of 170,576 m^3 of condensate at the Halyard-2 well location over 77 days.

8.3.1 Source control methods – All LOWC Scenarios

8.3.1.1 Emergency blow-out preventer activation

As part of the Spartan Development drilling and Halyard-2 Drilling and Completion Project drilling activities, a blow-out preventor (BOP) stack will be installed prior to drilling of the reservoir well sections, in accordance with API Standard 53: *Well control equipment systems for drilling wells* (API, 2018). The purpose of a BOP is to provide a secondary barrier to hydrocarbons by providing a mechanical means of shutting in the well if primary well control is lost, and hydrocarbons enter the wellbore.

BOP Activation (surface and subsea BOPs)

Manual Activation

If primary well control actions have failed and a loss of well control incident is anticipated, or is occurring, the drilling crew will initiate emergency BOP activation procedures immediately to shut in the well. This applies to both jack-up drilling (Spartan development) and semi-submersible drilling (Halyard-2 Drilling and Completion Project).

The relevant BOP rams will be activated, via the BOP control panel located in the drill shack. There is an additional BOP control panel located remote to the drill shack. Available BOP rams commonly include:

+ pipe ram: Seals the wellbore by sealing around drill pipe of a specific size
+ variable-bore ram: Seals the wellbore by sealing around various sizes of drill pipe
+ blind ram: Seals the wellbore when there is no tubing across the BOP[19]
+ blind-shear ram: Seals the wellbore by cutting through and displacing drill pipe/tubing.

One or more of the BOP rams may be activated depending on the status of the well and the severity of the well control incident. Once a BOP ram is closed, it cannot be opened without further hydraulic intervention. Well pressure acts to hold the ram closed. BOP shear rams often have a secondary lock mechanism to further ensure that the well remains shut in.

Sealing the wellbore in this manner provides an important safety barrier. It also allows the drill crew time to consider and plan actions to bring the well back under primary control.

BOP Activation (subsea BOPs)

The following subsea BOP activation aspects apply to the Halyard-2 Drilling and Completion Project (which uses a semi-submersible drilling unit) in addition to manual activation above.

Automatic Activation

In the event of loss of communication between the MODU and the BOP (i.e., the electrical connection between the BOP control panels on the MODU and the BOP on the wellhead is severed or damaged in some way), the BOP is designed to fail-safe close automatically on loss of signal, using stored electrical and hydraulic control power from the BOP battery and accumulators, respectively. In this situation the BOP will seal the well automatically.

MODU Emergency Disconnect

In the event of a serious loss of well control incident where the safety of the MODU and crew are threatened, the MODU emergency disconnect system (EDS) will be activated. This will unlatch the MODU riser from the lower marine riser package (LMRP) and activate the BOP rams. The EDS is used as a 'last resort' where all other attempts at well control have been unsuccessful and the safety of the MODU and its crew is threatened to an unacceptable level.

Failure Intervention

In the unlikely event that attempts to activate the BOP from the MODU have failed, and/or the fail-safe close operation of the BOP has malfunctioned, the BOP can be closed via remotely operated vehicle (ROV) hot-stab intervention. Either the ROV on the MODU or an ROV from a separate support vessel can actuate the BOP in this manner. ROV deployment would commence as soon as practicable from the MODU if safe to do

[19] Note: The jack-up MODU for the Spartan well (*Noble Tom Prosser*) does not have this feature on the BOP.

so. If an ROV was to be deployed from a support vessel, the IMT would immediately seek to source an ROV and suitable vessel to mobilise to the field and deploy the intervention ROV as soon as practicable. ROV operations would commence to navigate the ROV to the BOP and activate the BOP rams via a hydraulic hot-stab connection on the BOP side panel. This would serve to add hydraulic pressure to the BOP circuit from either the ROV pumps or an external hydraulic source, to enable manual close of the BOP rams to seal the well.

8.3.2 Relief well drilling

Relief well drilling is the primary source control strategy to control a LOWC (subsea and surface). The installation of a subsea capping stack and application of SSDI are considered as secondary response strategies for the Halyard-2 Drilling and Completion Project only. The capping stack and SSDI are not considered applicable for Spartan Development drilling (refer **Table 5-16**).

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

8.3.2.1 Relief well planning

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

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

The Spartan development well and Halyard-2 well will have specific source control plans (SCPs). The SCP is a Santos controlled document and is encompassed in the well operations management plan (WOMP).

The SCP will contain relief well planning information, specifically:

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

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

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

+ MODU name;
+ MODU contract status (Operator and contract duration);
+ current location;
+ maximum water depth capability;
+ MODU type (Floating vs jack-up; mooring type; Rig Design/Class);
+ available drilling envelope;

+ BOP specifications;
+ BOP connector specifications;
+ mud pumps specifications/capability;
+ choke and kill line internal diameters;
+ storage capability (i.e., diesel, base-oil, brine, drill-water, potable water, bulks); and
+ NOPSEMA safety case (yes/no).

The SCPs will also include relief well planning that involves a review of the most recent MODU capability register to identify the most suitable MODU for the well. In the event a suitable MODU is not in Australian waters, or is not predicted to be in Australian waters at the time of the activity, further work will be completed to identify a regionally suitable MODU, along with a mobilisation plan that demonstrates construction of a relief well within the time frame outlined in **Table 8-6** is achievable. Once a MODU is allocated as a potential relief well MODU for a project, the MODU capability register will be annotated as such. As such, any change to the register on a month-to-month basis that affects a preferred MODU will trigger a revision to the SCP for that particular well. The review will be completed within 4 weeks of identifying the change.

Santos commits to reviewing the SCP assumptions for relief well MODU availability and verifying that a suitable relief well MODU is either in Australian Waters, or there is a suitably robust plan in place to mobilise one outside of Australia. The activity will not proceed if there is not a least one relief well MODU option than could execute a relief well within the timeframes committed to in **Table 8-6**. In addition, during the activity, if the preferred relief well MODU/s becomes unavailable, work will commence on an update on the SCP to identify a suitable replacement relief well MODU regionally along with any required pre-work (contracting/logistics plans etc.).

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

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

8.3.2.2 Relief Well Schedule

An indicative relief well drilling schedule is provided in **Table 8-6**, which is applicable to both Spartan development drilling and the Halyard-2 Drilling and Completion Project. This is based on control of a blow-out well by 11 weeks (77 days). This period is used as a base case well control timeframe by Santos across its wells and is based on indicative mobilisation durations, relief well planning and operations. It could take up to 33 days to have a MODU onsite ready to spud.

Long lead item equipment to enable a relief well to be drilled within this timeframe is currently held in the Santos inventory or has been confirmed to be available at short notice from vendors or other operators in the region.

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

Table 8-6: Schedule for mobile offshore drilling unit arriving onsite

LOWC Relief Well		
Task	**Duration (days)**	**Controls**
Event reported Begin sourcing of rig for relief well drilling operations. Concurrently, stand up relief well drilling team and activate relief well specialists.	2	+ On-site communications + Active IMT on call including Operations Section Chief/Relief Well Team Lead + Stood-up relief well team (as per Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) + Relief Well Drilling specialist services contract (Wild Well Control) + Regional MODU tracking + APPEA MoU: Mutual Assistance
Relief well MODU confirmed. Relief well MODU suspends operations and prepares to mobilise to relief well location. Demobilisation of equipment from previous operator Concurrently, prepare relief well MODU Safety Case Revision and submit to NOPSEMA. Concurrently, prepare relief well design and dynamic kill plan. Prepare relief well WOMP and submit to NOPSEMA.	7	+ Active IMT + Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) + Pre-completed well specific Source Control Plan complete with relief well study + Relief Well Drilling specialist services contract (Wild Well Control) + Regional MODU tracking + APPEA MoU: Mutual Assistance + Access relief well long lead equipment from inventory or other operators (e.g. casing and wellhead) + Drilling services contracted.
Contract relief well MODU. Concurrently, continue preparations for rig mobilisation. Concurrently, NOPSEMA assessment of relief well MODU SCR and relief well WOMP. Mobilise relief well MODU to location.	24	+ Active IMT + Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) + Relief Well Drilling specialist services contract (Wild Well Control)
Total days prior to arrival, ready to spud/commence relief well operations	33	

LOWC Relief Well		
Task	**Duration (days)**	**Controls**
Drill and construct relief well and complete dynamic well kill operations	44	+ Active IMT + Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) + Relief Well Drilling specialist services contract (Wild Well Control)
Total days from LOWC to well kill	77	

8.3.3 Relief well implementation guidance

A high-level summary of relief well Implementation actions is provided in **Table 8-7**.

Table 8-7: Implementation guidance – relief well drilling

	Action	Responsibility	Complete
Initial Actions	**Relief well**		
	Implement the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Relief Well Team Leader	❑
	Notify Santos Drilling and Completions Team to assemble a Source Control Branch and immediately begin preparations.	Relief Well Team Leader	❑
	Notify well control service provider personnel for mobilisation.	Relief Well Team Leader and Source Control Branch Director	❑
	Source MODU through nearby drilling operations if available or procure from nearest operator through mutual aid agreement MoU.	Source Control Branch Director	❑
	Refine, as necessary, the relief well pre-planned work described in **Section 8.3.2** to reflect the actual depths and asses the suitability of well locations.	Source Control Branch Director	❑
	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Section Chief Section Chief	❑
	Deploy equipment and personnel to site to begin operations.	Relief Well Team Leader	❑
Ongoing Actions	**Relief well**		
	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.	Source Control Branch Director	❑
	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Section Chief	❑
	Deploy equipment and personnel to site to begin operations.	Relief Well Team Leader	❑
	Monitor progress of relief well drilling and communicate to IMT.	Relief Well Team Leader	❑

The following subsections (Section 8.3.4, 8.3.5, 8.3.6 and 8.3.7) apply to Halyard-2 Drilling and Completion Project only

8.3.4 Subsea first response toolkit – Halyard-2 Drilling and Completion Project

If a subsea LOWC was to occur, the site would require a detailed assessment to determine the most suitable intervention methods for the incident. This may be achieved through the use of ROVs (supplied by Santos via existing contractual arrangements) and the AMOSC Subsea First Response Toolkit. The SFRT includes debris clearance equipment, blowout preventer intervention equipment and ancillary tools. The SFRT also includes subsea dispersant equipment including a dedicated dispersant stockpile of Dasic Slickgone NS (500 m^3).

In the event of a loss of well control incident, Santos will mobilise the AMOSC SFRT from Fremantle to Dampier for transhipment to a suitable vessel for transport to, and deployment at the incident location. The SFRT and dispersants are located at Oceaneering's facilities at Jandakot. If required, the equipment would be mobilised via road from Jandakot to Dampier. It is estimated this would take 10 hours to arrange and up to 7 days to load and transport to Dampier. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier (within 9 days of the call out). Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 12 from call out. Specialist personnel to deploy the SFRT will be provided via Santos' contract with Oceaneering and will be available in Dampier within 72 hours (3 days). Vessel specifications are outlined in the Santos Offshore Source Control Planning and Response Guideline (DR-00-ZF-20001).

8.3.5 Capping stack – Halyard-2 Drilling and Completion Project

A capping stack provides a temporary means of sealing the well until a permanent well kill can be performed through either a relief well or well re-entry. It is considered a secondary source control measure (refer to **Table 5-16**).

Capping stack compatibility varies from well to well and can also depend on the extent of the blowout and water depth. Compatibility will also vary according to technical and safety constraints, and damage to an individual well, which would only be known at the time of the spill and assessed via the SFRT and accompanying ROVs.

The installation of a capping stack may be applicable for a subsea loss of well control during Halyard-2 Drilling and Completion Project drilling activities using a semi-submersible MODU where the BOP is present on the seabed. The use of a Subsea First Response Toolkit (SFRT) (**Section 8.3.4**), together with subsea dispersant application capability (**Section 8.3.6**), may be applicable in assisting the installation of a capping stack.

A capping stack would only be used where there is suitable vertical access over the wellhead and a suitable restricted flow rate was determined. Santos has contracts in place with Wild Well Control (WWC) and would deploy their Singapore-based capping stack as the primary option (another WWCI capping stack is available from Aberdeen). The Singapore-based capping stack would be assembled quayside, tested and then transported via barge to a suitable deployment vessel where it would then be transferred, fastened and then commence its transit to the well site.

The deployment vessel will need to meet the following criteria:

+ require an active heave compensator, capability of lifting minimum of 150 Tonne
+ 500 - 1,000 m^2 of deck space
+ located within a 4-day sail radius of Singapore.

Additional vessel specifications are outlined in the Santos Offshore Source Control Planning and Response Guideline (DR-00-0Z-20001). In addition, the Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001) provides further details on the vessel specification for capping stack deployment, and the ongoing process for monitoring vessel availability.

Santos would be responsible for managing the customs and importation issues related to equipment arrival into Australian Waters, obtaining support from WWC. To ensure access to suitable vessels to deploy the capping stack to the incident location, prior to and during the activity, Santos will monitor the availability of capping stack capable vessels on a monthly basis through shipbroker reports. This also includes the tracking of current vessel Safety Case status.

However, as an adaptive management measure, as part of the DCMP Assurance Review (described in Section **8.3.2.1**). Santos commits to verifying that a suitable deployment vessel is available and can meet the criteria defined above. In addition, this check will occur monthly. In the event a suitable vessel is not available, work will commence to identify a suitable vessel further afield, along with identifying any pre-work (contracting/logistics plans etc.) that might be needed to mobilise a vessel from further afield.

In addition, Santos has current contracts with vessels that have similar specifications for various scopes of work with approved Australian Safety Cases. These Safety Cases could be used as a basis of a Safety Case revision if one was required, which could create significant time efficiencies. Santos also has in place a contract with a specialist contractor highly experienced in the Safety Case revision process, to leverage their experience, further reducing the timeframes required to develop a Safety Case revision that meets NOPSEMA's requirements.

The location of these vessels can be tracked through Santos' offshore vessel tracking system accessed via the Santos Emergency Response Intranet page.

8.3.5.1 Capping stack schedule

An indicative capping stack schedule is provided in **Table 8-8**. This period is based on indicative mobilisation durations and is subject to weather conditions and availability of specialist personnel.

Table 8-8: Capping stack mobilisation schedule

LOWC capping stack timeline		
Task	**Duration (in days)**	**Controls**
Event reported – source suitable deployment vessel (with approved safety case) (Santos) Concurrently deploy capping stack components from warehouse to quayside (including assembly and testing) (WWC)	4	+ On-site communications + Active IMT on call including Operations/Drilling Team Lead + WellCONTAINED Logistics Plan + Monthly monitoring of suitable vessels
capping stack lifted on to barge, fastened and then tug operations transit to anchored deployment vessel (WWC)	2	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + capping stack specialist services (Wild Well Control) + WellCONTAINED Logistics Plan + capping stack Logistics Methodology
Handover of capping stack from WWC to Santos (WWC to continue to support via specialist personnel)		
capping stack mobilised to incident location by deployment vessel (Santos with support from vessel broker)	9	+ Stood-up Source Control Team (as per Santos Offshore Source Control Planning and Response Guideline (DR-00-OZ-20001) + capping stack specialist services contract (Wild Well Control) + WellCONTAINED Logistics Plan
Total days before arrival, ready to commence capping stack operations	**15**	
Days to installation of capping stack (worst case allowing for potential removal of debris and issues due to damaged wellhead, BOP and/or LMRP)	2 to 28 (estimated)	

8.3.6 Subsea dispersant injection – Halyard-2 Drilling and Completion Project

SSDI has been observed to break-up oil droplets forcing greater entrainment of the oil into the water column below the sea surface (Adams *et al*., 2013). SSDI has additional benefits over surface dispersant application including its ability to reduce volatile organic compounds (VOCs) reaching the surface in the vicinity of a spill, making the area safer for responders (IPIECA, 2015a; French-McCay *et al*., 2021) and enabling them to bring the release under control quicker (e.g., via capping stack) and reducing the overall volume of hydrocarbons being released into the environment.

SSDI typically requires smaller volumes of dispersant to be used, as it has a higher encounter rate with the hydrocarbons than surface application. SSDI can also be used day and night, whereas surface application via vessel or aircraft can only occur during daylight hours.

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

Water depth is a further limitation to the effectiveness of SSDI for VOC control; If SSDI use is proposed primarily for safety reasons, shallower depths may not be sufficient to enable VOCs to be reduced to a point which ensures a safe operating environment on the surface (OSRL, 2017). Some research suggests this may be around 500 metres (Adams & Socolofsky, 2005, in: IPIECA, 2015); however, there is currently no definitive recommended minimum water depth for SSDI use. Water depth in the vicinity of the Halyard-2 Drilling and Completion Project is approximately 140 m.

Therefore, SSDI may be employed as a secondary response strategy for a Halyard-2 Drilling and Completion Project LOWC for the purpose of VOC reduction, subject to the outcome of operational NEBA. The effectiveness of VOC reduction would be closely monitored through air quality monitoring as part of the overall dispersant effectiveness monitoring programme (refer to **Section 8.3.6.2**). If VOC reduction is minimal or ineffective, it is likely that SSDI operations would cease.

8.3.6.1 Dispersant selection process

8.3.6.1.1 Dispersant use

Dispersants should only be used when the risks associated with their use to the environment as a whole have been analysed, and it has been determined that there would be a net environmental benefit from their use. The type of dispersant that will be effective is influenced by the oil type and metocean conditions (Hook and Lee, 2015).

Most of the knowledge on the biological impacts of dispersants has been developed via laboratory experiments (Quigg *et al.*, 2021) rather than from in-situ use. This is also the case for those dispersants listed as approved in the National Plan for Maritime Environmental Emergencies Register of Oil Spill Control Agents (OSCA). Before a dispersant can be considered for use by AMSA, its toxicological impact must be tested on a diverse range of aquatic taxa, including algae, invertebrates and fish (Hook and Lee, 2015). However, this screening process ensures that these compounds have comparatively low toxicity (according to US Environmental Protection Agency criteria; Hemmer *et al*., 2011) and that they are much less toxic than oil (Hook and Lee, 2015).

Of the dispersants listed on the OSCA Register, only Corexit 9500A and 9527 (the latter is only on the transitional acceptance list) have been used in response to a large-scale spill and during subsea application, which was during the Macondo oil spill (Gulf of Mexico) in 2010. Six types of dispersant were used on the Montara oil spill in the Timor Sea in 2009, including Slickgone NS, Corexit 9500, Corexit 9527, Slickgone LTSW, Ardrox 6120 and Tergo R40 (AMSA, 2010). However, the total volumes sprayed equated to 150 m^3 (AMSA, 2010), as opposed to the 7,000 m^3 (4,100 m^3 surface application and 2,900 m^3 subsea application of just Corexit 9500A and 9527) (Quigg *et al*., 2021) used during the Macondo spill.

A detailed oil fate and mass balance assessment completed by French-McCay, *et al*. (2021) on the Macondo spill indicated on average, there was 9% less floating oil during the duration of the release due to subsea dispersant application. This assessment also showed subsea application was increasingly effective over the course of the spill in reducing VOC exposures in the immediate area of the wellhead by up to 27% (French-McCay *et al*., 2021), making source control operations safer for responders.

Despite the considerable amount of research, modelling and experimental work done to study the effects of subsea dispersant application, there is conflicting evidence as to the efficacy of the use of subsea dispersants (Quigg *et al*., 2021). However, NASEM (2020) found no compelling evidence that chemically dispersed oil at low to moderate oil concentrations was any more toxic than oil alone. At high concentrations the combination of oil and dispersant appeared more toxic (Quigg *et al*., 2021), suggesting caution should be applied when considering dispersant application rates and volumes. This also shows the importance of ongoing dispersant effectiveness monitoring (**Section 8.3.6.2**) and its use through the operational NEBA process.

8.3.6.1.2 Dispersant selection

Chemical dispersants listed as approved in the National Plan for Maritime Environmental Emergencies Register of Oil Spill Control Agents (OSCA) are to be prioritised for use. OSCA listed dispersants are readily available to Santos through AMOSC, OSRL and AMSA. These include Slickgone NS, Slickgone EW, Corexit EC9500A, Corexit 9527 (transitional acceptance) and Finasol 52.

If dispersant types additional to those on the Register of OSCA are required, Santos will use its Offshore Division Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) before application. Finasol OSR 52 has been pre- assessed as low risk using the Santos Offshore Division Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) and is therefore designated as acceptable for use.

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

Where sufficient data is available, the chemical is risk assessed using the Offshore Chemical Notification Scheme (OCNS) Chemical Hazard and Risk Management (CHARM) or non-CHARM models depending on the model's applicability criteria. Chemicals that meet the selection criteria belonging to CHARM Colour-band Gold or Silver, or non-CHARM groups D or E are considered environmentally acceptable. According to the OCNS CHARM model, Gold ranked chemicals have a maximum Hazard Quotient (HQ) of <1 and Silver, HQ ≥1 and <30. According to the OCNS non-CHARM model guidelines, the worst case initial OCNS grouping would be group B based on aquatic toxicity data of LC50 or EC50 > 1 to 10 ppm. To obtain a final OCNS grouping of D, the chemical would need to be readily biodegradable (>60% biodegradation in 28 days) and non-bioaccumulative (Log Pow <3 or BCF ≤100 and molecular weight ≥700). The best case initial OCNS grouping would be group E based on aquatic toxicity data of LC50/EC50 > 1,000 ppm. The best case final OCNS grouping would remain E with the chemical readily biodegradable and non-bioaccumulative.

If the chemical cannot be rated using the method described above, it would be assigned a pseudo OCNS CHARM or non-CHARM group ranking. Where there is insufficient ecotoxicity data available to either rate the chemical or assign a pseudo ranking, robust justification demonstrating its environmental acceptability shall be provided, based on volume/concentration, receiving marine environment characteristics and ecotoxicity data (aquatic toxicity, biodegradability and/or bioaccumulation data where applicable; i.e., biodegradation and bioaccumulation potential are not applicable to inorganic substances).

During a response, chemical dispersant shall be tested on the released oil at a laboratory as part of the initial oil characterisation (refer **Section 9.6**) as well as through field testing using vessel-based spray systems/ dispersant shake test kits. The DBCA ESC can also advise on the location of AMSA National Plan Dispersant Effectiveness Test Kits, which could be utilised in addition to Santos' dispersant efficacy testing resources.

8.3.6.2 Dispersant effectiveness monitoring

To assess the effectiveness of dispersant application, Santos will use the Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to determine the efficacy of subsea dispersant application. These techniques assist in characterising the nature and extent of subsea or near surface dispersed oil, aid in the validation and accuracy of plume trajectory models and allow for rapid quantification of data to enable the IMT to make decisions about continuation of dispersant application. The IMT assesses the effectiveness of continued dispersant use against an operational NEBA assessment. This capability is provided by Santos' Dispersant Operational Monitoring Provider (refer to **Appendix P**).

Subsea dispersant injection monitoring includes the following phases:

+ **Phase 1:** Confirmation of dispersant effectiveness near the discharge point and reduction in surface VOCs. This is conducted visually via ROVs and aerial imaging; and via VOC monitoring.
+ **Phase 2:** Characterisation of oil droplet size near plume and dispersed oil concentrations at depth in the water column. This is conducted using a particle size analyser close to the release site and water column monitoring (as per operational water quality monitoring (**Section 9.7**)).
+ **Phase 3:** Detailed chemical characterisation of water samples. This involves characterisation of collected water samples using accredited contract laboratories. The transfer and shipping would be handled using the logistical pathways utilised for operational water quality monitoring (**Section 9.7**).

For a Halyard-2 Drilling and Completion Project subsea LOWC, SSDI application is considered a secondary strategy (refer to **Section 5.6**) and is primarily included to potentially reduce VOC exposure to response personnel working close to the well site. It is anticipated that operations in close proximity to the well site would only occur for deployment of the capping stack. Capping stack deployment is only relevant to the situation where a semi-submersible MODU is used. If capping stack deployment is selected as a response strategy, SSDI would only be deployed for the length of time taken to deploy the capping stack to reduce VOC levels during these operations. SSDI would also only be considered where VOC levels in the vicinity of the wellsite are shown through monitoring to be unacceptable.

Prior to any application of subsea dispersants, an initial ROV survey would be conducted at the release point to determine the nature of the release. This information will inform the potential for capping stack deployment, the applicability of subsea chemical dispersion and initial choice of dispersant injection methods (e.g., number of nozzles, nozzle sizes) and DOR. In addition, as per Industry Recommended

Subsea Dispersant Monitoring Plan (API, 2020), subsea dispersant effectiveness monitoring should commence prior to the application of any dispersant, to ensure baseline data is captured.

8.3.6.3 Subsea dispersant injection logistics

If a subsea LOWC was to occur, the site would require a detailed assessment to determine the most suitable intervention methods for the incident. This may be achieved through the use of ROVs (supplied by Santos) and the Subsea First Response Toolkit (see **Section 8.3.4**), which is stationed in Fremantle and Jandakot and managed by AMOSC. The SFRT includes debris clearance equipment and subsea dispersant equipment, including a dedicated dispersant stockpile (500 m^3 of Dasic Slickgone NS) and ancillary equipment (e.g., pumps, flying leads, dispersant wands). Santos can access a suitable vessel for transportation of the subsea dispersant injection system, dispersants and ancillary equipment including ROVs through its contracted vessel providers. As indicated in **Section 8.3.4**, the SFRT vessel and equipment would be infield and commencing operations by day 12.

The volumes of dispersant required will depend on the DOR used at the injection point. It has been assumed that the well release would require a DOR of 1:100. To achieve a DOR of 1:100 that IPIECA-IOGP (2015a) recommend for a flow rate of 20,000 bbl./day, a dispersant pump rate of 22 L/min is required. Scaling this dispersant application rate to align with the maximum credible flow rate for the Halyard-2 Drilling and Completion Project subsea LOWC scenario (2,321 m^3/day or 14,596 bbl/day) results in a dispersant pump rate of 16.1 L/min (23.2 m^3/day).

The resourcing needs for SSDI have been estimated using the Santos response needs calculator. The basis of the calculation is the well flow rate, in cubic metres per day for the duration of the modelled scenario, provided by Santos in the Technical File Note (TFN). The response needs calculator input, output and assumptions for SSDI are provided in **Table 8-9**. The SSDI calculation works on a dispersant to oil ratio (DOR) of 1:100. The AMOSC SFRT will be operational by day 12 of the response.

The calculator assumes an efficacy of 90%. There will be some oil therefore left-over following treatment, which will then be subject to further weathering processes in the marine environment. Some of this oil may emerge at the sea surface and some may remain in the water column. Of the oil that emerges at the sea surface, given the properties of the Halyard condensate (**Appendix A**) surface dispersant is not considered to be a suitable response (**Section 5.6**).

The response needs calculator indicates a total SSDI use of 1,477 m^3 throughout the duration of the response (refer to **Table 8-9**) and can be met by existing national and global dispersant stockpiles (**Table 8-10**).

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Table 8-9: Response needs calculator output for SSDI for the Halyard-2 Drilling and Completion Project

Parameter	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Details/ assumptions
Well flow rate (m^3/week)	16,247	16,142	16,037	15,939	15,834	15,736	15,638	15,547	15,449	15,358	15,267	Provided by Santos (via Technical File Note).
No. operational days per week (% days utilisation)	0 (0%)	3 (43%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	7 (100%)	SSDI will be operational by day 12.
Dispersant required at 1:100 (m^3/week)	-	69	160	159	158	157	156	155	154	154	153	Dispersant to oil ratio (DOR) of 1:100 has been used. It is best to use the lowest DOR to avoid adverse water column impacts from the dispersant.
Dispersant required at 1:100 (m^3/day)	-	23	23	23	23	23	23	23	22	22	22	SSDI not applied due to mobilisation of resources. SSDI commences with AMOSC SFRT system on day 12.
Dispersant applied (m^3/week)	-	69	160	159	158	157	156	155	154	154	153	This is the dispersant actually applied given the ~158 m^3/day delivery rate limit of the SFRT. SSDI not applied due to mobilisation of resources. SSDI commences on day 12 with AMSOC SFRT system.
Dispersant applied (m^3/day)	-	23	23	23	23	23	23	23	22	22	22	
Total dispersant stocks required (m^3)	**1,477**											Total dispersant stocks required based on the dispersant applied.

8.3.6.4 Dispersant supply

Supply stocks sufficient to cover dispersant requirements for the duration of the LOWC are presented in **Table 8-10**.

Santos has a detailed dispersant supply and logistics plan that ensures dispersant requirements can be met for the duration of the worst case LOWC scenario. Dispersant stockpiles are made available via AMOSC membership or AMSA agreement with most supplies within Australia being available within 48 to 55 hours. Santos can supply all required road logistics to meet these timeframes through its contracted logistics provider. Santos can also provide air logistics for all other stockpiles throughout Australia and internationally.

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

Table 8-10: Dispersant supply stock locations and volumes

Source	Stock location	Volume (m^3)	Type	Total volume (m^3)
AMSA (AMSA, 2021c)	Adelaide	10	Slick Gone EW	355
		10	Slick Gone NS	
	Brisbane	10	Slick Gone EW	
		10	Slick Gone NS	
	Townsville	10	Slick Gone EW	
		15	Slick Gone NS	
	Karratha	10	Slick Gone EW	
		10	Slick Gone NS	
	Darwin	10	Slick Gone EW	
		10	Slick Gone NS	
	Devonport	10	Slick Gone EW	
		10	Slick Gone NS	
	Fremantle	48	Slick Gone NS	
		52	Slick Gone EW	
	Horne Island	10	Slick Gone NS	
	Melbourne	10	Slick Gone EW	
		10	Slick Gone NS	
	Sydney	45	Slick Gone NS	
		55	Slick Gone EW	

Source	Stock location	Volume (m^3)	Type	Total volume (m^3)
AMOSC	Exmouth	75	Slick Gone NS	761
	Fremantle	8	Slick Gone NS	
		27	Corexit 9500	
		500 (SFRT* stockpile 50%)	Slick Gone NS	
	Geelong	75	Slick Gone NS	
		62	Corexit 9500	
	Broome	14	ARDROX 6120	
OSRL (Santos has access up to 50% of SLA stockpile)	Various (Singapore, UK, Bahrain, USA)	50% of SLA = 337†	Slick Gone NS Slick Gone EW Slickgone LTSW Finasol OSR 52 Corexit 9500	337
Total				**1,203 (surface)** **1,453 (subsea)**
OSRL Global Dispersant Stockpile (GDS)	Various (Singapore, France, South Africa, USA, Brazil)	5,000†	Slick Gone NS Finasol OSR 52 Corexit 9500	5,000
Total (including additional OSRL GDS stocks)				**6,203 (surface)** **6,453 (subsea)**

* As per the AMOSPlan, there is a provision made by the SFRT Steering Committee to provide up to 250m³ of dispersant into a surface spill response, given certain provisions are met in the first instance by AMOSC (AMOSC, 2021).

† Latest numbers as of September 2023. The SLA Equipment Stockpile Status Report and the Global Dispersant Stockpile Status Report (available from the Response Readiness Dashboard) provides the current status of the SLA dispersant stocks.

8.3.7 Implementation guidance - subsea first response toolkit, capping stack and subsea dispersant injection

Relief well drilling is the primary source control strategy to control a LOWC (subsea and surface). The installation of a subsea capping stack, use of the SFRT and SSDI are considered as secondary strategies for a subsea LOWC associated with the Halyard-2 Drilling and Completion Project.

The Source Control Planning and Response Guideline (DR-00-OZ-20001) outlines the overarching process for planning and mobilising personnel and equipment into the field for all source control methods.

A high-level summary of implementation actions for use of the SFRT, capping stack, and SSDI is provided in **Table 8-11**.

Table 8-11: Implementation guidance – subsea first response toolkit, capping stack and SSDI

Action		Responsibility	Complete
Initial actions	**SFRT**		
	Activate Subsea First Response Toolkit (SFRT) equipment. Activate Oceaneering personnel for deployment.	Designated call-out authority (Incident Commander) Source Control Branch Director	❑
	Contract suitable vessel capable of deploying SFRT equipment and dispersant.	Logistics Section Chief Source Control Branch Director	❑
	Arrange road transport of SFRT equipment and dispersant from Jandakot to Dampier.	Logistics Section Chief Source Control Branch Director	❑
	Arrange equipment to be loaded on to vessel once in Dampier and authorise transit to field.	Logistics Section Chief Operations Section Chief Source Control Branch Director	❑
	Conduct initial ROV survey at the release point to determine the nature of the release, behaviour of the oil, and estimate the oil and gas flow rates.	Operations Section Chief Source Control Branch Director	❑
	Capping stack		
	Consider technical and safety constraints and assess the suitability of a capping stack for the incident.	Source Control Branch Director	❑
	Implement the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Source Control Branch Director	❑
	Notify Santos Drilling and Completions Team to assemble a Source Control Team and immediately begin preparations.	Source Control Branch Director	❑
	Notify capping stack service provider of incident for activation of personnel and equipment as per the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Source Control Branch Director	❑
	Contract suitable vessel capable of deploying capping stack via freight contractor.	Logistics Section Chief Source Control Branch Director	❑

Action		Responsibility	Complete
	SSDI		
	Confirm operational NEBA supports subsea chemical dispersant injection. Use forecast modelling and any operational monitoring results in operational NEBA. Guidance is provided as per AMSA guideline: Obtaining approval to use an oil spill control agent at sea or on a shoreline (AMSA, 2022).	Operations Section Chief Incident Commander Environment Unit Leader Planning Section Chief	❑
	If dispersant use in Commonwealth waters could impact State waters, notify DoT. The DoT SMPC requests early notification if use of dispersant in Commonwealth waters could impact State waters – refer to **Section 4.2.3.1**.	Planning Section Chief	❑
	If viable and if the Operational NEBA supports SSDI, activate Subsea First Response Toolkit (SFRT) equipment and activate Oceaneering personnel for deployment. As described in **Section 5.6**, SSDI is considered a secondary response strategy. Separate contracts in place for SFRT (AMOSC) and Oceaneering.	Designated call-out authority (Incident Commander) Source Control Branch Director	❑
	Conduct initial ROV survey at the release point to determine the nature of the release, behaviour of the oil, estimate the oil and gas flow rates and determine DOR for injection.	Operations Section Chief Source Control Branch Director	❑
	Commence dispersant subsea injection adjusting DOR based on real-time monitoring.	Operations Section Chief Source Control Branch Director	❑
	Continue operational monitoring (including operational water quality monitoring and surveillance) near the release point to help determine dispersant effectiveness. Use guidance provided in API Technical Report 1152 (API, 2013) to determine dispersant efficacy. Surveillance should have commenced prior to any dispersant being added to the release so that changes and efficacy can be determined. Once baseline data has been collated, commence injection to help determine DOR and modify accordingly.	Source Control Branch Director Operations Section Chief	❑

Action		Responsibility	Complete
	If dispersant application is shown to be effective and approved by the Incident Commander, continue operations.	Source Control Branch Director Operations Section Chief Incident Commander	❑
Ongoing actions	**SFRT**		
	Arrange equipment to be loaded on to vessel once in Dampier and authorise transit to field.	Logistics Section Chief Operations Section Chief Source Control Branch Director	❑
	Deploy equipment and personnel to site to begin SFRT operations.	Source Control Branch Director	❑
	Capping stack		
	Take into consideration any feedback from ROV surveys in response planning.	Source Control Branch Director	❑
	Deploy equipment and personnel to site to begin capping process.	Source Control Branch Director Environment Unit Leader	❑
	SSDI		
	Reassess dispersant use, utilising the NEBA process for each operational period. Cease application if no net environmental benefit. Continue to use forecast modelling, operational monitoring data and dispersant efficacy results in operational NEBA.	Source Control Branch Director Operations Section Chief Incident Commander Planning Section Chief Environment Unit Leader	❑

Table 8-12: Subsea dispersant injection – first strike response timeline

Task	Time from IMT call-out
IMT Source Control Team activated	<24 hours
Suitable SFRT-dispersant injection vessel/s mobilised to Dampier	<9 days
Oceaneering to mobilise personnel to Dampier	<9 days
AMOSC to mobilise SFRT and dedicated dispersant to Dampier	<7 days
Load equipment, steam to site and commence SSDI	<12 days
Minimum Resource Requirements	
+ Suitable vessel and crew + SFRT + Dispersant (with SFRT) + Oceaneering personnel	

8.4 Pipeline release

Credible pipeline release events during VI Hub operations are:

+ Condensate/gas release from production pipelines; and
+ 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 environmental performance outcome, initiation and termination criteria and the implementation guide for pipeline releases are provided in **Table 8-13** and **Table 8-14** respectively.

Table 8-13: Pipeline Release - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment.				
Initiation criteria	Notification of a spill.				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	X	✔	✔	X	X
Termination criterion	The hydrocarbon release to the environment has stopped.				

Table 8-14: 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 (SO-00-ZF-00044) to activate riser / pipeline emergency shut down (ESD).		On-Scene Commander	❑
	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.	

Pipeline Release		
Activation time	Immediately upon receiving notification of incident/ spill.	
	Vessels	Santos operational sites Vessels of opportunity
Personnel	Santos Facility Incident Response Team members	Santos 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.	

8.4.1 Initial Response

The Varanus Hub Incident Response Plan (SO-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).

8.4.2 Identification and Repair

Where and when safe to do so, an inspection class ROV and support vessel, will be mobilised to visually identify any subsea incident location.

Santos has access to spare pipes and mechanical connectors/clamps as per below:

+ Spare pipes (at Exmouth Supply Base)
+ Mechanical connectors (at Forrestfield Supply Base): sizes 12” (SGL and Linda), 14” (East Spar), 16” (SGL and Reindeer) and 18” (John Brookes)
+ Clamps (at Forrestfield Supply Base): sizes 6” and 8” (8” HB Production line and 6”/8” HB Gas Lift Line)
+ Mechanical connectors and clamps for 8” HB Production line and 6”/8” HB Gas Lift Line (through the Response to Underwater Pipeline Emergencies (RUPE) group)

8.5 Crude oil cargo loading

A spill of crude oil from the rigid 30” / 16” flexible Tanker Oil Load Out lines or the connected 12” hose (Tanker Loading Hose) is considered credible during offtake tanker cargo loading.

A release could occur onshore or offshore within State waters only.

The environmental performance outcome, initiation and termination criteria and the implementation guide for crude oil cargo releases are provided in **Table 8-15** and **Table 8-16** respectively.

Table 8-15: Crude Oil Cargo Loading Spill - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine environment.				
Initiation criteria	Notification of a spill.				
Applicable hydrocarbons	**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 8-16: 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 (SO-00-ZF-00044)		On-scene Commander	❑
Initial Actions	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 ERT	Varanus Island	
Documentation		Start-up and Shutdown of Suck Back Pump (VI-91-IP-10197) Varanus Hub Incident Response Plan (SO-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 (SO-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 (SO-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 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 8-17** and **Table 8-18** respectively.

Table 8-17: Onshore Hydrocarbon Spills - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons to the terrestrial environment.				
Initiation criteria	Notification of an onshore spill				
Applicable hydrocarbons	**Lube oil/ hydraulic fluids**	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔	✔
Termination criterion	The hydrocarbons in the leaking or ruptured pipeline/tank/vessel is secured and release to the onshore (terrestrial) environment is stopped.				

Table 8-18: 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 (SO-91-IQ-00098).	Storage tanks and containers for fuel and chemicals are within impermeable bunded areas or self-bunded with secondary containment	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.	Closing/opening valves as per procedure Use of dry-break couplings as per procedure Full supervised operations Notifying of leak/spill through radio communications. Stopping pumping transfer	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	☐

Onshore Hydrocarbon Spill				
Activation time		Immediately upon receiving notification of incident/ spill.		
	Varanus Hub Incident Response Plan (SO-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.	Manual ESD is by way of push button in the VI Control Building Central Control Room or initiated manually by Manual Alarm Call Points located on main access ways throughout the plant	On-scene Commander	❑
Resources			**Location**	
Equipment		Spill kits containing sorbent materials and the use of secondary containment (equipment bunding, drip trays etc).	At Facility	
Personnel		Incident Response Team	VI Hub	
Document		Refuelling and Chemical Transfer Management Standard (SO-91-IQ-00098). Varanus Island Diesel Distribution System Operating Procedure (VI-91-IP-10200) Varanus Hub Incident Response Plan (SO-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 8-19 indicates the Environmental performance outcomes, controls and performance standards for the Source Control response strategy for relief well drilling, BOP activation and vessel collision associated with VI Operations, Spartan Development drilling and onshore releases associated with VI operations.

Table 8-20 indicates the Environmental performance outcomes, controls and performance standards for the Source Control response strategy of relief well drilling, BOP activation, SFRT, capping stack, SSDI response strategy and vessel collision for Halyard-2 Drilling and Completion Project drilling.

Table 8-19: Environmental performance – source control for VI Operations and Spartan Development drilling (aligned with Appendix B – Table B-6)

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine/onshore environment.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Response Preparedness			
Source control – BOP Activation	BOP Unit	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment, and then at regular intervals throughout the drilling programme.	BOP pressure and function tests recorded in Daily Drilling Report. Pressure tests charted.
Source control – relief well drilling	Source Control Planning and Response Guideline (DR-00-OZ-20001)	The Source Control Planning and Response Guideline (DR-00-OZ-20001) is in place and up to date during the activity	Source Control Planning and Response Guideline (DR-00-OZ-20001)
	MODU Capability Register	MODU Capability Register is maintained during the activity through monthly monitoring	Relief Well Rig Capability Register
	Well specific Source Control Plan developed prior to drilling.	Source control plan will identify suitable rig availability for relief well drilling.	Well specific Source Control Plan
	Contract and Equipment Access Agreement with WWC	Contract and Equipment Access Agreement with WWC are maintained providing technical support and equipment	Contract with WWC
	Suitable relief well MODU confirmed to be available prior to drilling	Activity will not proceed if there is not a least one relief well MODU option that could execute a relief well within the timeframes committed to in **Table 8-6**.	Relief Well Rig Capability Register Well specific Source Control Plan
	Regular monitoring of Relief Well MODU Capability Register to ensure preferred MODU remains available throughout the activity	If the preferred MODU becomes unavailable during the activity, Santos will update the SCP to identify a suitable alternative MODU	Relief Well Rig Capability Register Well specific Source Control Plan
	Arrangements for source control emergency response personnel	Arrangements for access to source control personnel are maintained during the activity	Contract/ Memorandums of Understanding for source control personnel
	Pre-Purchase relief well supplies	Long lead equipment for a relief well drilling will be pre purchased as part of the WOMP commitments for each well drilled.	Well-specific source control plan

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 - vessel collision	Vessel Spill Response Plan (SOPEP/SMPEP)	Support vessels have a SOPEP or shipboard marine pollution emergency plan (SMPEP) that outlines steps taken to combat spills	Audit records. Inspection records
		Spill exercises on support vessels are conducted as per the vessels SOPEP or SMPEP	Spill exercise close-out reports
Response Implementation			
Source control – BOP Activation	BOP installed in accordance with API Standard 53	BOP is activated manually in accordance with MODU Operator's Emergency Response Plan	Incident Log
Source control – relief well drilling	Source Control Branch	Source Control Branch mobilised within 24 hours of the well release	Incident Log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within five days of the well release	Incident Log
	Well Control Specialists	Well control specialists mobilised within 72 hours of the well release	Incident Log
	Relief Well MODU	MODU for relief well drilling to be onsite by Day 33 from the start of a well release.	Incident Log
	Relief Well	Relief well completed within 77 days of well leak incident	Incident Log
	Source Control Planning and Response Guideline (DR-00-OZ-20001)	Relief well drilling implemented in accordance with the Source Control Planning and Response Guideline (DR-00-OZ-20001) during a well release	Incident Log
Source control - vessel collision	As per the vessel SOPEP	Actions to control spill associated with a vessel incident followed in accordance with SOPEP	Vessel logs
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

Table 8-20: Environmental performance – source control and SSDI for Halyard-2 Drilling and Completion Project (aligned with Appendix B, Table B-5)

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine/onshore environment.		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Response Preparedness			
Source control – BOP Activation (subsea BOP)	BOP Unit	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment, and then at regular intervals throughout the drilling programme.	BOP pressure and function tests recorded in Daily Drilling Report. Pressure tests charted.
		BOP battery and accumulators function tested prior to deployment.	BOP battery and accumulators function test records
	EDS	EDS function tested prior to deployment.	EDS function test records
	ROV hot stab capability	Access to ROV capability for BOP hot-stab intervention maintained with MODU ROV contractor throughout the plug and abandonment activity.	ROV contractual arrangements.
Source control – relief well drilling	Source Control Planning and Response Guideline (DR-00-OZ-20001)	The Source Control Planning and Response Guideline (DR-00-OZ-20001) is in place and up to date during the activity	Source Control Planning and Response Guideline (DR-00-OZ-20001)
	MODU Capability Register	MODU Capability Register is maintained during the activity through monthly monitoring	Relief Well Rig Capability Register
	Well specific Source Control Plan developed prior to drilling.	Source control plan will identify suitable rig availability for relief well drilling.	Well specific Source Control Plan
	Contract and Equipment Access Agreement with WWC	Contract and Equipment Access Agreement with WWC are maintained providing technical support and equipment	Contract with WWC
	Suitable relief well MODU confirmed to be technically suitable prior to drilling	Activity will not proceed if there is not a least one relief well MODU option than could execute a relief well within the timeframes committed to in **Table 8-6**.	Relief Well Rig Capability Register Well specific Source Control Plan
	Regular monitoring of Relief Well MODU Capability Register to ensure preferred MODU remains available throughout the activity	If the preferred MODU becomes unavailable during the activity, Santos will update the SCP to identify a suitably alternative MODU	Relief Well Rig Capability Register Well specific Source Control Plan

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**
	Arrangements for source control emergency response personnel	Arrangements for access to source control personnel are maintained during the activity	Contract/ Memorandums of Understanding for source control personnel
	Pre-Purchase relief well supplies	Long lead equipment for a relief well drilling will be pre purchased as part of the WOMP commitments for each well drilled.	WOMP
Source control - vessel collision	Vessel Spill Response Plan (SOPEP/SMPEP)	Support vessels have a SOPEP or shipboard marine pollution emergency plan (SMPEP) that outlines steps taken to combat spills	Audit records. Inspection records
		Spill exercises on support vessels are conducted as per the vessels SOPEP or SMPEP	Spill exercise close-out reports
Source control_ SFRT	Arrangements to enable access to SFRT equipment and personnel	Maintenance of access to SFRT equipment and personnel	AMOSC SFRT participating member
			OTA Agreement with Oceaneering
	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
Source control – capping stack	Arrangements to enable access to capping stack and trained personnel	Maintenance of access to capping stack and personnel	Contract with capping stack service provider
	Arrangements in place to monitor availability of vessels capable of transporting capping stack	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Suitable capping stack deployment vessel is confirmed to be available prior to drilling	Verify suitable capping stack deployment vessel is available as part of DCMP pre-spud Assurance Review	Shipbroker reports Well-specific Source Control Plan DCMP pre-spud Assurance Review
	Monthly monitoring of shipbroker reports to ensure suitable capping stack deployment vessel is available throughout the activity	If a suitable capping stack deployment vessel becomes unavailable, Santos will commence work to identify a suitable alternative vessel	Shipbroker reports

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**
	Arrangements to enable timely mobilisation of capping stack	capping stack mobilised to site and ready to commence deployment by day 15	capping stack mobilisation schedule (**Table 8-8**)
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
Source control - SSDI	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Maintenance of access to dispersant, equipment and personnel through AMOSC, AMSA and OSRL throughout activity	Access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			AMOSC SFRT Participant
			OTA Agreement with Oceaneering
			OSRL Associate Member Contract and Global Dispersant Supply Supplementary Agreement
	Maintenance of MSAs with multiple vessel providers	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
Response Implementation			
Source control – BOP Activation (subsea BOP)	BOP installed in accordance with API Standard 53	BOP is activated manually in accordance with MODU Operator's Emergency Response Plan	Incident Log
Source control – relief well drilling	Source Control Branch	Source Control Branch mobilised within 24 hours of the well release	Incident Log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within five days of the well release	Incident Log
	Well Control Specialists	Well control specialists mobilised within 72 hours of the well release	Incident Log
	Relief Well MODU	MODU for relief well drilling to be onsite by Day 33 from the start of a well release.	Incident Log
	Relief Well	Relief well completed within 77 days of well leak incident	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 Planning and Response Guideline (DR-00-OZ-20001)	Relief well drilling implemented in accordance with the Source Control Planning and Response Guideline (DR-00-OZ-20001) during a well release	Incident Log
Source control - vessel collision	As per the vessel SOPEP	Actions to control spill associated with a vessel incident followed in accordance with SOPEP	Vessel logs
Source control – SFRT	Access to capping stack and suitable vessel	capping stack to be onsite and ready to commence deployment by day 15 from the start of the release	Incident Log
	Access to trained personnel for the deployment and operation of the capping stack and well intervention equipment	capping stack trained personnel mobilised to site within 15 days	Incident Log
Source control-SSDI	Mobilisation of SFRT and dedicated dispersant resource requirements for subsea dispersant application	SFRT and dedicated dispersant stockpile mobilised to site within 12 days	
	Chemical Dispersant Application Plan	Only chemical dispersants that are listed as approved on the National Plan Oil Spill Control Agent (OSCA) list or evaluated as acceptable as per the Santos Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) are to be used	Incident Log
		If dispersant application is approved by the Incident Commander, request OSRL to initiate dispersant manufacture in week 1 to ensure a build-up of supply	Incident Log
		Analysis of dispersant amenability provided to IMT within 24 hours of oil delivery to Laboratory	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**
		If dispersant application is approved by the Incident Commander for subsea injection, ROV monitoring of the site will commence to help determine injection method/s	Incident Log IAP
		Prepare operational NEBA to determine if chemical dispersant application is likely to result in a net environmental benefit. NEBA will consider: + forecast spill modelling of oil comparing simulations with and without effect of chemical dispersants + laboratory dispersant efficacy testing results + operational monitoring results (surveillance and shoreline assessment) showing distribution of floating, stranded oil and location of sensitive fauna and habitats + operational water quality monitoring results showing distribution and concentration of subsea oil (once available) + scientific monitoring water sampling results (SMP1) (once available) + consultation with DoT	Incident Log IAP
		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

9 Monitor and Evaluate Plan (Operational Monitoring)

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

+ vessel surveillance;
+ aerial surveillance;
+ tracking buoys;
+ oil spill trajectory modelling;
+ satellite imagery;
+ initial oil characterisation;
+ operational water quality monitoring; and
+ shoreline clean-up assessment.

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.**

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

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making.			
Initiation criteria	Notification of Level 2/3 spills – may be deployed for a Level 1 incident (to be determined by OSC			
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 and a surface sheen is no longer observable, OR NEBA is no longer being achieved, OR Agreement is reached with Jurisdictional Authorities to terminate the response.			

9.1.1 Implementation guidance

Table 9-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 9-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial vessel surveillance operations are listed in **Table 9-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-2: Vessel Surveillance Implementation Guide

Action		Consideration	Responsibility	Complete
Initial Actions	Notify nearest available Support Vessel to commence surveillance.	Current Santos on hire vessels or Vessels of Opportunity (VOO) can be used. Automatic Identification System (AIS) vessel tracking is available through ER intranet page. Activate VI Rapid Assessment Teams (RAT) and support vessels in accordance with the Varanus Island First Strike Response Plan.	On-Scene Commander Operations Section Chief	❑
	Source additional contracted vessels if required for assistance.	Refer to Santos Vessels for Oil Spill Response (7110-650-ERP-0001) for the process for vessel monitoring and guidance on vessel types.	Logistics Section Chief	❑
	Record surface slick location and extent, weather conditions, and marine fauna. Complete vessel surveillance forms, located in **Appendix E** and provide to On-Scene Commander (Level 1 spills) or IMT (Level 2-3 spills).	Photographic images are to be taken where possible and included with surveillance forms. Trained observers will not be available immediately – photos and locations will provide initial information that can be interpreted by IMT.	Vessel Observers	❑
	Relay surveillance information (spill location, weather conditions, marine fauna sightings and visual appearance of the slick to the IMT within 60 minutes of completing vessel surveillance.	Initial reports to the IMT may be verbal (followed by written transmission) if the vessel is out of range or has no facilities for transmitting forms.	Vessel Master and/or On-Scene Commander	❑
Ongoing Actions	Review surveillance information to validate spill fate and trajectory.	-	Planning Section Chief/ GIS	❑
	Use available data to conduct operational NEBA and confirm that pre-identified response options are appropriate.	-	Environment Unit Leader	❑
	Use monitor and evaluate data to periodically reassess the spill and modify the response (through the IAP), as required	Surveillance data is useful in updating the Common Operating Picture	Planning Section Chief	❑

Table 9-3: Vessel Surveillance resource capability

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

Table 9-4: Vessel surveillance – first strike response timeline

Task		Time from IMT call-out
IMT begins sourcing Santos-contracted vessel or VOO for on-water surveillance		<90 minutes
VOO onsite for surveillance		<12 hours (daylight dependent)
Minimum Resource Requirements		
One vessel. No specific vessel or crew requirements.		
Approximate Steam Time		
Deployment Location	Approximate Distance to Operational Area[20] (nautical miles)	Approx. steam time[21] (hours)
Port Hedland	180	18
Exmouth	95	9.5
Dampier/Karratha	84	8.5
Varanus Island	19	2

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.

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 9-5** to **Table 9-7** and respectively.

Table 9-5: Aerial Surveillance – Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.			
Initiation criteria	Notification of a Level 2/3 spill			
Applicable hydrocarbons	**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 As directed by the relevant Control Agency			

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

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

Table 9-6: Implementation guidance – aerial surveillance

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

Action		Consideration	Responsibility	Complete
	Source available Santos Aerial Observers, arrange accommodation/logistics and deploy to Forward Operations/Air base location.	Santos Aerial Observer list available from First Strike Resources on Santos Offshore ER Intranet page.	Operations Section Chief Logistics Section Chief	❑
	Develop flight plan (frequency and flight path) to meet IMT expectations and considering other aviation ops. Expected that two overpasses per day of the spill area are completed.	Flight plan to confirm with OSC that aircraft are permitted in the vicinity of the spill. Flights are only to occur during daylight and in weather conditions that do not pose significant safety risks.	Operations Section Chief / Aviation Superintendent	❑
	Pre-flight briefing.	-	Aerial Observers Contracted aircraft provider/ pilots	❑
	Aerial Observers to commence surveillance	Consider procedure for interacting with marine fauna.	Operations Section Chief	❑
	Determine the spill extent by completing Aerial Surveillance Log (**Appendix G**) and Aerial Surveillance Surface Slick Monitoring Template. Calculate volume of oil. Take still and/or video images of the slick.	Thickness estimates are to be based on the Bonn Agreement Oil Appearance Code (BAOAC) (**Appendix F**).	Aerial Observer	❑
	Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (**Appendix H**).	-	Aerial Observer	❑
	Record shoreline habitat type and degree of oiling by completing the Shoreline Aerial Reconnaissance Log (**Appendix I**).	Thickness estimates are to be based on the BAOAC (**Appendix F**).	Aerial Observer	❑
	Relay all surveillance records: logs, forms, photographic images, video footage to the IMT	Where possible, a verbal report via radio/telephone en route providing relevant information should be considered if the aircraft has long transits from the spill location to base	Aerial Observer Planning Section Chief Operations Section Chief	❑

Action		Consideration	Responsibility	Complete
Ongoing Actions	Update flight schedule for ongoing aerial surveillance as part of broader Aviation Subplan of IAP	Frequency of flights should consider information needs of IMT to help maintain the Common Operating Picture and determine ongoing response operations	Operations Section Chief/ Aviation Superintendent Planning Section Chief	❑
	Mobilise additional aircraft and trained observers to the spill location to undertake ongoing surveillance activities	-	Logistics Section Chief	❑
	Update common operating picture with surveillance information and provide updates to spill trajectory modelling provider	-	Planning Section Chief GIS Team Leader	❑

Table 9-7: Aerial surveillance resource capability

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

Table 9-8: Aerial surveillance – first strike response timeline

Task		Time from IMT call-out
Santos helicopter activated for aerial surveillance		<3 hours
Helicopter onsite for aerial surveillance		<6 hours (daylight dependent)
Trained Aerial Observers mobilised to airbase		<24 hours
Minimum Resource Requirements		
Santos contracted helicopter and pilots Santos trained Aerial Observers		
Approximate Flight Time		
Nearest Airport	Approximate Distance[22] (NM)	Approximate flight time[23] (hours:minutes)
Port Hedland	180	1:30
Karratha	84	0:45
Learmonth	95	0:50

9.3 Tracking Buoys

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

Table 9-9: Oil spill trajectory modelling – environmental performance outcome, initiation criteria and termination criteria

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

9.3.1 Implementation guidance

Table 9-10 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

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

[23] At average flight speed of 120 knots/hr

Table 9-11 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-10: Implementation guidance – tracking buoys

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

Action		Consideration	Responsibility	Complete
	Monitor movement of tracking buoys.	-	Planning Section Chief/GIS	❑
	Relay information to spill trajectory modelling supplier for calibration of trajectory modelling.	-	Planning Section Chief/GIS	❑

Table 9-11: Tracking buoys resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Tracking buoys x 12	Santos	2	MODU	MODU buoys – <2 hours for incident (Spartan Development and Halyard-2 Drilling and Completion Project)
		2	Exmouth	Exmouth buoys – 24 to 48 hours pending vessel availability
		4	Varanus Island	VI/Dampier buoys – <12 hours pending vessel availability
		4	Dampier	Additional buoys available from Dampier if required
AMOSC tracking buoys	AMOSC	4	Fremantle	Response via duty officer within 15 minutes of first call- AMOSC personnel available within 1 hour of initial activation call. Equipment logistics varies according to stockpile location (refer to **Table 9-12**).
		4	Geelong	

Table 9-12: Australian Marine Oil Spill Centre equipment mobilisation timeframes

	Perth	Darwin	Exmouth	Dampier	Broome
Geelong	40 hrs / 3,395 km	44 hrs / 3730 km	64 hrs / 4,520 km	70 hrs / 4,840 km	68 hrs / 4,970 km
Perth	NA	48 hrs / 4,040 km	15 hrs / 1,250 km	19 hrs / 1,530 km	27 hrs / 2,240 km
Exmouth	15 hrs / 1,250 km	38 hrs / 3,170 km	NA	7 hrs / 555 km	16 hrs / 1,370 km
Broome	27 hrs / 2,240 km	22 hrs / 1,870 km	16 hrs / 1,370 km	11 hrs / 855 km	NA

Table 9-13: Tracking buoy – first strike response timeline

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

9.4 Oil spill trajectory modelling

Table 9-14 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 9-14: Oil spill trajectory modelling – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making			
Initiation criteria	Notification of a Level 2 or 3 spill			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**MDO**	**HFO**
	✔	✔	✔	✔
Termination criteria	+ Spill fate modelling will continue for 24 hours after the source is under control and a surface sheen is no longer observable, or until no longer beneficial to predict spill trajectory and concentrations, OR + As directed by the relevant Control Agency			

Oil spill trajectory modelling uses computer modelling (e.g. OILMAP, SIMAP) to estimate the movement, fate and weathering potential of spills. Santos has engaged RPS Group to provide forecast spill fate modelling. RPS Group use SIMAP and OILMAP modelling systems that comply with Australian Standards (ASTM Standard F2067-22 "Standard Practice for Development and Use of Oil Spill Trajectory Models"). RPS Group also provide the capacity for forecast air quality monitoring to enable an assessment of potential health and safety risks associated with VOCs released from a surface slick.

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

9.4.1 Implementation Guidance

Table 9-15 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 9-16** provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned. **Table 9-41** lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-15: Implementation guidance – oil spill trajectory modelling

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

Action		Consideration	Responsibility	Complete
Ongoing Actions	Request spill trajectory modelling be provided daily throughout the duration of the response and integrate data into Common Operating Picture.	-	Planning Section Chief/ GIS	❑
	Use results from other monitor and evaluate activities, and/or data derived from hydrocarbon assays of the source hydrocarbon or from other reservoirs in the region (that may be available) as input data (if or when available) to improve model accuracy.	-	Planning Section Chief/ GIS	❑

Table 9-16: Oil spill trajectory modelling resource capability

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

Table 9-17: Oil spill trajectory modelling – first strike response timeline

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

9.5 Satellite Imagery

Table 9-18 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 9-18: Satellite imagery – environmental performance outcome, initiation criteria and termination criteria

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

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

Suitable imagery may be available via satellite imagery suppliers. This can be done through existing AMOSC and OSRL contracts. The most appropriate images for purchase will be based on the extent and location of the oil spill. Synthetic aperture radar and visible imagery may both be of value. Availability of satellite images for a specific location will be dependent on several factors including satellite current position, satellite availability/tasking, and weather conditions (cloud cover obscures images).

9.5.1 Implementation guidance

Table 9-19 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 9-20** provides a list of resources that may be used to implement this strategy. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned. **Table 9-41** lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-19: Satellite imagery implementation guide

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

Table 9-20: Satellite imagery resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Satellite Imagery	KSAT – activated through AMOSC MDA – activated through OSRL	Dependent upon overpass frequency (TBC on activation)	Digital	If satellite images are required, Santos to notify provider within 12 hours

9.6 Initial Oil Characterisation

Table 9-21 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 9-21: Initial oil characterisation - environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making			
Initiation criteria	Notification of a Level 2 or 3 spill			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**MDO**	**HFO**
	✔	✔	✔	✔

Termination criteria	+ Oil sample and analysis to terminate once enough data has been collected to profile the oil characteristics throughout weathering and to provide oil for toxicity testing, OR + As directed by the relevant Control Agency

9.6.1 Overview

Given MDO and HFO are common fuel types with known properties and the VI Hub hydrocarbons 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.

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

9.6.2 Implementation guidance

Table 9-22 provides guidance to the IMT on the actions and responsibilities for this strategy. **Table 9-23** provides a list of resources that may be used to implement this tactic. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-22: Implementation guidance – initial oil characterisation

Action		Consideration	Responsibility	Complete
Initial Actions	Source available vessels (on hire or VOO) for oil sampling.	Can be multi-tasked – e.g. for vessel surveillance or tracking buoy deployment. Activate VI Rapid Assessment Teams (RAT) and support vessels in accordance with the Varanus Island First Strike Response Plan.	Operations Section Chief Logistics Section Chief	❑
	Source sampling equipment. Confirm sampling methodology. Confirm laboratory for sample analysis. Develop health and safety requirements/controls.	Refer **Table 9-23** for resource availability. The Santos Oil and Water Sampling Procedures (7110-650-PRO-0008) provide the procedures for sampling.	Environment Unit Leader Safety Officer	❑
	Vessel directed to sampling location.	Sampling of oil at thickest part of slick – typically leading edge.	Operations Section Chief	❑
	Vessel crew to undertake sampling and delivery of samples to Exmouth or Dampier for dispatch to laboratory. Environment Unit Lead to confirm analysis of oil with lab.	Exmouth and/or Dampier Logistics personnel to assist with logistics of sending oil samples to laboratory for analysis.	Operations Section Chief Environment Unit Leader Logistics Section Chief	❑
Ongoing Actions	Continue sample collection post release where oil is available or until response is terminated.	Initial monitoring by crew of available vessels – Once mobilised to site Santos scientific monitoring provider to continue sampling of oil in conjunction with operational water quality monitoring.	Operations Section Chief Environment Unit Leader Logistics Section Chief	❑

Table 9-23: Initial oil characterisation – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Dispersant efficacy kits (shake test)	AMOSC/Santos	3	2 x Exmouth, 1 x Varanus Island	Within 12 hours
Oil sampling kits (full kit)	AMOSC/Santos	2	1 x Exmouth, 1 x Varanus Island	Within 12 hours
Oil sampling kits (rapid kit)	Santos	4	1 x Exmouth 2 x Varanus Island 1 x Ningaloo Vision	Within 12 hours
Bulk oil sampling bottles	Intertek/Santos	As required	Perth Exmouth, Varanus Island	Within 12 hours
Monitoring Vessel	Santos contracted vessel providers Vessels of opportunity identified through AIS vessel tracking system	Availability dependent upon Santos and Vessel Contractor activities. Locations verified through AIS vessel tracking system	Pending availability and location.	Expected within 12 hours Availability dependent upon Santos and vessel contractor activities
National Association of Testing Authorities accredited laboratory/ personnel for analysis	Intertek / ALS / ChemCentre / Leeder Analytical	N/A	Perth	24+ hours

Table 9-24: Initial oil characterisation – first strike response timeline

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

9.6.3 Oil sampling and analysis

Oil sampling kits are provided by Santos for the purposes of taking spilled oil/ oily water samples, which include procedures for untrained personnel. Initial samples will be taken by the vessel crew using the sampling kits and included procedures. Trained personnel may be deployed to the field at a later time to continue sampling as required as part of ongoing monitoring.

Sampling kits are positioned at Santos strategic locations (refer to **Table 9-23**) and will be mobilised to the required locations when needed. The kits contain all necessary equipment and sampling containers for shipping to a laboratory for analysis. Two rapid sampling kits are located at Varanus Island for deployment with Varanus Island Rapid Assessment Teams, as per the Varanus Island First Strike Response Plan.

The Santos Oil and Water Sampling Procedures (7710-650-PRO-0008) defines the sampling protocol and procedures.

Using onsite VOOs, oil samples are to be taken daily where possible from fresh oil, and from the weathered oil locations, nominally representing 24 hours old, 48 hours old and 72 hours old (as they occur) and dispatched to a laboratory for analysis.

9.6.3.1 Laboratory analysis

Laboratory analysis of the chemical and physical properties of the recovered oil, including gas chromatography/mass spectrometry for the purpose of fingerprinting the oil constituents, is to be undertaken. Fingerprinting of the released hydrocarbon potentially allows contamination to be traced back to the source where this is otherwise unclear or in dispute. The Santos Oil and Water Sampling Procedures (7710-650-PRO-0008) outlines the suite of available oil testing and fingerprinting analyses that can be performed by the preferred laboratories. Details of the testing laboratories can also be found within the document.

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

9.7 Operational Water Quality Monitoring

9.7.1 Operational Water Sampling and Analysis

Table 9-25 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 9-25: Operational water quality sampling and analysis – environmental performance outcome, initiation criteria and termination criteria

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

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

Table 9-26 presents the water quality sampling and analysis plan considerations.

This monitoring is complimentary to scientific water quality monitoring (SMP1) delivered through the Oil Spill SMP in terms of methodology and required skillset and can be provided through Santos' Scientific Monitoring Provider (**Section 17**).

9.7.1.1 Implementation guidance

Refer to **Table 9-27** for the Operational Water Quality Sampling and Analysis implementation guide. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-26: Operational Water Quality Sampling and Analysis Plan considerations

Considerations for Operational Water Quality Sampling and Analysis	
Scope of work	The work scope for operational water quality monitoring will be driven by the IMT, confirming objectives for each operational period.
Survey design	The operational water sampling activities will be conducted by experienced environmental scientists and managed through the IMT Incident Action Planning process. The exact nature of the sampling activities will depend upon the objectives for each operational period; however, the sampling design and methodology will consider the following points: + Sampling locations will be moved with the slick and/or plume based on the observed or predicted location and movement of oil on water and subsea plumes. This will be informed by vessel/aerial surveillance, satellite tracking buoys and spill fate modelling. + At each discrete location, sampling will initially be conducted using a conductivity-temperature-depth (CTD) meter along a depth profile which captures the three-dimensional distribution of the oil. The CTD would require fluorometry and dissolved oxygen sensors as part of the sensor package to record the presence of oil (fluorometry) and the activity of hydrocarbon degrading bacteria (dissolved oxygen). Fluorometers appropriate to the hydrocarbon type will need to be selected. + The CTD would help inform the depth at which water samples would be taken; and in the case of incidents where SSDI is to be used, may inform the water sampling locations for subsea dispersant efficacy monitoring (using API (2020) Technical Report 1152) methods. + Where surface oil is present in shallow water (<5 m) sampling should involve a depth profile from the seabed to surface waters + For a subsea release or where surface oil is present in deeper water (>5 m) sampling should involve a depth profile ensuring that the full gradient of oil in water concentration can be determined. + Oil and oil in water samples are to be collected using suitable pumping or sampling apparatus. For samples at depth a Niskin bottle(s) or similar device that allows remote closing and discrete sampling at depth is to be used. Alternatively, water samples can be pumped from defined depths using a hose suspended vertically using a suitable pump for water sampling (e.g. a peristaltic pump). + Samples are to be collected in clean, fully labelled glass jars, filled to the top and refrigerated/ kept cool and in darkness during storage and transport. Handling, storage and documentation requirements to be confirmed with laboratory but holding time <7 days is expected requirement. + Oil and oil in water samples will be replicated at each site to allow intra-site variability to be assessed and appropriate quality assurance and control samples incorporated into replicates. + Santos will coordinate transportation of samples from the sampling location to the laboratory. Samples will be accompanied with a completed Chain of Custody form. + Water samples also to be provided to an independent National Association of Testing Authorities-accredited laboratory in Perth for hydrocarbon suite analysis including polycyclic aromatic hydrocarbons.

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

Table 9-27: Implementation guidance – operational water quality sampling and analysis

Action		Consideration	Responsibility	Complete
Initial Actions	Activate Santos Monitoring Service Provider for Operational Water Quality Monitoring.	Refer to **Appendix P** for activation guidance.	Environment Unit Leader	❑
	Obtain spill trajectory modelling and provide to Monitoring Service Provider.	-	Environment Unit Leader Planning Section Chief GIS Support	❑
	Develop Monitoring Action Plan (Including Sampling and Analysis Plan) for operational water quality monitoring. Plan to also consider oil characterisation sampling (**Section 9.6**)– Monitoring Service Provider to take over this sampling once mobilised.	Sites to be selected using oil spill trajectory modelling and distribution of oil from surveillance tactics. Refer **Table 9-26** for considerations for Sampling and Analysis Plan.	Monitoring Service Provider Environment Unit Leader	❑
	Develop health and safety plan including potential exposure to volatile gases/VOCs.	Refer Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016).	Monitoring Service Provider Safety Officer	❑
	Monitoring Service Provider to assemble team/s and water quality monitoring equipment.	-	Monitoring Service Provider	❑
	Organise Vessels, accommodation and transport requirements to mobilise monitoring team/s to site.	Monitoring Service provider to outline requirements in resource request form.	Logistics Section Chief	❑

Action		Consideration	Responsibility	Complete
	Undertake sampling and analysis. Daily communication and confirmation of sampling plan with OSC and IMT. Daily activity/data reports provided to IMT. Oil/water samples dispatched to nominated laboratories for analysis.	-	Monitoring Service Provider On-Scene Commander Operations Section Chief Environment Unit Leader Logistics Section Chief	❑
Ongoing Actions	Monitoring results to be conveyed to IMT through Common Operating Picture and provided to spill trajectory modeller to validate predictions.	-	Planning Section Chief GIS Support Environment Unit Leader	❑

Table 9-28: Operational water quality sampling and analysis – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Water quality monitoring personnel	Monitoring Service Provider	Approx. 6 (based on capability reports)	Perth based	Personnel and equipment within 72 hours from monitoring action plan approval – pending vessel availability
Water quality sampling equipment and water quality meters	Third-party suppliers via Monitoring Service Provider	Multiple providers	Australia based	
Contracted water quality monitoring vessels	Santos Contracted Vessel Providers	Availability dependent upon Santos and Vessel Contractor activities; suitable vessels identified through AIS Vessel Tracking	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS Vessel Tracking Software	<72 hours

Table 9-29: Operational water quality sampling and analysis – first strike response timeline

Task	Time from IMT call-out
IMT activates monitoring service provider.	<4 hours
Operational water quality monitoring personnel, equipment and vessel deployed to spill site.	<72 hours from monitoring action plan approval
Minimum Resource Requirements	
+ Water quality monitoring vessel/s – refer Santos Offshore ER Intranet and Santos Offshore - Vessel Requirements for Oil Spill Response (7710-650-ERP-0001) for vessel specification, if a vessel charter is needed. + Water quality monitoring team (through monitoring service provider). + Water quality monitoring equipment (through monitoring service provider).	

9.7.2 Continuous Fluorometry Surveys

Table 9-30 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 9-30: Continuous fluorometry surveys – environmental performance outcome, initiation criteria and termination criteria

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

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

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

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

Fluorometers towed behind vessels will be used as an alternative or complementary approach for a subsea release and would be preferred for surface spills.

9.7.3 Implementation guidance

Table 9-31 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 9-32** provides a summary of resources that may be used to implement this strategy. **Table 9-33** details the minimum first strike requirements to be mobilised on activation. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-31: Continuous fluorometry surveys – implementation guidance

Action		Consideration	Responsibility	Complete
Initial Actions	Activate Monitoring Service Provider and engage to provide towed fluorometry services (personnel and equipment) as part of Operational Water Sampling and Analysis – refer **Table 9-26** for actions.	-	Monitoring Service Provider Environment Unit Leader	❑
	Activate OSRL monitoring and determine availability of subsea gliders and towed fluorometry equipment.	OSRL can provide specialist technical advice on operation of towed fluorometers. Consider: Engaging OSRL for review and input into monitoring action plan for towed fluorometry.	Incident Commander Environment Unit Leader	❑
	Determine suitability of subsea gliders for monitoring.	Sub surface gliders containing fluorometers built into the body of the glider may be used for this monitoring and would be preferential for monitoring a continuous subsea release (well leak scenario).	Environment Unit Leader	❑
	If gliders and pilot/s available and suitable for incident, engage provider to develop Monitoring Action Plan.	Arrange joint meeting with spill modelling provider and OSRL/glider operator to develop monitoring design and ongoing data transfer protocols to meet objective of model validation.	Environment Unit Leader	❑
	Source vessels and other logistics to support monitoring.	-	Logistics Section Chief Operations Section Chief	❑
	Conduct monitoring as per monitoring action plan with deployment area guided by other operational monitoring studies.	The scope of monitoring will be dictated by the response strategies being employed. Where dispersant application is being undertaken, fluorometry surveys will have to be coordinated with application activities so subsea oil distribution can be assessed before and after dispersant addition to determine effectiveness. Appendix F of CSIRO oil spill monitoring handbook (CSIRO, 2016) provides standard operating procedures using fluorometry equipment.	Operations Section Chief Planning Section Chief Environment Unit Leader	❑
Ongoing Action	Provide daily data reports and spatial outputs IMT.	-	Monitoring Provider	❑

Action		Consideration	Responsibility	Complete
	Monitoring results to be incorporated into Common Operating Picture.	-	Planning Section Chief GIS Support	❑

Table 9-32: Continuous fluorometry surveys – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Towed fluorometers	OSRL	Towed Fluorometers: seven Turner C3 fluorometers globally	4 in Southampton, 2 in Singapore and 1 in Fort Lauderdale	<72 hours
Glider mounted fluorometers	OSRL	Subsea glider: Qty subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the Glider	Gliders based in Perth OSRL towed fluorometers out of Singapore, Southampton and Fort Lauderdale	<72 hours dependent upon availability
Vertical particle size analyser – Sequoia LISST 100x	Monitoring Service Provider	1	Perth	<72 hours
Water quality monitoring personnel to operate towed fluorometers	Monitoring Service Provider	Approx. 6 (based on capability reports)	Perth based	<72 hours
Glider (remote) pilot/s and deployment crew	Third-party provider via OSRL	Subsea glider: Qty subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the glider	Perth based pilot and deployment crew	<72 hours dependent upon availability

Table 9-33: Continuous fluorometry surveys – first strike response timeline

Task	Time from IMT call-out
IMT activates OSRL and Monitoring Service Provider.	<4 hours
Monitoring Service Provider water quality monitoring personnel deployed to site.	<72 hours from monitoring action plan approval
Towed fluorometers deployed to site.	<72 hours from monitoring action plan approval
Glider and pilot/s and deployment crew deployed (if gliders available and appropriate).	<72 hours (if gliders available and appropriate) from monitoring action plan approval
Minimum Resource Requirements	
+ Water quality monitoring vessel/s – refer Santos Offshore ER Intranet and Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001) for vessel specification, if a vessel charter is needed. + Water quality monitoring team (through monitoring service provider). + OSRL towed fluorometer (Turner C3). + Particle size analyser	

9.8 Low Flow Well Leak Monitoring

Table 9-34 provides the Environmental Performance Outcome, initiation criteria and termination criteria for this activity.

Table 9-34: Low Flow Leak Monitoring - Environmental Performance Outcome, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making.			
Initiation criteria	Subsea inspection activities identify a low flow well leak.			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**MDO**	**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 clean-up assessment

Table 9-35 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 9-35: Shoreline clean-up assessment – environmental performance outcome, initiation criteria and termination criteria

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

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

Shoreline Clean-up Assessment Technique (SCAT) will be used to document the status of oiled shorelines in the event of a worst-case release and their subsequent treatment recommendations.

DoT are the designated Control Agency for shoreline response for spills within WA waters and will direct resources provided through Santos for the purposes of shoreline clean-up assessments and shoreline response activities. Santos will provide additional information on shoreline character and oiling collected as part of aerial surveillance activities carried out under its control (refer **Section 9.2**).

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

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

9.9.1 Implementation guidance

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

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

Table 9-36 presents considerations for planning and conducting the assessments. The implementation guide for Shoreline Clean-up Assessment is found in **Table 9-37**. **Table 9-38** provides a list of resources that may be used to implement this strategy and **Table 9-39** details the minimum first strike mobilisation requirements for Santos on activation. **Table 9-41** lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 9-36: Shoreline clean-up assessment considerations

Considerations for Shoreline Clean-up Assessment	
Survey design	Shoreline Clean-up Assessment requires a systematic assessment of shorelines, which is typically undertaken in a number of stages (according to the extent of the spill): + reconnaissance surveys: designed as an initial phase (or further as required, such as inaccessible shorelines) to characterise the distribution, extent, and condition of shoreline habitats; and + Continual monitoring surveys: monitors hydrocarbon spill extent at the shoreline to assess the potential impact, extent of actual impact, and the effectiveness of clean-up. A shoreline clean-up assessment may include the following tasks: + Assessment of shoreline character, habitats and fauna, including: – shoreline structured biotic habitats – distribution of fauna – shoreline and processes (e.g. wave, tidal flows – shoreline substrate (e.g. mud, sand, pebble, rock) – shoreline form (e.g. width, shape and gradient) – access/safety constraints. + Assessment of shoreline oiling (if present):

Considerations for Shoreline Clean-up Assessment	
	– surface distribution and cover – subsurface distribution – oil type, thickness, concentration and physical character – sampling of oil for laboratory analysis. + Recommendations for response: – applicable strategies based on oil type and habitat – potential access, safety and environmental constraints – likely resourcing (personnel and equipment) requirements. Ground surveys undertaken on foot, by vehicles or by small vessel will occur at prioritised areas to provide a close-range assessment of shoreline physical characteristics, coastal habitats/fauna, scale and character of oiling and safety/access constraints. Shoreline clean-up assessment team leaders will include personnel from AMOSC Core Group, State and National Response Team and OSRL, or contracted staff who have completed SCAT training. Team members may include personnel who have completed a brief training course and are supervised on the job by team leaders, particularly for deployment to locations that are not contacted in the first few weeks of the spill. The deployment of ground survey teams will be directed by DoT as the HMA and Control Agency for coastal/shoreline pollution in WA. The deployments will be informed by the observed and predicted contact of oil and from existing baseline information on shoreline character. Shoreline surveys will be undertaken within segments that are recorded and/or mapped that share common traits based on coast geomorphology, habitat type, fauna presence, level of oiling or access. Information on shoreline character and habitat/fauna distribution for each segment should be recorded through the use of: + still or video imagery collected with simultaneous GPS acquisition; + field notes together with simultaneous GPS acquisition; + mud maps outlining key natural features, oil distribution, imagery locations of quantitative data (transects, oil samples); + transects (cross-shore, longshore) and vertical sediment profiles; and + samples of oil and/or oiled sediments. The parameters that should be assessed are: + physical characteristics: rocky, sandy beach, flat, dune, other wetland; + major habitat types: mangrove, salt marsh, saltpan flats, fringing reef, rubble shore, seagrass verge; + coastal fauna and key habitats (e.g. nests) including quantification/distribution of oiled fauna; + state of erosion and deposition: deposition, erosion, stable; + human modified coastline (access tracks, facilities, etc); and + oil character, if present, including appearance, surface thickness, depth (into sediments), distribution, area and percentage cover.
Analysis and reporting	Shoreline survey reports to be submitted to the Control Agency IMT at completion of assessments. All raw data collected will be included as appendices to the report and provided in a geospatial format for subsequent use in GIS mapping software.

Table 9-37: Shoreline clean-up assessment – implementation guidance

Action		Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to WA DoT have been made.	Refer to **Section 6** for reporting requirements.	Environment Unit 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 Operational NEBA.	Existing shoreline sensitivity mapping information for potential oil contacted locations is available on the Santos ER intranet site.	Environment Unit Leader Planning Section Chief	❑
	Actions below are indicative only and are at the final determination of the Control Agency			
	Mobilise the AMOSC core group responders as required for industry support to Control Agency.	Refer to **Table 9-38**.	Incident Commander Operations Planning Section Chief Logistics Planning Section Chief	❑
	Conduct assessment of shoreline character, habitats and fauna.	Refer to **Table 9-36**. Refer to the WA DoT Shoreline Assessment Form for spills contact WA shorelines	AMOSC Core group and Control Agency	❑
	Conduct assessment of shoreline oiling (if present).	Refer to **Table 9-36.**	AMOSC Core group and Control Agency	❑
	Develop recommendations for clean-up activities and clean-up end-points and communicate recommendations and SCAT forms back to IMT at the end of each operating period.	Refer to **Table 9-36**.	AMOSC Core group and Control Agency	❑

Table 9-38: Shoreline clean-up assessment – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Shoreline assessment team leaders	Santos	12	Perth, Varanus Island	<24 hours from time of activation (WA-based, Santos personnel, AMOSC staff and Core Group personnel)
	AMOSC Core Group	As per monthly availability (84 members - industry core group)	Perth, Dampier and other Australian locations	
	AMOSC staff	12 trained in SCAT	Perth and Geelong	
	OSRL	18	Perth and international	5 personnel available from 2-3 days, remaining personnel available from 4-5 days (subject to approvals/ clearances)
Shoreline assessment team members	Santos contracted work force hire company (e.g. Dare)	As per availability (up to 2,000)	Australia-wide	Subject to availability (indicatively 72+ hours)
Drones and pilots ** To assist shoreline and vessel-based surveillance	AMOSC	1 x pilot	Geelong	<48 hours
	OSRL – Third-Party UAV provider	2 x qualified remote pilots, however response is on best endeavour	Perth	Depending on the port of departure, 1-2 days if within Australia
	Local WA hire companies	10+	Perth and regional WA	<48 hours

Table 9-39: Shoreline assessment – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction and begins sourcing personnel for shoreline clean-up assessment team.	<4 hours
AMOSC core group and drone pilots (shoreline clean-up assessment personnel) mobilised to deployment location.	<24 to 48 hours
Minimum Resource Requirements	
+ 1 x AMOSC drone pilot trained in SCAT to undertake initial reconnaissance surveys + 1 x AMOSC drone + Minimum 2 x AMOSC core group personnel to undertake initial vessel or ground surveys.	

9.9.2 Resourcing requirements

Shoreline clean-up assessment teams will comprise two to three members per team and are assumed to be able to cover 10 km per team per day. Teams may be able to exceed this distance, especially if remote sensing techniques (e.g. UAVs) are employed to cover shorelines that have access limitations, which includes many receptor locations in the EMBA.

Spill modelling results (**Section 5.4**) indicate that a spill of VI crude blend from an offtake tanker collision/grounding (**Table 5-9**) results in the greatest length of shoreline oiling above 100 g/m^2. **Table 9-40** presents the protection priorities contacted at ≥100 g/m^2 using the stochastic modelling results for the VI crude blend release from an offtake tanker in State waters, showing worst-case time to contact and worst-case maximum length of oiled shoreline, along with the SCAT planning considerations and estimated number of SCAT teams required. It should be noted that not all of the receptors listed in **Table 9-40** will be contacted by one single spill. These results are presenting the range of possible worst-case timeframes to contact and length contacted based on all runs that make up the stochastic model, and is therefore considered a conservative approach to planning resource capability. Santos will use initial operational monitoring data (e.g. trajectory modelling and aerial surveillance) to determine where resources should be allocated. This may include directing resources to conduct SCAT at locations not identified as protection priority areas, to determine if protection and clean-up activities may be required at these receptors.

Initially, shoreline clean-up assessment may be conducted via reconnaissance surveys and later confirmed via ground and/or vessel surveys. For example, **Table 9-40** shows the Lowendal Islands, Montebello Islands and Barrow Island may be contacted within hours, therefore reconnaissance surveys may be employed to provide initial assessments for these remote shorelines.

For worst-case personnel requirements, Barrow Island presents the greatest resource requirement of 18 to 27 personnel (up to 9 teams of two to three members each).

Table 9-40: Resource requirements for shoreline clean-up assessment for all locations contacted >100 g/m^2 based on stochastic results for VI crude blend release from an offtake tanker in State waters (RPS, 2019)

All receptors	Minimum time (days) to contact with receptor ≥100 g/m^2 from stochastic results	Maximum length (km) of shoreline oiling ≥ 100 g/m^2 in from stochastic results	Planning considerations	Estimated No. of teams required
Montebello Islands	0.41	69	Offshore Islands with varied access. Facilities exist at Thevenard and Barrow Islands.	6-7
Lowendal Island	0.08	11		1-2
Barrow Island	0.16	86		8-9

Note: SCAT numbers not to be added up as spill will not contact all receptors modelled. Number required will be based on direction of spill and timeframes to contact.

9.10 Monitor and Evaluate Plan Environmental Performance

Table 9-41: Environmental performance – monitor and evaluate

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**
Response preparedness			
Monitor and Evaluate – vessel and aerial surveillance	Maintenance of Master Services Agreements (MSAs) with multiple vessel providers	Santos maintains MSAs with multiple vessel providers as specified in **Table 9-3**	MSAs with multiple vessel providers
	MSA with aircraft supplier	MSA in place with helicopter provider throughout activity	MSA with aircraft suppliers
	Santos trained Aerial Observers	Santos maintains a pool of trained aerial observers	Exercise Records Training Records
	AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	Maintenance of AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	AMOSC Participating Member Contract
	Access to certified UAV providers	Maintenance of contract for access to UAV providers	List of certified UAV providers AMOSC Participating Member contract OSRL Associate Member contract
	Aircraft charter companies for fauna observations	Maintain a list of aircraft charter companies that could potentially provide fauna observation services	List of providers
Response Implementation			
Monitor and Evaluate – vessel and aerial surveillance	Vessel surveillance	Minimum first strike resource requirements mobilised in accordance with **Table 9-4**	Incident log
		Varanus Island support vessels and RAT activated in accordance with the Varanus Island First Strike Response Plan	Incident log
		Daily observation reports submitted to IMT until termination criteria is met	Incident log
	Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	Vessels comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising the risk of collision with marine fauna	Completed vessel statement of conformance

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**
		Aircraft comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising interaction with marine fauna	Aircraft contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure
	Aerial surveillance	Minimum first strike resource requirements mobilised in accordance with **Table 9-8**	Incident log
		Following initiation two passes per day of spill area by observation aircraft provided	Incident log
		Trained Aerial Observers supplied from Day 2 of response	Incident log
		Flight schedules are maintained throughout response	Incident Action Plan
		Observers completed aerial surveillance observer log following completion of flight	Aerial Observer Logs
Response Preparedness and implementation			
Monitor and Evaluate – tracking buoys	Tracking buoys available	Maintenance of 12 tracker buoys throughout the activity	Computer tracking software Tracker buoy tests
Response Implementation			
Monitor and Evaluate – tracking buoys	Tracking buoy mobilisation	Minimum requirements mobilised in accordance with **Table 9-11**	Incident log
		Varanus Island support vessels and RAT to deploy Varanus Island based tracking buoys, in accordance with the Varanus Island First Strike Response Plan	Incident log
Response Preparedness			
Monitor and Evaluate – oil spill modelling	Maintenance of contracts for emergency response modelling	Maintenance of contract for forecast spill trajectory modelling services throughout activity	Modelling services contract
		Access to additional spill modelling capability to ensure redundancy.	Membership in place with OSRL
Response Implementation			
Monitor and Evaluate – oil spill modelling	Oil spill modelling	Oil Spill Modelling provider will be contacted immediately (within two hours) upon notification of a Level 2 or 3 spill	Incident Log
		Modelling delivered to IMT within two hours of request to service provider	Incident Log
Response Preparedness			

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 – satellite imagery	Satellite imagery	Satellite imagery and analysis accessed through third party provider activated through AMOSC and/or OSRL	AMOSC Participating Member contract, OSRL Associate Member contract
Response Implementation			
Monitor and Evaluate – satellite imagery	Satellite imagery	Data incorporated into common operating picture and provided to spill modelling provider	Incident Log and Incident Action Plan
Response Preparedness			
Monitor and Evaluate – oil and oil in water monitoring	Maintenance of Monitoring Service Provider contract for water quality monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity as per **Table 9-28.**	Contract with monitoring service provider
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Entrained oil monitoring equipment and services	Maintenance of arrangements to enable access to fluorometry services throughout activity	Arrangement with provider of fluorometry equipment
	Water quality monitoring vessels	Maintenance of vessel specification for Water quality monitoring vessels	Vessel specification
	Oil sampling equipment (full kits)	Oil sampling kits pre-positioned at Exmouth and Varanus Island	Evidence of deployment to site
	Oil Sampling equipment (rapid kits)	Two rapid response oil sampling kits pre-positioned at Varanus Island	Evidence of deployment site
Response Implementation			
Monitor and Evaluate – oil and oil in water monitoring	Initial Oil Characterisation	Minimum requirements mobilised in accordance with **Table 9-24**.	Incident Log
		Varanus Island support vessels and RAT activated in accordance with the Varanus Island First Strike Response Plan	Incident log
		Oil samples sent to laboratory for initial fingerprinting	Incident Log
		Oil samples collected to be sent for laboratory ecotoxicity testing of oil	Incident Log
		90, 95 and 99% Species protection triggers levels will be derived from ecotoxicity testing results (minimum five species' tests) within 24 hours of receiving all results	Incident Log

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**
	Operational oil and oil in water monitoring	IMT activates monitoring service provider within four hours	Incident Log
		Operational water sampling and analysis surveys mobilised within 72 hours of monitoring action plan approval	Incident Log
		Fluorometry surveys mobilised within five days of initiation	Incident Log
		Daily report including fluorometry results provided to IMT	Incident Log
Response Preparedness			
Monitor and Evaluate – shoreline assessments	SCAT trained personnel are available	Maintenance of AMOSC contract to facilitate mutual aid arrangements for access to Oil Spill Responders **Table 9-38.** Maintain capability throughout activity through AMOSC Core Group, DoT State Response Team, AMSA National Response Team and OSRL	AMOSC Participating Member Contract, Access to National Plan resources through AMSA, OSRL Associate Member Contract.
The performance standards for TRP's are found in **Section 7.3**.			
Response Implementation			
Monitor and Evaluate – shoreline assessments	SCAT	SCAT trained personnel are mobilised as per the numbers and deployment schedules provided in **Table 9-39.**	Incident Log
		SCAT will be implemented under the direction of DoT as the HMA	Incident Log
		SCAT team leader positions will be filled with personnel trained in shoreline clean-up assessment techniques	Training records
		Santos will make available OSRO Responders for SCAT positions to the Control Agency	Incident Log
		If required ongoing shoreline assessment teams will be available to meet the requirements specified in **Table 9-40**.	Incident Log
		SCAT reports provided to the IMT daily detailing the assessed areas to maximise effective utilisation of resources	Incident Log
	Just-In-Time training	Training providers and personnel providers contacted during week 1 to initiate training	Incident Log
	Use of shallow draft vessels for shoreline and nearshore operations	Shallow draft vessels are used for shoreline and nearshore operations unless directed otherwise by the designated Control Agency (i.e., DoT)	Vessel specification documentation contained in IAP.

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

10 Mechanical Dispersion Plan

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

Table 10-1: Mechanical dispersion – environmental performance outcome, initiation criteria and termination criteria

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

10.1 Overview

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

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

10.2 Implementation Guidance

Table 10-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-3 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or reassigned.

Table 10-2: Implementation guidance – mechanical dispersion

Action		Consideration	Responsibility	Complete
Initial Actions	The Operational NEBA will confirm the suitability and environmental benefit of conducting mechanical dispersion at appropriate locations.	Water depth and sea state Possible impacts to sensitive shorelines and/or wildlife This activity is to be conducted during daylight hours only and requires a safety plan to be developed prior to implementation.	Operations Section Chief Environment Unit Leader Planning Section Chief	❑
	Safety Officer to develop a safety plan for the activity with respect to potentially dangerous gasses and VOCs (including applicable controls).	-	Operations Section Chief Safety Officer	❑
	Notify vessel-based responders to trial mechanical dispersion.	-	Operations Section Chief	❑
	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 Section Chief for inclusion in Operational NEBA.	-	Vessel Master/s Santos AMOSC Core Group Responders	❑

Table 10-3: Mechanical dispersion resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Vessels undertaking other activities Vessel(s) can be specifically contracted for the strategy if required (refer to Santos Vessel Requirements for Oil Spill Response document [7710-650-ERP-0001])	Santos contracted vessel providers	Availability dependent upon Santos and Vessel Contractor activities	Vessels mobilised from Exmouth, Dampier, and NW locations. Locations verified through AIS Vessel Tracking Software.	Varies subject to location/ availability

10.3 Environmental Performance

Table 10-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 10-4: Environmental performance – mechanical dispersion

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

11 Offshore Containment and Recovery Plan

This strategy is considered applicable for VI crude blend and 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 as a Supporting Agency will provide first strike response and then all necessary resources (equipment and personnel) to support DoT. **Table 11-1** provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

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

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

11.1 Overview

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

Table 11-2 provides applicability criteria on when containment and recovery may be a suitable response option.

Table 11-2 Containment and recovery application criteria

Criteria	Recommended	Not Recommended
Spill characteristics	+ Patchy slick + Extended operations + Surface concentrations >50 g/m² (BAOAC of 4) at a minimum, 100 g/m² (BAOAC of 5) is optimal	+ Situation dependent + Surface thickness <50 g/m² (BOAC <4)
Hydrocarbon type	+ Group 3 hydrocarbons and above + Persistent components of Group 1 and 2 hydrocarbons may be suitable	+ Minor to moderate spills of Group 1 and 2 hydrocarbons are likely to weather rapidly. High volatiles of these hydrocarbons may be a safety risk to personnel

Criteria	Recommended	Not Recommended
Operating environment	+ Waves <1 m for nearshore containment and recovery systems (Santos Containment and Recovery Boom) + Waves <1.8 m for offshore systems + Winds <20 knots	+ Wave heights exceed 1.8 m + Current >0.75 knots

11.2 Implementation Guidance

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

Table 11-3: Implementation guidance – containment and recovery

	Action	Consideration	Responsibility	Complete
Initial Actions	**Containment and recovery**			
	Identify and activate containment and recovery equipment stockpiles based on incident location. Initial equipment mobilisation from Karratha and Exmouth.	Initial deployment from Karratha or Exmouth pending vessel availability. Up to date stockpile information accessed through Santos' Emergency Response Intranet Site.	Logistics Section Chief Supply Unit Leader Operations Section Chief	❑
	Identify suitable deployment vessels/crew. Mobilise resources port location – Karratha and/or Exmouth.	Refer to **Table 11-4** for location of containment and recovery resources. Initial deployment from Karratha or Exmouth pending vessel availability. Preference will be for vessels and crew that are exercised in regular Santos booming exercises.	Logistics Section Chief Supply Unit Leader Operations Section Chief	❑
	Assess the spill trajectory modelling, other operational monitoring data to identify operational area for containment and recovery (C&R) deployments.	Refer to **Table 11-2** for guidance.	Operations Section Chief Planning Section Chief	❑
	Confirm conditions are suitable for containment and recovery activities.	Refer to **Table 11-2** for guidance.	Operations Section Chief Planning Section Chief	❑
	Mobilise deployment personnel to nominated marine base(s).	Each vessel conducting containment and recovery is to be manned with a trained AMOSC, Santos or OSRL Oil Spill Responder, who is the Team Leader tasked with controlling the operations and implementing them in a safe and responsible method. The Team Leader has the responsibility of evaluating the effectiveness of the containment and recovery operations and communicating the information to the IMT Operations Section Chief.	Operations Section Chief Logistics Section Chief	❑

Action		Consideration	Responsibility	Complete
	Coordinate aerial surveillance support to vessels to ensure they are being directed to priority locations for containment and recovery activities within operational zones.	Focus on containment and recovery activities to areas of slick of a sufficient thickness whereby containment and recovery activities will be effective. Refer to **Table 11-2** for guidance.	Planning Section Chief Operations Section Chief	❑
	Direct containment and recovery operations to designated operational zones.	The base case restrictions for containment and recovery is no operations within 25 km of well site.	Operations Section Chief	❑
	Decanting (if selected)			
	Obtain decanting approval from AMSA (Commonwealth waters) or DoT (WA waters).	Under both MARPOL and POWBONS, decanting must be approved by the relevant Jurisdictional Authority where the discharge will occur. Approval should be sought to discharge water that has separated from oil into the apex of the already deployed containment boom system (with operational skimmer). This will increase the oil storing capacity of storage tanks.	Environment Unit Leader	❑
	Ensure personnel onboard the vessels are familiar with decanting procedure approved by the relevant authority AMSA (Commonwealth waters) or DoT (WA waters).	-	Operations Section Chief	❑
	Commence decanting operations, ensuring that any discharged water is directed into the apex of the already deployed containment boom system (with operational skimmer).	-	Vessel Master/s	❑
	Ensure there is sufficient temporary storage for oily wastewater onboard vessel.	-	Operations Team Leader	❑

Action		Consideration	Responsibility	Complete
Ongoing Actions	**Containment and recovery**			
	Coordinate the dispatch of operationally ready (all equipment and personnel on board) vessels via the IAP.	Equipment will be maintained and replaced if necessary through existing stockpiles.	Operations Section Chief	❑
	Maintain operational zones and provide updates to Vessel Masters on most suitable locations for containment and recovery operations.	Continue to utilise aerial surveillance data to inform the location of operational zones.	Operations Section Chief	❑
	Develop waste transfer process to secondary vessels/barge to enhance C&R vessel operational time, reduce port visits for waste unloading and reduce contamination.	Consider location and size/ type of waste collection vessel/barge and suitability of equipment and waste receptacles for dynamic lifts. Consider waste transfer to Dampier port rather than Exmouth which is a small multi-use port facility.	Operations Section Chief Planning Section Chief Logistics Section Chief	❑
	Decanting (if selected)			
	Record volumes of all water decanted.	This information must be supplied to the relevant jurisdictional authority.	Vessel Master/s	❑
	Manage any solid wastes generated.	-	Vessel Master/s	❑

Table 11-4: Containment and recovery – resource capability

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
Recovery booms and skimmers	Santos	Containment and recovery boom (Current Buster 4[24] / Expandi Boom Comes with accessories and powerpacks Total – 4	Exmouth container – 2 x Expandi boom systems and accessories Varanus Island container – 1 x Expandi boom system and accessories, 1 x Current Buster 4 boom system and accessories	Within 12 hours (for Exmouth or Varanus Island based deployment)
		Desmi DBD16 brush skimmer For inshore/calm seas deployment Comes with hoses/powerpacks Total – 2	Exmouth – 1 Varanus Island – 1	Within 12 hours (for Exmouth or Varanus Island based deployment)
	AMOSC	200 m offshore boom on hydraulic reel Total – 10	Broome – 2 Exmouth – 2 Fremantle – 6	Response via Duty Officer within 15 minutes of first call – AMOSC personnel available within 1 hour of initial activation call. Equipment mobilisation times vary according to stockpile location (refer to **Table 9-12)**.
		15 x RO boom (200 m) Total – 7	Geelong – 7	
		Current buster boom System Total – 1	Geelong – 1	
		Speed sweep system Total – 1	Geelong – 1	
		LWS 500 weir skimmer Total – 6	Fremantle – 3 Geelong – 3	

[24] Santos have procured this system which will be available for use from Q4 2023.

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
		GT 185 weir skimmer Total – 1	Exmouth – 1	
	AMSA	RO boom (200 m) Total – 8	Karratha – 4 Fremantle – 4	Access to National Plan equipment through AMOSC. Equipment mobilisation times vary according to stockpile location.
		Vikoma Hi Sprint boom Total – 4	Karratha – 2 Fremantle – 2	
		LWS 500 weir skimmer Total – 8	Fremantle – 4 Karratha – 4	
		Desmi termite skimmer Total – 2	Fremantle – 1 Karratha – 1	
	Industry Mutual Aid equipment	2 x 200m Offshore boom (Chevron) 2 x 200m Offshore boom (Woodside) 2 x Weir skimmers (Woodside) 1 x Weir skimmer (Jadestone) 2 x Weir skimmer (Chevron) 1 x Weir skimmer (INPEX)	WA	Access to Industry Mutual Aid through AMOSPlan and facilitated by AMOSC
	OSRL (Guaranteed access to 50% by type of equipment available. Additional access considered on a case-by-case basis)	37 x RO boom (200m)	Various - Singapore, UK, Bahrain, Fort Lauderdale	Response via Duty Officer within 10 minutes of first call. Equipment mobilisation times vary according to stockpile location.
		2 x Hi Sprint boom (300m)		
		100 x Ocean boom (30m)		
		50 x Offshore recovery skimmers		

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
Offshore waste storage	AMOSC	Lancer barges (25 m^3 each) Total – 4	Fremantle –2 Geelong – 2	Response via Duty Officer within 15 minutes of first call – AMOSC personnel available within 1 hour of initial activation call. Equipment mobilisation times vary according to stockpile location (refer to **Table 9-12)**.
		Deck bladders (25 m^3 each) Total – 6	Fremantle –3 Geelong – 3	
	AMSA	8 x Vikoma flexidam (10 m^3 each) Total – 8	Fremantle –4 Karratha –4	Access to National Plan equipment through AMOSC. Equipment mobilisation times vary according to stockpile location.
		5 x Canflex sea slug (10 m^3 each) Total – 5	Fremantle –3 Karratha – 2	
		4 x Vikoma frost barge (25 m^3 each) Total – 4	Fremantle –2 Karratha – 2	
		2 x Covertex tow tank (20 m^3 each) Total – 2	Karratha – 2	
	Via North West Alliance Contract	Refer to Waste Management (**Section 16**) for details on Santos' waste service provider	Perth Karratha	<24 hours
	Santos OEG Contract	Liquid waste ISO tanks (4 m^3)	WA	<24 hours. Offshore rated ISO tanks are readily available through existing contract arrangements through OEG.
	OSRL (Guaranteed access to 50% by type of equipment	14 x Storage barges (50 m^3 each)	Various - Singapore, UK, Bahrain, Fort Lauderdale	Response via Duty Officer within 10 minutes of first call. Equipment mobilisation times vary according to stockpile location.
		21 x Storage barges (25 m^3 each)		
		9 x Waste containment tanks (10 m^3 each)		

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
	available. Additional access considered on a case-by-case basis)	2 x Sea slug (10 m^3 each)		
Offshore containment and recovery deployment vessels, towing vessels and vessel crew Waste transfer vessels/barges for waste oil storage and transfer	Santos contracted vessel providers. Preference for vessels used in Santos deployment exercises	Varies – check through vessel contractors / Santos vessel tracking system. Santos *Vessel Requirements for Oil Spill Response (7710-650-ERP-0001)* provides the required vessel specifications.	Exmouth, Dampier, NW locations, Singapore	Varies subject to location / availability
Personnel (field responders) for OSR strategies	AMOSC Staff	12	Fremantle – 3 Geelong – 9	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site.
	AMOSC Core Group (Santos)	12	Perth / NW Australian facilities – 10	From <12 hours (NW-based personnel) From <24 hours (Perth personnel)
			Port Bonython (SA) – 2	<48 hours to WA locations
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84 members)	Office and facility locations across Australia	Location dependent. Confirmed at time of activation.

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

Task	Time from IMT call-out
IMT confirms applicability of strategy and begins sourcing C&R resources for applicable spills	<3 hours
Santos Offshore Core Group members mobilised to deployment port	<12 hours
C&R equipment (offshore boom/skimmer) mobilised to deployment port	<12 hours
Waste storage equipment mobilised to port	<24 hours
Suitable C&R vessels mobilised to port	<24 hours
C&R trained personnel mobilised to deployment port	<24 hours
C&R operation deployed to spill site (weather/daylight dependent)	<30 hours (weather/daylight dependent)*
Minimum Resources Per Containment and Recovery Unit	
+ Two suitable C&R vessels (one deployment vessel + one tow vessel) – refer Santos Offshore ER Intranet for vessel specification + 200 m of offshore boom + One offshore skimmer appropriate to heavy oil and operating conditions (e.g. large weir) + Waste storage (comprising a combination of towable bladder, IBCs, Iso-tanks, inbuilt vessel storage tanks or combination allowing for 33+ m^3 liquid waste volume storage) + One trained responder + Personal protective equipment	

*Assumes a 6-hour transit time to spill location by C&R vessels departing Dampier port (155 km at 12 knots) and that weather/daylight allows operation to commence

11.3 Resource requirements

11.3.1 Assumptions

Containment and recovery is more effective when a sufficient oil thickness can be achieved by the containment booms (minimum of 50 g/m^2). Whilst containment and recovery would not be suitable for MDO or condensate, it could be suitable for crude oil and HFO under suitable weather conditions (winds less than 20 knots and currents less than 0.75 knots).

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

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

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

Velocity = 1 knot

Thickness of slick = 50 g/m^2 or 0.047 mm

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

BER = (200 x 0.3) x 1 x 0.047 = 2.82 m^3 per operation/hour x 12 hours of operation = 33 m^3/operation/day

11.3.2 Worst-case credible scenario requirements – HFO release

Containment and recovery operations are recognised to have low recovery rates in the emergency spill response industry when compared against estimated total spill volumes; the Macondo incident in 2009 (Gulf of Mexico) had an estimated containment and recovery rate of approximately 4% of the total volume of oil spilled, and the MV *Erika* oil tanker spill in 1999 (Atlantic Ocean) had an estimated containment and recovery rate of 6% (IPIECA, 2015c). The Montara well blowout of 2009 had a higher recovery rate due to calm metocean conditions – 10% of the total oil spilled was estimated to be contained and recovered (Montara Commission of Enquiry, 2010) and with only two units in operation throughout the duration of the response (AMSA, 2010).

For planning purposes, the amount of oil that could possibly be recovered by C&R was conservatively assumed as:

+ HFO - 236 m^3 of the surface HFO spill volume (83% residual x 15% recovery rate); and
+ VI crude blend – 113 m^3 of the surface crude blend spill volume (8.7% residual x 15% recovery rate)

Therefore, the HFO scenario presents the worst-case volume for containment and recovery.

Assuming that a single unit can remove 33 m^2 per day (231 m^3 per week), a total of 2 units would be required, which theoretically could recover the available oil in one week following the release. Each unit requires:

+ 1 x vessel master;
+ 1 x Supervisor;
+ 4 x deployment crew.

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

Vessel availability and the capacity to store and transfer oil volumes are key operational factors that need to be effectively managed in order to meet maximum recovery levels. Santos has identified the response need for the number, and storage capacity of containment and recovery vessels in **Section 11.4** and can meet the demand.

11.4 Containment and Recovery Implementation Plan

The minimum components required for implementing offshore containment and recovery operations are detailed in **Table 11-5**.

For planning purposes, a J-Sweep configuration (**Figure 11-1**) using two vessels, one deployment vessel and one towing vessel, is assumed for each containment and recovery unit.

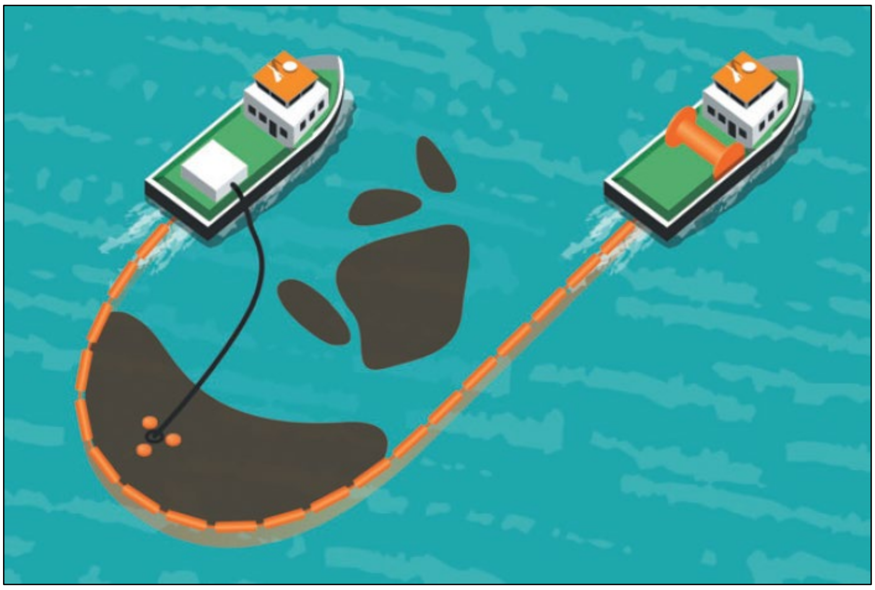

Figure 11-1: 'J' Configuration for Containment & Recovery Operations (Source: OSRL)

The deployment vessel will have onboard an offshore containment boom, offshore skimmer and a temporary storage capacity of 33 m^3 (as per **Section 11.3.1**). The deployment vessel will be tasked to carry out the deployment of boom, skimmer and towable temporary storage barge (if required) using the towing vessel for support. If required (depending on vessel type), the 33m^3 temporary storage requirement will be achieved using one 25 m^3 towable storage barge and two 4m^3 offshore rated ISO tanks for each containment and recovery unit. The proposed vessel deck layout plan is shown in **Figure 11-2**.

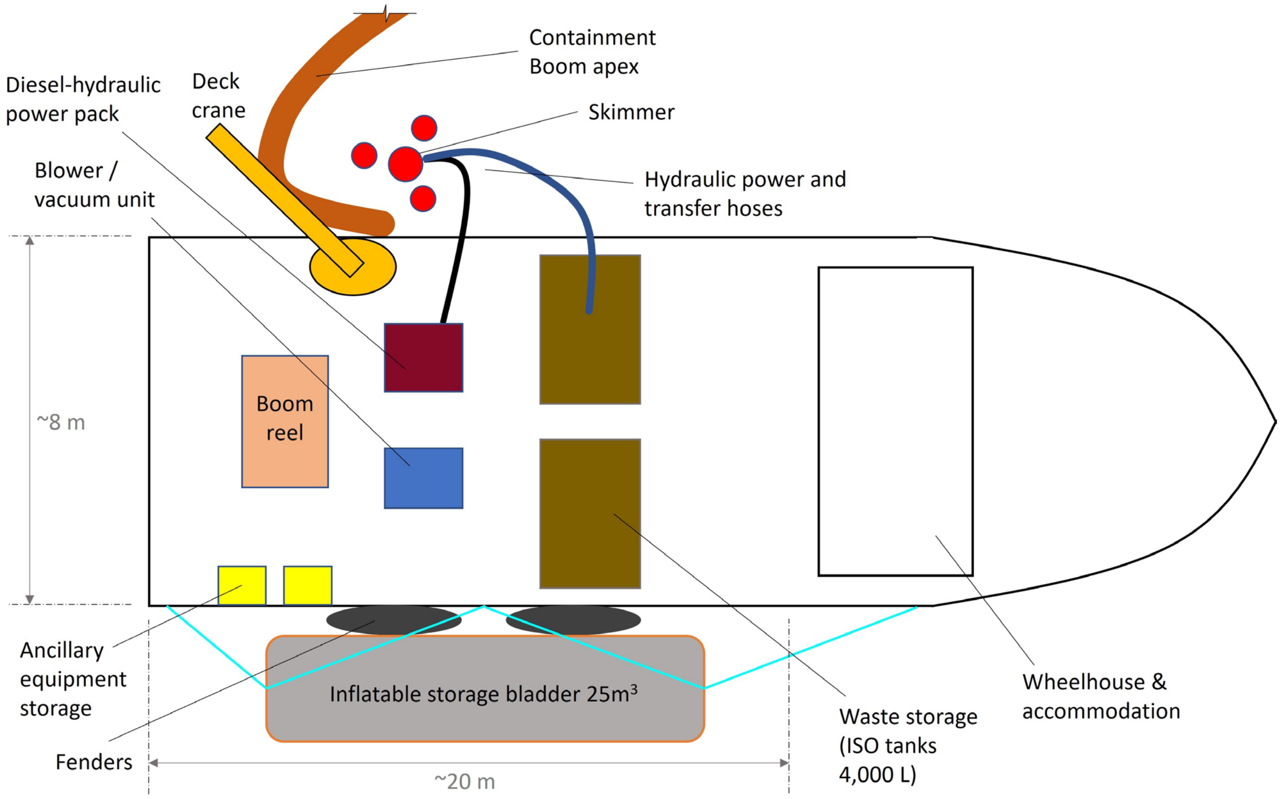

Figure 11-2: Containment and recovery vessel deck layout plan (OSRL, 2021)

The use of vessels of an appropriate specification is essential to ensure successful containment and recovery operations. The required specification for deployment and towing vessels are defined in **Table 11-6**, and in the Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001).

Table 11-6: Containment and recovery vessels specification (OSRL, 2021)

Deployment vessels specification	Towing vessels specification
+ Clear deck space, of at least 20 m x 8 m (to safely load, secure and deploy equipment); + Deck crane, capacity of ~1-2 tonnes with 2 m reach + Minimum bollard pull of 8 tonnes + Open stern (to allow pay-out of boom) + Ability to manoeuvre and tow at low speed + Accommodation and shelter for crew	+ Ideally smaller vessel size than deployment vessel, to aid in manoeuvrability + Minimum bollard pull of 8 tonnes + Suitable towing attachment point

The resources available to carry out containment & recovery operations are detailed in **Table 11-4**. Considering the requirement of 200 m offshore boom and one offshore skimmer for each containment and recovery unit, Santos has access to more than the required 2 units through the arrangements with AMOSC and AMSA.

Temporary waste storage requirements for containment and recovery operations are assumed to be 33 m^3 per day. Temporary waste storage volumes could potentially be reduced through decanting of water (refer to **Section 11.5**), however, it is assumed for worst-case planning purposes that decanting permission may not be granted by the relevant authority. It is assumed that temporary storage solutions from the OSRO stockpiles are required for each deployment vessel, in the event that vessels with integrated recovered oil storage tanks are not available, to meet the temporary storage requirements as per the configuration shown in **Figure 11-1**. The requirements can be met with the resources from AMOSC and AMSA as shown in **Table 11-4**.

Liquid waste collection, transport and final disposal of waste received at port will be through Santos' Waste Service Provider (NWA) (as detailed in **Section 16.5**).

To ensure availability of appropriate vessels, the Santos Marine Logistics team maintains a number of service arrangements, including the IHS Maritime Portal, MSAs with vessel operators and a service agreement with Clarkson Platou for the provision of offshore market intelligence.

The IHS Maritime Portal allows Santos to access the real time location of any vessel anywhere in the world which is transmitting an AIS signal. Through this portal, Santos can identify vessels in the region via the map function and access details about the basic specifications of the vessel along with the name of the vessel operator. Santos maintains MSAs with a number of vessel operators in Australia (over 10) for the provision of marine services. The MSAs set out the high-level terms and conditions of engagement between the entities and will be used to gain access to additional vessels to support spill response activities. Also, through Clarkson Santos maintains offshore market intelligence globally with a focus on the south-east Asia region.

The estimated vessel availability for containment and recovery operations was established in consultation with the Santos Marine Logistics Team. The assessment of appropriate vessel availability for containment and recovery operations indicated ample vessels available in Australia that can be used to make up the two containment and recovery units needed, which are covered under existing Santos MSAs.

For a sustained operation, it is necessary for daily transfer of recovered oil onboard containment and recovery deployment vessels to a larger waste storage/transfer vessel, which will be captured by the waste transfer concept of operations procedure. This will be primarily achieved through the use of a barge or

Platform Supply Vessel (PSV) which would act as a temporary offshore waste oil storage facility, before transiting to an approved port for waste transfer. Santos can gain access to barges and PSVs locally.

Santos maintains close relationships with vessel contractors to remain appraised of the location and availability of vessels in the region. Vessel contractors provide regular updates to Santos on the locations and availability of vessels within their fleets during Quarterly Review Meetings (QRM). Additionally, Santos is able to call upon the contractors at any time to request availability of vessels to support Santos marine logistics requirements.

11.5 Decanting

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

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

The *Pollution of Waters by Oils and Noxious Substances (POWBONS) Act 1986*; section 8 allows for decanting for combating specific pollution incidents. Additionally, Annex 1 of MARPOL (Regulation 9) allows for decanting for combating specific pollution events to minimise the damage from pollution. Under both MARPOL and POWBONS decanting must be approved by the relevant Jurisdictional Authority. In WA State waters this is DoT (as the Hazard Management Agency under the *Emergency Management Act* 2005) and in Commonwealth waters this is AMSA. Approval will be sought if decanting is required.

If decanting approval is not obtained through AMSA/DoT, the complete collected oil and water will remain in the collection tanks, and all will be treated as collected waste. In this event, the duration of containment and recovery operations may be reduced due to restricted available sullage.

11.6 Environmental Performance

Table 11-7 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 11-7: Environmental performance – containment and recovery

Environmental Performance Outcome	Implement containment and recovery tactics to reduce hydrocarbon contact to surface and shoreline priority protection areas		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
Offshore Containment and Recovery	**Response Preparedness**		
	Access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity as specified in **Table 11-4**.	Access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract

Environmental Performance Outcome	Implement containment and recovery tactics to reduce hydrocarbon contact to surface and shoreline priority protection areas		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
	Offshore waste transfer concept of operations in place	Offshore waste transfer concept of operations to help maximise waste storage availability for C&R vessels.	Waste transfer concept of operations (within Santos Vessel Requirements for Oil Spill Response [7710-650-ERP-0001]).
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Offshore containment and recovery vessels	Maintenance of vessel specification for offshore containment and recovery vessels	Vessel specification
	Planning and arrangements to enable fast access to containment and recovery resources	Santos trained personnel and Santos owned equipment to mobilise to the spill site on the first day post spill.	Equipment manifests Training records MSAs with multiple vessel providers
	Response Implementation		
	First strike resources	Minimum first strike resource requirements mobilised in accordance with **Table 11-5**	Incident Log
	Response requirements for extended operations.	Maintain and operate the containment and recovery systems specified in **Section 11.3.2.**	Incident Log
	Aerial surveillance reports (to direct operations to areas with greatest oil concentration)	Aerial surveillance reports communicated to C&R Team Leaders	Incident Log
	Decanting to free up liquid oil waste container storage)	Application for offshore decanting is made to AMSA (Commonwealth Waters) or DoT (State Waters). When approved decanting of water occurs back into boomed area.	Incident Log
	Spill response activities selected and reviewed on basis of a Net Environmental Benefit Analysis	Prepare operational NEBA to determine if containment and recovery is likely to result in a net environmental benefit	Incident Log
		Operational NEBA for containment and recovery is conducted each operational period and considers oil thickness and weather constraints to effectiveness.	IAP/Incident Log

12 Shoreline Protection and Deflection Plan

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

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

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

12.1 Overview

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

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

Protection and deflection is part of an integrated nearshore/shoreline response to be controlled by DoT as the relevant Control Agency. Santos will undertake first-strike protection and deflection activities as required. Upon assumption of Control Agency responsibilities, DoT will direct resources (equipment and personnel) provided by Santos for the purposes of shoreline protection. Santos will provide all relevant information on shoreline character and oiling collected as part of surveillance activities carried out under its control (refer **Section 9**).

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

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

Shoreline protection and deflection techniques include:

+ nearshore booming, which can involve different booming arrangements including:
  - exclusion booming: boom acts as a barrier to exclude the spill from areas requiring protection

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

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

12.2 Implementation Guidance

Table 12-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 12-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial protection and deflection operations, unless directed otherwise by DoT, are listed in **Section 12.4**. The Incident Commander of the DoT's IMT (once the DoT assumes control) is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 12-2: Shoreline Protection Implementation Guide

Action		Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to WA DoT have been made.	Refer to **Table 6-1** for reporting requirements.	Planning Section Chief	❑
	Collect and provide spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to Control Agency for confirmation of priority protection areas and NEBA.	-	Environment Unit Leader Planning Section Chief	❑
	Where DoT has assumed roles as Control Agency, actions undertaken by DoT may differ to those below.			
	Conduct Operational NEBA to determine if protection and deflection is likely to result in a net environmental benefit using information from shoreline assessments (**Section 9.9**) and any tactical response plans for the area.	TRPs exist for the majority of the Priority Protection areas, further described in **Section 5.7.1.1**. TRPs are available on the Santos ER Intranet page [25].	Environment Unit Leader	❑
	If NEBA indicates that there is an overall environmental benefit, develop a Shoreline Protection Plan (IAP Sub-Plan) for each deployment area.	Shoreline Protection Plan should reference any existing TRPs and may include (but not be limited to): + priority nearshore and shoreline areas for protection (liaise with Control Agency for direction on locations) + locations to deploy protection and deflection equipment + permits required (if applicable) + protection and deflection tactics to be employed for each location + list of resources (personnel and equipment) required + logistical arrangements (e.g. staging areas, accommodation, transport of personnel)	Operations Section Chief Planning Section Chief Environment Unit Leader	❑

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

Action		Consideration	Responsibility	Complete
		+ timeframes to undertake deployment + access locations from land or sea + frequency of equipment inspections and maintenance (noting tidal cycles) + waste management information, including logistical information on temporary storage areas, segregation, decontamination zones and disposal routes + no access and demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat (utilise existing roads and tracks first) + Shift rotation requirements.		
	If required identify vessels with relevant capabilities (e.g. shallow draft) for equipment deployment in consultation with Control Agency.	Ensure vessels have shallow draft and/or a suitable tender (with adequate towing capacity and tie-points) if they are required to access shorelines.	Operations Section Chief Logistics Section Chief	❑
	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 Section Chief On-Scene Commander	❑
Ongoing Actions	Conduct daily re-evaluation of NEBA to assess varying net benefits and impacts of continuing to conduct shoreline protection and deflection activities.	-	Environment Unit Leader	❑
	Report to the Operations Section Chief on the effectiveness of the tactics employed.	-	Shoreline Response Programme Manager – AMOSC core group responder	❑

Action		Consideration	Responsibility	Complete
	Response teams to conduct daily inspections and maintenance of equipment.	Shoreline protection efforts will be maintained through the forward operation(s) facilities setup at mainland locations under direction of DoT. Response crews will be rotated on a roster basis, with new personnel procured on an as needs basis from existing human resource suppliers.	Shoreline Response Programme Manager	❑

12.3 Shoreline Protection and Deflection Resources

Shoreline protection equipment available for use by Santos is a combination of Santos 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 are a combination of Santos Facility Incident Response Team members, AMOSC Core Group Responders (comprising AMOSC trained Santos 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 9.9**) and existing Tactical Response Plans will provide information to guide the strategy and deployment of resources.

Worst-case modelling (VI crude blend and HFO scenarios) 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 AMOSC Core Group personnel, ERT members and shoreline/nearshore booming equipment held at Varanus Island. Regular deployment exercises conducted by Varanus Island AMOSC Core Group and ERT 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.

Table 12-3: Shoreline protection and deflection – resource capability

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
Santos owned nearshore boom/skimming equipment	Santos	Beach Guardian (25 m lengths) Total – 6	Varanus Island – 4 Exmouth – 2	Within 12 hours for deployment by vessel from Varanus Island
		Zoom Boom (25 m lengths) Total – 13	Varanus Island – 8 Exmouth - 5	
		Desmi DBD16 brush skimmer Total – 2	Exmouth – 1 Varanus Island – 1	
AMSA nearshore boom/skimmer equipment	AMSA	Canadyne inflatable Total – 5	Karratha – 5	Access to National Plan equipment through AMOSC For mobilisation timeframes refer to **Table 9-12**
		Structureflex inflatable Total – 25	Karratha – 10 Fremantle – 15	
		Versatech zoom inflatable Total – 18	Karratha – 5 Fremantle – 13	
		Slickbar – solid buoyancy Total – 2	Karratha – 2	
		Structureflex – solid buoyancy Total – 13	Karratha – 3 Fremantle – 10	
		Structureflex – land sea Total – 60	Karratha – 30 Fremantle – 30 other locations around Australia	
AMOSC nearshore boom and skimming equipment	AMOSC	Beach Guardian (25 m lengths) Total – 98	Broome – 4 Exmouth – 20	Response via duty officer within 15 minutes of first call; AMOSC

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
			Fremantle – 23 Geelong – 51	personnel available within one hour of initial activation call. Equipment logistics varies according to stockpile location For mobilisation timeframes refer to **Table 9-12**
		Zoom Boom (199 x 25 m lengths) Total – 28	Broome – 8 Exmouth – 20	
		HDB Boom (2 x 200 m lengths) Total – 171	Fremantle – 30 Geelong – 141	
		Curtain Boom (58 x 30 m lengths) Total – 60	Broome – 2 Fremantle – 18 Geelong – 40	
		Passive weir skimmer Total – 3	Exmouth – 1 Fremantle – 1 Geelong – 1	
		GT 185 skimmer Total – 2	Exmouth – 1 Geelong – 1	
		Desmi 250 weir skimmer Total – 1	Geelong – 1	
		Ro-skim weir boom Total – 2	Geelong – 2	

Equipment Type/ Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
OSRL nearshore boom/skimming equipment (Note: further booms are available; the listed items are shown as an example). Guaranteed access to 50% of stockpile by equipment type. Access to more than 50% on a case-by-case basis.	OSRL	Air-skirt boom 10 m: 228 Air-skirt boom 20 m: 658 Air-skirt boom 200 m: 4 Beach sealing boom 10 m: 154 Beach sealing boom 15 m: 65 Beach sealing boom 20 m: 113 Inshore recovery skimmers: 126 Range of ancillaries to support above equipment	OSRL global stockpiles at base locations: + UK + Singapore + Bahrain + Fort Lauderdale	Response from OSRL Duty Manager within 10 minutes. Equipment logistics varies according to stockpile location.
Personnel (field responders) for OSR strategies	AMOSC Staff	Total – 12	Fremantle – 3 Geelong – 9	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	Total – 12	Perth/NW Australia facilities – 10 Port Bonython (South Australia) – 2	From 24 hours <48 hours to WA locations
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84 members)	Office and facility location across Australia	Location dependent. Confirmed at time of activation

12.4 Worst-case resourcing requirements

Protection and deflection resourcing requirements have been determined for affected shorelines based on shortest time to contact, length of shoreline contacted, and number of shorelines contacted. As discussed in **Section 9.9.2**, the VI crude blend spill scenario results in the greatest length of oiled shorelines (above 100 g/m^2).

Resource requirements for protection and deflection will be situation/receptor specific. TRPs are held by Santos and DoT and have been developed for all the mainland and offshore island PPA's (refer to **Section 5.7.1.1**).

12.4.1 Offshore islands

The islands in the EMBA are a mixture of large islands, such as Barrow Island, and smaller uninhabited islands. Access to many of these islands will be limited to shallow draft vessels, or larger vessels supported by smaller shallow draft vessels. Helicopters may also be deployed to deliver equipment and personnel and remove collected waste, further discussed in the shoreline clean-up strategy in **Section 13**.

For the VI crude blend release scenario, the earliest shoreline arrival time at offshore islands, were for the Lowendal Islands (2 hours), Montebello Islands (10 hours) and Barrow Island (11 hours). **Table 12-4** shows the required resources to shoreline receptors from the initial contact. 6 teams will be staggered at these locations to implement protection and deflection. It is assumed that given the staggered shoreline contact, teams will be able to move between locations to set up and monitor protection and deflection boom.

Table 12-4: Shoreline protection and deflection –Arrival of hydrocarbons

Receptor	Time from shoreline contact	Required protection and deflection resources
Montebello Islands	12 hours	2 protection and deflection teams to implement and monitor P&D at each of these receptors.
Lowendal Islands	2 hours	
Barrow Island	11 hours	

12.4.2 Resourcing

Capability allows for the initial mobilisation of protection and deflection resources in **Section 12.3** in four hours if required (**Section 9.9.2**). The shortest contact is 2 hours at Lowendal Islands and therefore, it may not be possible to deploy protect and deflect resources to the Lowendal Islands prior to first oil contact with shorelines. A typical shoreline protection and deflection team would consist of 12 personnel as a minimum, comprised of the following:

+ 1 x Incident Commander/Site Supervisor;
+ 1 x Shallow draft vessel skipper;
+ 1 x Shallow draft vessel deck-hand;
+ 9 x Protection and deflection operatives.

The total required teams for the worst-case P&D response is six (a total of 72 personnel), required to cover the contacted locations; this is based on two teams deployed to each of Lowendal Islands, Montebello Islands and Barrow Island.

The resourcing requirements will be determined based on feedback from SCAT activities, operational NEBA outputs and in consultation with DoT as the Control Agency. Shoreline effort will likely consist of a combination of protection and deflection and clean-up, with resources often working together and/or in parallel.

Table 12-5: Shoreline protection and deflection – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirm if protection of shoreline sensitivity/s is required and begins sourcing resources	<4 hours
Santos Offshore Core Group mobilised to protection site or deployment port location	<4 hours (Varanus Island personnel) <12 hours
Protection booming equipment mobilised to protection site or deployment port location	<4 hours (Varanus Island equipment) <12 hours
Waste storage equipment mobilised to protection site or deployment port location	<4 hours (Varanus Island equipment) <12 hours
Boom deployment vessel / remote island transfer vessel mobilised to protection site or deployment port location	<4 hours (initial response from Varanus Island) <12 hours
AMOSC Staff and Industry Core Group mobilised to protection site or deployment port location	<24 hours
Protection/deflection operation deployed to protection location	<6 hours (initial response from Varanus Island, weather/daylight dependent) <24 hours (weather/daylight dependent)
NB: Resource requirements for protection and deflection will be situation/receptor specific. TRPs, if developed for the area/receptor will outline suggested resource requirements. TRPs are held by Santos and DoT. For further description on relevant TRPs refer to **Section 5.7.1.1**[26]. Indicative first strike resources for a single site protection area are: + One small vessel suitable for boom deployment + Shoreline (e.g. Beach Guardian) and nearshore booms (e.g. Zoom Boom) plus ancillary equipment (e.g. anchors, stakes) sufficient for protection of shoreline resource (refer TRP if applicable) + One skimmer appropriate for oil type + Waste storage equipment + One Protection and Deflection Team + Personal protective equipment	

12.5 Environmental Performance

Table 12-6 indicates the Environmental performance outcomes, controls and performance standards for the Protection and Deflection response strategy.

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

Table 12-6: 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 Standard**	**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	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 will maintain the capability to deploy first strike protection and deflection resources within the first 6 hours of a spill notification.	VI oil spill response exercise records
	Maintenance of a list of small vessel providers for Exmouth, Dampier and Broome regions	List of small vessel providers	Small vessel providers for nearshore booming operations
	Response Implementation		
	Minimum requirements mobilised in accordance with **Table 12-5** unless directed otherwise by the Control Agency	Incident log	Mobilisation of minimum requirements for initial response operations
	Shoreline Protection and Deflection Plan	Santos IMT to confirm protection priorities in consultation with DoT	IAP/Incident Log
		Prepare operational NEBA to determine if shoreline protection and deflection activities are likely to result in a net environmental benefit	Records indicate operational NEBA completed prior to shoreline protection and deflection activities commencing
		IAP Shoreline Protection and Deflection Sub-plan developed to provide oversight and management of shoreline protection and deflection operation	Records indicate IAP Shoreline Protection and Deflection Sub-plan prepared prior to shoreline protection and deflection operations commencing
		NEBA undertaken each operational period by the relevant Control Agency to determine if response strategy is continuing to have a net environmental benefit. NEBA	IAP/Incident Log

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

13 Shoreline Clean-up Plan

Table 13-1: Shoreline Clean-up – Objectives, Initiation Criteria and Termination Criteria

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery.			
Initiation criteria	Level 2 or Level 3 spills where shorelines with identified or potential protection priorities that will be , or have been, contacted; NEBA indicates shoreline clean-up will benefit receptors; and Approval has been obtained from DoT IC or delegate (as the Control Agency) to initiate response strategy			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	As directed by DoT			

13.1 Overview

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

Shoreline clean-up is part of an integrated nearshore/ shoreline response to be managed by the relevant Control Agency. Where Santos is not the Control Agency (refer to **Table 3-2**), it will undertake first-strike activations as required. In this circumstance, the relevant Control Agency will direct resources (equipment and personnel) provided by Santos 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 assessed against natural attenuation for sensitive sites. Selection of shoreline clean-up methods and controls to prevent further damage from the clean-up activities are to be undertaken in consultation with the Control Agency and selected based on NEBA.

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

Condensate is the only product that could load onto shorelines from credible spills in Commonwealth Waters. Marine diesel, condensate, crude oil and HFO may load onto shorelines from credible spills in State Waters.

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.

Shoreline clean-up techniques include:

+ Shoreline Clean-up Assessment – uses assessment processes (refer to **Section 9.9**) to assess shoreline character, assess shoreline oiling and develop recommendations for response. Typically, this should be the first step in any shoreline clean-up response.

+ Natural Recovery – oiled shorelines are left untreated, and the oil naturally degrades over time.
+ Manual and Mechanical Removal – removes oil and contaminated materials using machinery, hand tools, or a combination of both.
+ Washing, Flooding and Flushing – uses water, steam, or sand to flush oil from impacted shoreline areas.
+ Sediment reworking and Surf washing – uses various methods to accelerate natural degradation of oil by manipulating the sediment.

13.2 Implementation guidance

Table 13-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. **Table 13-2** provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 13-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial shoreline clean-up operations, unless directed otherwise by DoT, are listed in **Table 13-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 13-2: Implementation guidance – shoreline clean-up

Action		Consideration	Responsibility	Complete
Initial Actions	Actions below are indicative only and are at the final determination of DoT as the Control Agency.			
	Initiate Shoreline Clean-up Assessment (if not already activated).	Refer to **Section 9.9** for additional information Unmanned Aerial Vehicles (UAVs) may be necessary for some sensitive environments and where personnel safety is at risk (e.g. dangerous fauna in remote locations).	Environment Unit Leader	❑
	Using results from Shoreline Clean-up Assessment, conduct Operational NEBA to assess shoreline-clean up suitability and recommended tactics for each shoreline location.	Shoreline Clean-up Assessment Teams are responsible for preparing field maps and forms detailing the area surveyed and make specific clean-up recommendations. The condition of affected shorelines will be constantly changing. Results of shoreline surveys should be reported as quickly as possible to the IMT to help inform real-time decision-making. Engage a Heritage Adviser if spill response activities overlap with potential areas of cultural significance.	Environment Unit Leader	❑
	If operational NEBA supports shoreline clean-up, prepare a Shoreline Clean-up Plan for inclusion in the IAP,	Shoreline Clean-up Plan may include (but not be limited to): + clean-up objectives + clean-up end points (may be derived from Shoreline Clean-up Assessment) + clean-up priorities (may be derived from Shoreline Clean-up Assessment) + assessment and location of staging areas and worksites (including health and safety constraints, zoning) + utility resource assessment and support (to be conducted if activity is of significant size in comparison to the size of the coastal community)	Environment Unit Leader Planning Section Chief Operations Section Chief	❑

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

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

Table 13-3: Shoreline clean-up – resource capability

Equipment Type/Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
Manual clean-up tools (shovels, rakes, wheelbarrows, bags, etc.)	AMOSC shoreline kits	Shoreline support kits first-strike Total – 2	Fremantle – 1 Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; equipment logistics varies according to stockpile location (**Table 9-12**)
	Santos	Shoreline clean-up container	Varanus Island – 1	Within 12 hours for deployment from Varanus Island
	Hardware suppliers	As available	Karratha / Exmouth / Perth	-
Shoreline flushing (pumps/hoses)	AMOSC	Shoreline flushing kit Total – 2	Fremantle –1 Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 9-12**
		Shoreline impact lance kit Total – 1	Geelong – 1	
Nearshore booms/ skimmers	AMOSC AMSA	Refer to Protection and Deflection (**Table 12-3**)	-	-
Decontamination/staging site equipment	AMOSC	Decontamination stations Total – 3	Fremantle –1 Exmouth –1 Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 9-12**
	AMSA	Decontamination station Total – 4	Karratha –2 Fremantle – 2	Access to National Plan equipment through AMOSC
	Oil spill equipment provider (e.g. Global Spill., PPS)	As available	Perth	Subject to availability

Equipment Type/Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
Waste storage (including temporary storage and waste skips and tanks for transport)	AMOSC temporary storage	Fast tanks (9,000 L and 3,000 L) Total – 9	Broome –1 Geelong – 4 Fremantle – 2 Exmouth – 2	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see **Table 9-12**
		Vikotank (13,000 L) Total – 2	Broome – 1 Geelong – 1	
		Lamor (11,400 L) Total – 4	Fremantle – 4	
		IBCs (1 m^3) Total – 13	Geelong – 13	
	AMSA temporary storage	Fast tanks – (10 m^3) Total – 22	Darwin – 2 Karratha – 2 Fremantle – 4 Adelaide – 1 Brisbane – 2 Devonport – 2 Melbourne – 1 Sydney – 4 Townsville – 4	Access to National Plan equipment through AMOSC
		Structureflex – (10 m^3) Total – 3	Brisbane – 1 Adelaide – 2	
		Vikoma – (10 m^3) Total – 20	Darwin – 1 Adelaide – 1 Brisbane – 1 Devonport – 2 Fremantle – 4 Fremantle – 3	

Equipment Type/Personnel Required	Organisation	Equipment Specifications / Total Quantity Available	Location / Quantity Available	Mobilisation Timeframe
			Melbourne – 2 Sydney – 2 Townsville – 4	
	Santos Waste Management Service Provider	Refer to Waste management (**Section 16**)	Perth, Karratha	<12 hours
Personnel (field responders) for OSR strategies	AMOSC Staff	Total – 12	Fremantle – 3 Geelong – 9	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	Total – 12	Perth/NW Australia facilities – 10 Port Bonython (South Australia) – 2	12+ hours <48 hours to WA locations
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84 members)	Office and facility location across Australia	Location dependent. Confirmed at time of activation
	Santos contracted Work Force Hire company (e.g. Dare)	As per availability (up to 2,000)	Australia-wide	Subject to availability (indicatively 72+ hours)

Santos

Table 13-4: Shoreline clean-up – first strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirms applicability of strategy and begins sourcing resources.	<4 hours
Santos Offshore Core Group mobilised to site/deployment port location.	<24 hours
Clean-up equipment mobilised to site/deployment port location.	<24 hours
Waste storage equipment mobilised to site/ deployment port location.	<24 hours
Remote island transfer vessel (if required) mobilised to deployment port location.	<24 hours
AMOSC Staff, Industry Core Group and Labour Hire mobilised to site/deployment port location.	<48 hours
Clean-up operation deployed to clean-up area under advice from Shoreline Assessment Team.	<48 hours
Minimum Resource Requirements	
NB: Resource requirements for shoreline clean-up will be situation/receptor specific. TRPs if developed for the area/receptor will outline suggested resource requirements and shoreline assessments (as part of operational monitoring strategy) will be conducted prior to clean-up to confirm techniques. TRPs are held by Santos and DoT. For further description on relevant TRPs refer to **Section 5.7.1.1**[27]. Indicative minimum requirements for one Santos-activated shoreline clean-up team are: + manual clean-up/shoreline flushing equipment kit + waste storage (bags, temporary storage tanks, skips as appropriate) + decontamination/staging equipment kit + personal protective equipment. One clean-up team comprises: + one Team Leader (AMOSC staff, Industry Core Group or Santos Core Group) + Six shoreline clean-up responders (AMOSC Core Group, Santos contracted labour hire personnel	

13.3 Shoreline clean-up resources

Shoreline clean-up equipment available for use by Santos is a combination of Santos owned, AMOSC, AMSA, DoT and OSRL equipment as well as other industry resources available through the AMOSPlan mutual aid arrangements. Shoreline consumables are available through hardware, PPE and specialist oil/chemical spill suppliers and mobile plant is available through hire outlets in Perth, Karratha and other regional centres. Where vessel deployments are required, Santos will leverage from existing contracted vessel providers in the first instance, and if required will source vessels from vendors that Santos already has a master service agreement with, or spot hiring vessels as needed. The Santos Vessel Requirements for Oil Spill Response (7710-650-ERP-0001) contains the specification for various types of vessel that may be required in an oil spill response, including vessels for shoreline clean-up support.

Shoreline clean-up personnel available to Santos is a combination of Santos Facility Incident Response Team members, AMOSC Core Group Responders (comprising AMOSC trained Santos 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's emergency response labour hire arrangements.

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

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

13.4 Worst-case resourcing requirements

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. Spill modelling results (**Section 5.4**) indicate that a spill of VI crude blend from an offload tanker collision/grounding results in the greatest length of shoreline oiling above 100 g/m^2, whilst a HFO spill results in the greatest volumes onshore. 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. 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 10 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. In response to the worst-case shoreline loading of approximately 1,500 m^3 of HFO, 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 12 weeks (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.

13.4.1 Operational and environmental considerations affecting resourcing

Tidal ranges in the EMBA are large (7 to 8 m) and much of the coastline is remote and inaccessible via road, making many shoreline clean-up techniques difficult and their use may result in greater environmental impacts than the oil itself. In addition, the remote nature, presence of dangerous fauna (i.e., saltwater crocodiles and Irukandji jellyfish) present significant safety risks to responders working in these environments.

Large scale operations involving large numbers of personnel may cause adverse environmental impacts at many of these sensitive shoreline locations. The constant removal of oil, even via manual removal can result in a removal of substrate (e.g. sand, pebbles). If intrusive clean-up is conducted frequently, over a long period of time and along contiguous lengths of coastline, this may result in geomorphological changes to the shoreline profile and adverse impacts to shoreline invertebrate communities which provide an array of ecosystem services (Michel *et al.*, 2017).

Given the safety constraints and ecological sensitivities of these shorelines, shoreline clean-up operations should be conducted by smaller teams for a longer period of time. Intermittent manual treatment (<20 visits/month) and use of passive recovery booms is likely to be more effective than intrusive methods (e.g. intrusive manual removal >20 visits/month). 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 shore profile and will minimise ecological impacts on the shorelines and their sensitive species.

The number of shoreline clean-up teams recommended to treat these shorelines (as shown in **Section 13.4**) is not based on extensive, intrusive and contiguous removal of oil and waste along all shorelines, but rather use of smaller teams and at lower frequency of visits. Where shoreline based manual removal is safe and deemed advantageous by shoreline clean-up assessment teams and operational NEBA, this should be conducted via land access (if possible) or via suitable vessels. However, it should be noted that it is generally not feasible to move response equipment into and out of mangroves, tidal flats and delta environments without causing excessive damage. Even foot traffic must be minimised, either by laying down wooden walkways or relying on vessel-based activities as much as possible (API, 2020). Santos has considered the access limitations, safety issues and number of clean-up teams that may be able to operate in each of these environments. A summary of these findings is presented below.

13.4.1.1 Offshore islands

The islands in the EMBA are a mixture of large islands, such as Barrow Island, and smaller uninhabited islands. Access to many of these islands will be limited to shallow draft vessels, or larger vessels supported by smaller shallow draft vessels. Helicopters may also be deployed to deliver equipment and personnel and remove collected waste. Only Barrow Island has aircraft access and roads across the island providing land-based access. Manual removal is the preferred method of clean-up for these islands.

Access and all clean-up activities will be conducted via vessels or helicopters in front of the primary dune of the impacted shoreline. Santos will not access any areas behind the primary dune of impacted offshore islands during any stage of the clean-up operation, in order to minimise impacts.

If the impacted shorelines can be accessed with a barge and landing craft, crew on the barge will deliver an appropriate number of clean-up packs (to cater for the number of response personnel defined in the IAP) onto the impacted shoreline above the high tide mark. A helicopter will deliver the appropriate number of clean-up packs if barge access is not possible.

Response personnel may be transported to the impacted shoreline on a barge. If access is not possible by barge, helicopters may be used to transport personnel. Response personnel will not camp on the islands due to potential for additional impacts from this activity.

Initially, response personnel will shovel the oily waste into small manageable bags (weighing 20–30 kg when full) which will be stored in a lined, temporary storage area until they are removed from the island. The temporary storage area will be located at the bottom of the primary dune and above the Highest Astronomical Tide (HAT) mark.

13.4.1.2 Mainland locations

The majority of mainland locations have reasonable access either via 4WD tracks or via shallow draft vessels, with the exception of the Dampier Archipelago, which includes numerous small islands. Numerous long sandy beaches are also present across this area, providing potential for mechanical removal (upon agreement with SCAT personnel and DoT).

13.5 Shoreline clean-up decision guides

A number of shoreline types are found within the EMBA associated with Varanus Island Hub Operations activities, including:

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

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

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

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

13.6 Environmental Performance

Table 13-5 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 13-5: Environmental performance – shoreline clean-up

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Shoreline Clean-Up	**Response Preparedness**		
	Access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL.	Maintenance of access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity as per **Table 13-3**.	Access to National Plan resources through AMSA.
			AMOSC Participating Member Contract.
			OSRL Associate Member Contract.
	Maintenance of MSAs with multiple vessel providers.	Santos maintains MSAs with multiple vessel providers.	MSAs with multiple vessel providers.
	Vessels for offshore island response.	Maintenance of vessel specification for resource transfer for offshore island response.	Vessel specification.
	Labour hire contract.	Maintenance of contract with labour hire provider.	Labour hire Contract.
	The performance standards for TRP's are found in **Section 7.3**		
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations.	Minimum requirements mobilised in accordance with **Table 13-4** unless directed otherwise by DoT.	Incident log.
	Response requirements for extended operations.	If required mobilisation of the required number of shoreline teams throughout the release to meet the need specified in **Section 13.4.**	Incident log.
	Just-In-Time training	Training providers and personnel providers contacted during week one to initiate training	Incident Log
	Shoreline Clean-Up Plan.	Santos IMT to confirm protection priorities in consultation with DoT.	IAP. Incident Log.
		Prepare operational NEBA to determine if shoreline clean-up activities are likely to result in a net environmental benefit.	Records indicate operational NEBA completed prior to shoreline clean-up activities commencing.

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

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**
	Select temporary base camps in consultation with DoT and DBCA.	Any establishment of forward staging areas at shoreline areas done under direction or in consultation with DoT and DBCA.	Documented in IAP and Incident Log.
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions.	OSR Team Leader assess/select vehicles appropriate to shoreline conditions	IAP demonstrates requirement is met.
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/ roosting areas and turtle nesting habitat.	Unless directed otherwise by the designated Control Agency (i.e., DoT) demarcation zones are mapped out in sensitive habitat areas.	IAP demonstrates requirement is met.
	Operational restriction of vehicle and personnel movement to limit erosion and compaction.	Unless directed otherwise by the designated Control Agency (i.e., DoT) action plans for shoreline operations include operational restrictions on vehicle and personnel movement.	IAP demonstrates requirement is met.
	Stakeholder consultation.	Consultation is undertaken with relevant stakeholders prior to deployment of resources to townships and marine/coastal areas.	Consultation records

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 area for DFES under the State Hazard: HAZMAT Plan. Therefore, for VI onshore spills, Santos 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). 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

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 For any free oil at surface the use of boom (e.g. beach guardian boom or sorbent boom) can be used to protect coastal areas if there is movement of oil to these areas. Where oil is pooling and can be safely be accessed the use of sorbent materials to absorb oil or vacuum pumping equipment to remove oil can reduce potential for oil spreading further or moving downwards through sediments to groundwater. Contaminated sediment can be moved to main bund to prevent spread of contamination.	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	❑
	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	❑

Onshore Response				
Activation time		Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by On-Scene Commander)		
	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 of contamination include methods such as: + Bentonite slurry walls + Sheet pile walls + Permeable reactive barriers + Funnel and gate systems + Hydraulic containment systems	Santos Contaminated Sites Project Team	❑
Resources			**Location**	
Equipment		Spill kits	Throughout VI Hub onshore facilities	
		Sorbent booms, shore-sealing boom, shovels, sorbent material, wheel barrows, temporary waste storage containers	VI oil spill response containers	
		2x vacuum trailers (3,000L and 10,000L) and 1,000L IBCs for liquid oil and oily water	VI	
		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	

Onshore Response		
Activation time	Level 2 or 3 spills – may be deployed in a Level-1 incident (to be determined by On-Scene Commander)	
Personnel	VI Incident Response Team members	VI
	Santos AMOSC Core Group Members	Santos 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 has equipment and personnel available to implement and maintain a shoreline response at the VI Hub. Santos 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 8.6**.

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 5.5.1**, 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 **Table 14-2** and **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 **Table 14-2** and **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 5.5.2**).

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 5.5.1**, 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 will make available AMOSC Core Group Responders for onshore clean-up team positions to the Control Agency	Incident Log
		Santos will make available to the Control Agency equipment from Santos, AMOSC and OSRL stockpiles	Incident Log
		NEBA undertaken every operational period by the relevant Control Agency to determine if response strategy is having a net environmental benefit. NEBA included in development of following period Incident Action Plan.	IAP/Incident Log
		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

Note: DoT is the Control Agency and DBCA is the Jurisdictional Authority for oiled wildlife response within State waters. DBCA will lead the oiled wildlife response within State waters under the control of DoT as the relevant Control Agency. Santos is the Control Agency for oiled wildlife response within Commonwealth waters from facility spills.

Table 15-1: Oiled wildlife response – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement tactics in accordance with the Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife			
Initiation criteria	Operational monitoring shows that wildlife is contacted or is predicted to be contacted by a spill			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**MDO**	**HFO**
	✔	✔	✔	✔
Termination criteria	+ Oiling of wildlife has not been observed over a 48-hour period, and + Oiled wildlife has been successfully rehabilitated, and + Agreement is reached with Jurisdictional Authorities and stakeholders to terminate the incident response			

15.1 Overview

The short-term effects of hydrocarbons on wildlife may be direct such as the external impacts from coating or internal effects from ingestion and inhalation. Oiled wildlife response (OWR) includes wildlife surveillance/reconnaissance, wildlife hazing, pre-emptive capture and the capture, cleaning, treatment, and rehabilitation of animals that have been oiled. In addition, it includes the collection, post-mortem examination, and disposal of deceased animals that are found in the vicinity of an oil spill or are reasonably suspected of having succumbed to the effects of oiling.

Long-term effects of a spill on wildlife may be associated with loss/degradation of habitat, impacts to food sources, and impacts to reproduction. An assessment of such impacts is covered under scientific monitoring (**Section 17**).

Table 15-2 provides guidance on the designated Control Agency and Jurisdictional Authority for Commonwealth and State waters for OWR. For a petroleum activity spill in Commonwealth and Territory waters, Santos acts as the Control Agency and will be responsible for the wildlife response. The Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) will be referred to for guidance for coordinating an OWR when Santos is the Control Agency and for the OWR first-strike response, otherwise the relevant State OWR Plan will be referred to, as described below.

The key plan for OWR in WA is the Oiled Wildlife Response Plan (WAOWRP) (DBCA, 2022a). The WAOWRP establishes the framework for preparing and responding to potential or actual wildlife impacts during a spill and sets out the management arrangements for implementing an OWR in conjunction with the State Hazard: SHP-MEE. It is the responsibility of DBCA to administer the WAOWRP under the direction of the DoT (**Table 15-2**). The Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) is consistent with and interfaces the WAOWRP and WA Oiled Wildlife Response Manual (WA OWR Manual) (DBCA, 2022b).

If a spill occurs in WA State waters or enters State waters, DBCA is the Jurisdictional Authority for wildlife, and for Level 2/3 spills, will also lead the oiled wildlife response under the control of the Department of

Transport (DoT). DBCA is the State Government agency responsible for administering the *Biodiversity Conservation Act (WA) 2016* (BC Act), which has provisions for authorising activities that affect wildlife.

For Level 1 spills, Santos will be the Control Agency, including for wildlife response. It is however also an expectation that for Level 2/3 petroleum activity spills, Santos will conduct the initial first-strike response actions for wildlife and continue to manage those operations until DBCA is activated as the lead agency for wildlife response and formal handover occurs. Following formal handover, Santos will function as a support organisation for the OWR and will be expected to continue to provide planning and resources as required.

Table 15-2: Jurisdictional and control agencies for oiled wildlife response

<table>
<tr><th rowspan="2">Jurisdictional boundary</th><th rowspan="2">Spill source</th><th rowspan="2">Jurisdictional authority for OWR</th><th colspan="2">Control agency</th><th rowspan="2">Relevant Documentation</th></tr>
<tr><th>Level 1</th><th>Level 2/3</th></tr>
<tr><td rowspan="2">Commonwealth waters (three to 200 nautical miles from territorial/state sea baseline)</td><td>Vessel</td><td rowspan="2">Department of Climate Change, Energy, the Environment and Water (DCCEEW)</td><td colspan="2">AMSA</td><td rowspan="4">Western Australian Oiled Wildlife Response Plan (WAOWRP)
Western Australia Oiled Wildlife Response Manual</td></tr>
<tr><td>Petroleum activities</td><td colspan="2">Titleholder</td></tr>
<tr><td rowspan="2">Western Australian (WA) state waters (State waters to three nautical miles and some areas around offshore atolls and islands)</td><td>Vessel</td><td rowspan="2">Department of Biodiversity, Conservation and Attractions (DBCA)</td><td colspan="2">WA DoT[28]</td></tr>
<tr><td>Petroleum activities</td><td>Titleholder</td><td>WA DoT</td></tr>
<tr><td rowspan="2">International waters[29]</td><td>Vessel</td><td rowspan="2">Relevant foreign authority</td><td colspan="3" rowspan="2">Santos will liaise with the Australian Government Department of Foreign Affairs and Trade (DFAT) in the event that an oil spill may enter international waters. Santos will work with DFAT and the respective governments to support response operations.</td></tr>
<tr><td>Petroleum activities</td></tr>
</table>

15.2 Wildlife priority protection areas

For planning purposes, determination of wildlife priority protection areas is based on stochastic modelling of the worst-case spill scenarios, the known presence of wildlife, and in consideration of the following:

+ Presence of high densities of wildlife, threatened species, and/or endemic species with high site fidelity
+ Greatest probability and level of contact from floating oil and/or shoreline accumulation
+ Shortest timeframe to contact

The wildlife priority protection areas for VI Hub operations are outlined in **Table 15-3** and align with the priority protection sites for spill response described in **Section 5.7**. Onshore environmental sensitivities on Varanus Island and priorities for protection and priorities for protection are given in **Section 5.7.2**.

[28] If an OWR is required in WA State waters, the DBCA is responsible for the administration of the Western Australian Oiled Wildlife Response Plan (WAOWRP) under the direction of the DoT.

[29] As per AMSA (2017b), Coordination of International Incidents: Notification Arrangements Guidance NP-GUI-007.

Depending on the timing of a potential hydrocarbon spill, certain species could be more impacted because of key seasonal biological activities such as breeding, mating, nesting hatching or migrating. **Table 15-4** provides further detail of key wildlife activities in the Pilbara/Kimberley regions and the corresponding time of year.

Table 15-3: Wildlife priority protection areas

Wildlife priority protection area	Key locations	Reason
Muiron Islands	South Island	+ Major loggerhead turtle (*Caretta caretta*) (Vulnerable) nesting site, significant green turtle (*Chelonia mydas*) (Endangered) nesting site, low density hawksbill turtle (*Eretmochelys imbricata*) (Critically Endangered) nesting site, occasional flatback turtle (*Natator depressus*) presence.
	-	+ Seabird nesting: Wedge-tailed shearwater (*Ardenna pacifica*) nesting colony, birds forage at sea in large aggregations. Crested tern (*Thalasseus bergii*) nesting colony. + Humpback whale (*Megaptera novaeangliae*) migration
Ningaloo Coast North	North Mauds Landing, south of Point Cloates, Mandu Creek to Yardie Creek, Jurabi point, Gnarraloo Bay and Cape Farquhar	+ Loggerhead (Endangered), green (Vulnerable), hawksbill (Vulnerable) + Turtle nesting and breeding Nov to Mar with peak in late Dec/ early Jan
	Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island	+ 33 species seabird and avifauna (Including Critically Endangered Eastern Curlew) + Seabird nesting Sep to Feb
	-	+ Pygmy blue whales (*Balaenoptera musculus brevicauda*) (foraging area) Migration: Apr to Aug + Dugongs (*Dugong dugon*) (Vulnerable) (Marine/migratory) (breeding and foraging) + Seasonal aggregations of whale sharks (*Rhincodon typus*) (Mar to Jul) (Vulnerable) and manta rays
Barrow-Montebello Surrounds	Western side of Barrow Island – green turtles Eastern side of Barrow Island – flatback turtles Turtle Bay north beach, North and west coasts and John Wayne Beach – loggerhead and hawksbill turtle nesting	+ Regionally and nationally significant green turtle (Endangered) (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerhead turtle (Vulnerable) and hawksbill turtle (Critically Endangered)
	Double Islands – migratory birds	+ Migratory birds (important habitat); 10th of top 147 bird sites, Highest population of migratory birds on Barrow Island Nature Reserve (south-south-east of the Island), Double

Wildlife priority protection area	Key locations	Reason
	Bandicoot Bay and widespread on Barrow Island – migratory birds	Island has important bird nesting habitat (shearwaters [*Puffinus sp*.], sea eagles [*Haliaeetus sp.*])
	Island surrounds	+ Coral reef habitats + Inter-nesting turtles + Migratory seabirds + Humpback/ pygmy blue whale (*Balaenoptera musculus brevicauda*) migration areas
Montebello Islands	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	+ Turtles nesting– significant green turtle (Endangered) nesting; hawksbill (Critically Endangered), loggerhead (Vulnerable) and flatback turtles + Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan
	Surrounding waters	+ Pygmy blue whale migration: Apr to Aug + Humpback whale migration: peak migration Jun - Aug + Dugong foraging (Vulnerable) + Migratory shorebirds and threatened seabirds - at least 14 species + Significant nesting (Sep to Feb), foraging and resting areas
Lowendal Islands	All beaches on Beacon, Bridled, Varanus, Abuitlon, Parakeelya Islands	+ Seabird nesting all year, peak Oct – Jan. + Significant flatback turtle rookery, nesting season for flatback turtles peaks Dec - Jan
	Surrounding waters	+ Dugongs (Vulnerable)
	Abutilon, Beacon, Bridled, Parakeelya, Varanus islands	+ Diverse avifauna comprising of approximately 89 species + Seabirds nesting: wedge-tailed shearwater (*Puffinus pacificus*), bridled tern (*Onychoprion anaethetus*), crested tern (*Thalasseus bergii*), lesser crested terns (*T. bengalensis*) and silver gull (*Chroicocephalus novaehollandiae*) + Regularly supports 1% of the world population of crested and bridled terns + Estimated breeding pairs during 2021-22 seabird monitoring programme: – 28,525 breeding pairs of crested tern and 1,034 breeding pairs of lesser crested tern (*Thalasseus bengalensis*) on Varanus Island

Wildlife priority protection area	Key locations	Reason
		+ 6,037 breeding pairs of bridled tern on Parakeelya Island, 2,787 on Bridled Island and 2,365 on Abutilon Island
Barrow Island	Western side of Barrow Island – green turtles Eastern side of Barrow Island – flatback turtles Turtle Bay north beach, North and west coasts and John Wayne Beach – loggerhead and hawksbill turtle nesting	+ Regionally and nationally significant green turtle (Endangered) (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerhead turtle (Vulnerable) and hawksbill turtle (Critically Endangered)
	Double Islands – migratory birds Bandicoot Bay and widespread on Barrow Island – migratory birds	+ Migratory birds (important habitat); 10th of top 147 bird sites, Highest population of migratory birds on Barrow Island Nature Reserve (south-south-east of the Island), Double Island has important bird nesting habitat (shearwaters, sea eagles)

Table 15-4: Key wildlife activities in the Pilbara and Kimberley regions and corresponding time of year

Wildlife type	Activity	Period
Humpback whales	Migration pathway to and from Kimberley calving grounds	Peak between Jun-Aug
Dugong	Breeding Mating	Mar-Aug Aug-Mar
Marine turtles	Nesting Hatching	Sep-Dec Jan-April
Shorebirds	Migratory pathway stop-over	Sep-Apr

15.3 Magnitude of wildlife impact

Given the distribution and behaviour of wildlife in the marine environment, a spill which only impacts Commonwealth offshore waters is likely to result in limited opportunities to rescue wildlife. In such instances, continued wildlife reconnaissance, carcass recovery, sampling of carcasses that cannot be retrieved and scientific monitoring are more likely to be the focus of response efforts. In contrast, a spill which results in shoreline accumulation is likely to result in far greater wildlife impacts and opportunities to rescue wildlife.

The oil spill modelling for the worst-case spill scenarios for the VI Hub activities (**Section 5.4**) predicts that the greatest accumulation of oil will occur at Barrow Island, Lowendal Islands, Montebello Islands and Barrow-Montebello Surrounds (**Table 5-8**). Using the WAOWRP (DBCA 2022a) *Guide for Rating the Wildlife Impact of an Oil Spill* (**Table 15-5**), it is predicted that high wildlife impacts may occur as a result of a worst-case spill scenario associated with this activity.

Table 15-5: WAOWRP Guide for rating the wildlife impact of an oil spill (DBCA, 2022a)

Wildlife impact rating	Low	Medium	High
What is the likely duration of the wildlife response?	< 3 days	3-10 days	>10 days
What is the likely total intake of animals?	< 10	11-25	>25
What is the likely daily intake of animals?	0-2	2 to 5	>5
Are threatened species, or species protected by treaty, likely to be impacted, either directly or by pollution of habitat or breeding areas?	No	Yes - possible	Yes - likely
Is there likely to be a requirement for building primary care facility for treatment, cleaning and rehabilitation?	No	Yes - possible	Yes - likely

15.4 Implementation Guidance

Refer to Section 6 of the Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) for guidance on the tasks and responsibilities that should be considered when implementing an OWR when Santos is the Control Agency or prior to formal hand over to the relevant Control Agency. The implementation guidance within the Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) includes:

- Record keeping;
- Situational awareness;
- Activation of Santos IMT Wildlife Branch;

- Notifications;
- Santos Oiled Wildlife Rapid Assessment Teams (RATs);
- Wildlife Reconnaissance;
- Santos Oiled Wildlife Sample Collection Protocol;
- Mobilisation of required resources;
- Handover to external Control Agency (if relevant).

The OWR first strike plan will focus on notifications, wildlife reconnaissance and response preparation (refer to Section 6.1 of the Santos Oiled Wildlife Response Framework Plan [7700-650-PLA-0017]). Refer to **Table 15-6** for an indicative timeframe and **Appendix T** for resource capability. Preventative actions, such as hazing, along with capture, intake and treatment require a higher degree of planning, approval (licences) and skills and will be planned for and carried out under the wildlife portion of the IAP (refer to Section 6.2 of the Santos Oiled Wildlife Response Framework Plan [7700-650-PLA-0017]).

Table 15-6: Oiled wildlife response – first strike response timeline

Task	Time from oiled wildlife contact (predicted or observed)
IMT notifies regulatory authorities and AMOSC of oiled wildlife / potential for contact	<2 hours
Mobilise Santos personnel for oiled wildlife reconnaissance **this will be already occurring through Aerial Observer mobilisation and Shoreline Assessment Team mobilisation**	<24 hours
Mobilisation of AMOSC oiled wildlife equipment and industry OWR team to forward staging area	<48 hours
Minimum Resource Requirements	
The requirements for oiled wildlife response will be situation specific and dependent upon reconnaissance reports. First strike resources: + Reconnaissance platforms (Refer to Santos Oiled Wildlife Framework Plan (7700-650-PLA-001 and **Appendix T**) + 6 x trained industry oiled wildlife response team personnel (AMOSC staff & contractors/ AMOSC Industry OWR group) + Additional resources: – Refer to Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) – Refer to **Appendix T**	

15.5 Oiled wildlife resourcing requirements

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). It should however be noted that toxicity thresholds for wildlife are likely to be highly variable due to differences in species sensitivity, type of hydrocarbon, type of exposure (ingestion or external oiling), life-stage, and on-water versus land habitat.

Review of the worst-case spill modelling indicates that floating HFO and VI crude blend concentrations above 10g/m^2 may extend up to 400 km from the spill location. HFO has the highest shoreline loading potential of approximately 1,500 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 Montebello Islands, dugong and migrating pygmy blue and humpback 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 1,733 tonnes (approx. 1,780 m^3) and lost over 360 tonnes (approx. 370 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. At the height of the Rena OWR in 2011, approximately 250 personnel were involved in daily wildlife operations, including field staff, the oiled wildlife facility staff, and the numerous support staff required to assist with the management, logistics, planning and human resourcing (Massey University, 2016).

In State waters and for a spill associated with petroleum activities, Santos is required to provide the first strike OWR actions until formal handover to DBCA occurs, whereby, Santos then becomes the support organisation. The Santos Oiled Wildlife Framework Plan (7700-650-PLA-0017) provides guidance for coordinating an OWR when Santos is the Control Agency/providing the first strike OWR/ or acting as a support organisation when DBCA is the lead organisation.

The first strike response actions for this scenario would focus on the Montebello Islands and would initially consist of reconnaissance measures to assess the extent of wildlife impact and formulate the Wildlife Portion of the IAP (in consultation with DBCA), and until formal handover to DBCA. Santos has staff that have had OWR training and would be capable of implementing an OWR first strike and formulating the initial Wildlife Portion of the IAP in consultation with DBCA and the AMOSC OWA. Following formal handover Santos will continue to provide resources as required, the overall OWR capability of Santos is outlined in **Appendix T**.

15.6 Environmental Performance

Table 15-7 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 15-7: Environmental performance – oiled wildlife response

Environmental Performance Outcome	Implement tactics in accordance with the Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Oiled Wildlife Response	**Response preparedness**		
	Maintenance of access to oiled wildlife response equipment and personnel	Maintenance of access to oiled wildlife response equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity.	Access to National Plan resources through AMSA
			AMOSC Participating Member Contract.
			OSRL Associate Member Contract.
	Santos Oiled Wildlife Framework (7700-650-PLA-0017)	Santos Oiled Wildlife Response Framework (7700-650-PLA-0017) provides guidance for coordinating an OWR when Santos is the Control Agency and outlines Santos' response arrangements	Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017)
	Labour hire contract	Maintenance of contract with labour hire provider	Labour hire contract
	Labour hire onboarding procedure (for low skilled shoreline clean-up personnel)	Maintenance of an onboarding procedure for oil spill response labour hire	Onboarding procedure
	Maintain Santos personnel trained on OWR and positioned at Perth and VI	Santos personnel trained in OWR	Training records
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 15-6** unless directed otherwise by DoT/ DBCA.	Incident log
	OWR managed in accordance with the Santos Oiled Wildlife Framework Plan (7700-650-PLA-0017)	Prepare operational NEBA to determine if OWR activities are likely to result in a net environmental benefit.	Records indicate operational NEBA completed prior to OWR operations commencing
		IAP Oiled Wildlife Response sub-plan developed to provide oversight and management of OWR operations.	Records indicate IAP Wildlife Plan prepared prior to OWR operations commencing
		Oiled wildlife sample collection carried out in accordance with the Santos Oiled Wildlife Sample Collection Protocol.	Incident log

16 Waste Management Plan

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

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

Environmental Performance Outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, reusing and recycling waste where possible			
Initiation criteria	Response activities that will be generating oily waste have been initiated.			
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 Overview

The implementation of some spill response strategies will generate solid and liquid waste that will require rapid management, storage, transport and disposal. It is important that waste is collected and removed efficiently to ensure waste management does not create a bottleneck in response operations.

The type and amount of waste generated during a spill response will vary depending on the spill type/characteristics, volume released, and response strategies implemented. To account for this potential variability, waste management (including handling and capacity) needs to be scalable to allow a continuous response to be maintained.

Where Santos is the Control Agency, or at the request of the designated Control Agency, Santos will engage its contracted WSP to provide sufficient waste receptacles to store collected waste and manage oily waste collection, transport and disposal associated with spill response activities. The WSP will arrange for all personnel, equipment and vehicles to carry out these activities from nominated collection points to licensed waste management facilities. All transport will be undertaken via controlled-waste-licensed vehicles and in accordance with the Environmental Protection (Controlled Waste) Regulations 2004. Santos' Oil Pollution Waste Management Plan (7715-650-ERP-0001) provides detailed guidance to the WSP in the event of a spill.

Where DoT is the Control Agency, Santos will provide the Deputy Waste Management Coordinator to the DoT IMT Logistics Unit to support the DoT IMT in coordinating waste management services.

16.2 Implementation Guidance

Table 16-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 16-3** provides a list of resources that may be used to implement this strategy. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 16-2: Implementation guidance – waste management

Action		Consideration	Responsibility	Complete
Initial Actions	Contact WSP (Primary or Secondary Contact Person) and activate Waste Project Manager.	Refer to Incident Response Telephone Directory (SO-00-ZF-00025.020) for contact details.	Logistics Section Chief	❑
	Based on operational modelling and applicable response strategies communicate the type and quantity of empty liquid and solid waste receptacles required to support planned operations.	It is better to overestimate volumes and scale back resources then to underestimate waste volumes.	Logistics Section Chief Planning Section Chief	❑
	Using most recent monitor and evaluate data and any existing and future response activities, determine most suitable locations for waste receptacles to be positioned and for temporary storage locations to be established.	Consideration would be given to positioning receptacles and locating temporary storage sites to ensure secondary contamination of sensitive receptors is avoided or minimised. The approval of temporary storage sites would be given through Department of Water and Environmental Regulation (DWER).	Logistics Section Chief Planning Section Chief Environment Unit Leader	❑
	For each receival location indicate the anticipated: + material types + material generation rates + material generation quantities + commencement date/time + anticipated clean-up duration + receptacle types required + logistical support requirements + any approvals required from Ports, Local Governments, Landowners, State Government Agencies (Refer to Oil Pollution Waste Management Plan (7715-650-ERP-0001)).	Consider facilities for waste segregation at source.	Logistics Section Chief Planning Section Chief	❑

Action		Consideration	Responsibility	Complete
	Once the above information is obtained, ensure all necessary waste management information is included in the IAP.	Waste management should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (7715-650-ERP-0001); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan.	Logistics Section Chief (or delegate) Planning Section Chief Deputy Waste Management Coordinator (DoT IMT) WSP Location Responsible Person or Operations Supervisor	❑
	Mobilise waste management resources and services to agreed priority locations.	-	WSP Location Responsible Person or Operations Supervisor Logistics Section Chief (or delegate) Deputy Waste Management Coordinator (DoT IMT)	❑
Ongoing Actions	Provide ongoing point of contact between IMT and WSP.	If DoT is the Control Agency, the Deputy Waste Management Coordinator shall be the point of contact between DoT and the WSP.	Deputy Waste Management Coordinator (DoT IMT) Logistics Section Chief	❑
	Ensure all waste handling, transport and disposal practices comply with legislative requirements.	Alert Logistics Section Chief (or delegate)/Deputy Logistics Officer (if DoT is the Control Agency) if any non-compliance is anticipated or detected. Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (7715-650-ERP-0001); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan.	WSP Location Responsible Person or Operations Supervisor	❑

Action		Consideration	Responsibility	Complete
	Ensure records are maintained for all waste management activities, including but not limited to: + waste movements (including types of receptacles, receival points, temporary storage points, final disposal locations) + volumes generated at each site (including total volume and generation rates) + types of waste generated at each site + approvals obtained (as required).	-	WSP Location Responsible Person or Operations Supervisor	❑

16.3 Waste approval

Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (7715-650-ERP-0001); and where relevant, the DoT Waste Management Guidelines, and the respective Port, Port Operator and/or Ship Owner's waste management plan. In addition, regulatory approval may be required for the temporary storage, transport, disposal and treatment of waste, through DWER. DWER administers the *Environmental Protection Act 1986* (WA) and is the relevant Regulatory Authority for waste management approvals. If required, DoT may establish an Operational Area Support Group, as defined in the State Hazard: SHP-MEE, to request support from relevant WA Government Agencies, including DWER, during a State waters spill response. The Santos Oil Pollution Waste Management Plan (7715-650-ERP-0001) provides detail on the regulatory requirements for each port/location likely to be used for waste management during any spill response operation associated with Santos' activities.

16.4 Waste Service Provider Capability

Detailed guidance on Santos' WSP responsibilities for spill response waste management is provided in the Santos Oil Pollution Waste Management Plan (7715-650-ERP-0001).

Key responsibilities of the WSP include:

- Maintain emergency response standby preparedness arrangements, including:
  - Have access to personnel, equipment and vehicles required for a first strike and ongoing response commensurate to Santos worst-case spill and waste requirements.
  - Provide primary and secondary contact details for activation of spill response waste management services.
  - Have suitably trained personnel for completing critical tasks in spill response waste management.
  - Participate in exercises undertaken by Santos.
- Maintain ability to assist in the Control Agency's IAP and Waste Management Sub-plan process as required.
- Mobilise resources to waste collection points identified by the Control Agency.
- Ensure waste handling, transport and disposal practices meet legislative requirements.
- Keep auditable records of waste streams from collection points to final disposal points.
- Provide regular progress reporting to the Control Agency IMT and a final report relating to quantities and destinations of collected waste.
- Provide a project manager responsible for the rollout of spill response resources to meet spill response waste management objectives.
- Provide location-specific Operations Supervisor/s to handle on-site operational aspects (management of personnel and equipment, reporting, liaison with relevant field-based spill responders).

16.5 Waste management resources

Santos has access to capacity to deliver storage receptacles, remove, transport and dispose of all waste material from oil spill response activities to predetermined disposal points.

Table 16-3 provides waste service provider capability for waste removal and storage, which is in excess of the waste management requirements for spill response activities associated with this OPEP. The weekly removal capacity is 8,778 m^3 totalling 105,336 m^3 over the estimated 12 weeks (84 days) expected for shoreline clean-up response (**Section 13.4**).

Stochastic modelling conducted for a worst-case hydrocarbon release shows that the highest shoreline loading was from an offtake tanker HFO spill (1,900 m^3) which could result in a maximum loading of approximately 1,500 m^3 on shorelines of the Montebello Islands. Lesser amounts were modelled as potentially arriving at 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. Conservatively assuming all loaded hydrocarbons are required to be removed from shorelines with a bulking factor of 10 to account for contaminated waste (sediments and organics) collected with the oil, total worst-case waste storage and transport requirements would be in the order of ~15,000 m^3 over the estimated 12 weeks (approximately 1,250 m^3 per week) expected for shoreline clean-up (**Section 13.4**). The storage capacity of the waste storage provider exceeds the removal capacity.

Liquid waste from containment and recovery operations over one week is 236 m^3 based on the worst-case scenario for offshore containment and recovery identified in **Section 11.3.2.** This is exceeded by the waste service provider weekly liquid waste removal capacity of 5,250 m^3 at the port of reception (Dampier).

Table 16-3: North West Alliance vehicle and equipment availability for waste storage and removal capability (as per Oil Pollution Waste Management Plan [7715-650-ERP-0001])

Plant and Equipment	No	Capacity	Functionality	Uses per week	Waste stored/shifted per week (m^3)
Waste removal					
Oily waste					
Skip Lift Truck	14	Lift up to 10 Tonnes, 4.3 m^3 per service	Servicing of skip Bins	7	420
Front Lift Trucks	10	28 m^3 Body, 11.2 m^3 per service	Servicing of Front lift Bins	7	784
Side Loading Truck	10	18 m^3 Body, 7.2 m^3 per service	Servicing of MGB's	7	504
Hook Lift Truck	8	Lift up to 15T, 17.5 m^3 per service	Servicing of hook lift Bins	7	980
Flat Bed Truck	16	15 pallet spaces, 17.5 m^3 per service	Servicing of bins	7	840
Liquid oil					
Liquid waste tankers (triple 'road-train' configuration)	10	75 m^3 capacity	Collection of liquid waste at the port of reception (Dampier)	7	5,250
Waste storage					
Oily waste					

Plant and Equipment	No	Capacity	Functionality	Uses per week	Waste stored/shifted per week (m^3)
ISO-tainers	15	$22m^3$ capacity	Various waste streams	2	660
MGBs	500	240L	Mobile bins	2	240
Offshore 8 pack Lifting Cradle (MGBs)	2	16 x 240L MGBs	Able to remove 16 x 240L MGBs simultaneously	continuous	
Lidded Bins	6	1,100L	contain various waste streams	2	13
Front Lift Bins	50	3 m^3	various waste streams	2	300
Front Lift Bins	25	4.5 m^3	various waste streams	2	225
Offshore Rated Front Lift Bins	100	3 m^3	various waste streams	2	600
Offshore Rated Skip Bins	45	7 m3	various waste streams	2	630
Marrell Skip Bins (onshore)	60	6–9 m^3, assumed 8 m^3 per service	various waste streams	2	960
Hook Lift Bins	12	15–30 m^3, assumed 23 m^3 per service	various waste streams	25	6,900
Forklift	4	4 tonne Forklift	All areas	continuous	
				Weekly waste storage capacity	**10,528**
				Weekly total waste removal capacity	**8,778**
				Weekly liquid oil removal capacity	**5,250**

16.6 Environmental Performance

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

Table 16-4: Environmental performance – waste management

Environmental Performance Outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, reusing and recycling waste where possible		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement Criteria**
Waste Management	**Response preparedness**		
	Maintain access to waste management equipment, personnel, transport and disposal facilities	Maintain access to waste management equipment, personnel, transport and disposal facilities throughout activity	Contract with WSP for emergency response services

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**
	Response Implementation		
	Implement Oil Pollution Waste Management Plan (7715-650-ERP-0001)	WSP to appoint a Project Manager within 24 hours of activation	Incident Log
		Provision of liquid oil waste tanks for containment and recovery operations to deployment port, if requested, within 24 hours	Incident Log
		Provision of waste bins for oil and oily waste for shoreline clean-up operations to clean-up site or deployment port, if requested, within 24 hours	Incident Log
		WSP shall track all wastes from point of generation to final destination	Waste tracking records
		WSP to provide monthly waste management reports and more regular situation reports during the response until termination criteria are met	Waste reports

17 Scientific Monitoring Plans

Table 17-1: Scientific monitoring – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill or affected by a spill response.			
Initiation criteria	Refer to individual Receptor SMPs – **Appendix O**			
Applicable hydrocarbons	**Condensate**	**Crude oil**	**Marine Diesel**	**HFO**
	✔	✔	✔	✔
Termination criterion	Refer to individual SMPs – **Appendix O**			

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

Santos will activate and implement scientific monitoring in State and Commonwealth waters for hydrocarbon spills in line with its SMPs unless directed otherwise by the relevant Control Agency/s.

17.1 Objectives

The overarching objective of Santos' SMPs is to provide guidance to staff, consultants and contractors in developing monitoring a monitoring program for detecting impacts and recovery to environmentally sensitive receptors contacted by a spill.

Receptor-specific SMPs have different objectives as outlined in **Appendix O.**

17.2 Scope

Santos will implement its SMPs, as applicable, for Varanus Island Hub Operations activity oil spills across both State and Commonwealth waters. In the event that control of scientific monitoring in State waters is taken over by DoT under advice from the State Environmental Scientific Coordinator, Santos will follow the direction of DoT and provide all necessary resources (monitoring personnel, equipment and planning) to assist as a Supporting Agency.

17.3 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.

Santos

Scientific monitoring is designed to provide data for short-term and longer-term environmental effects assessment. This is typically required to be quantitative in nature and appropriate for statistical analyses. However, these two types of monitoring are related, and Operational Monitoring outputs typically inform the final design of the related SMP.

17.4 Scientific Monitoring Plans

Owing to the diverse nature of sensitive receptors that could be contacted by an oil spill and the different techniques and skillsets required to monitor impact and recovery to these receptors, there are a number of Oil Spill Scientific Monitoring Plans relevant to Varanus Island Hub Operations activities (**Table 17-2**). These are detailed further in **Appendix O;** 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 Varanus Island Hub Operations activities

Study	Title
SMP1	Marine Water Quality
SMP2	Marine Sediment Quality
SMP3	Shorelines and Coastal Habitats – Sandy Beaches and Rocky Shores
SMP4	Shorelines and Coastal Habitats – Mangroves
SMP5	Shorelines and Coastal Habitats – Intertidal Mudflats
SMP6	Benthic Habitats
SMP7	Seabirds and Shorebirds
SMP8	Marine Mammals
SMP9	Marine Reptiles
SMP10	Seafood Quality
SMP11	Fish, Fisheries and Aquaculture
SMP12	Whale Sharks

17.5 Baseline monitoring

Baseline monitoring provides information on the condition of ecological receptors prior to, or spatially independent of (e.g. if used in control chart analyses), a spill event and is used for comparison with the post-impact scientific monitoring where required. This is particularly important for scientific monitoring where the ability to detect changes between pre-impact and post-impact conditions is necessary.

In the event of a spill to marine or coastal waters, reactive pre-impact monitoring should, where practicable, be implemented to gather additional data on the current state of the environment.

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

In addition, Santos is undertaking a review of Varanus Island water quality and sediment quality data that is due to be completed by the end of Q3 2023.

17.6 Monitoring service providers

The Oil Spill Scientific Monitoring will be conducted on behalf of Santos by contracted monitoring service providers (MSPs) and applies to the implementation of SMPs 1 to 12 (**Table 17-2**). These services are provided by Santos' Monitoring Service Provider. **Appendix Q** provides further information regarding the Monitoring Service Provider's capability and assurance arrangements.

For whale sharks, scientific monitoring of whale sharks (SMP12) along the Ningaloo Coast and north-west Australian coastline will be undertaken. Santos has historically and currently supports research on the behaviour, demography and migration patterns of whale sharks at Ningaloo Reef conducted by Australian Institute of Marine Science. In the event of a spill that could impact whale sharks, Santos will leverage off this long-term research program to assess potential impacts to whale sharks at, and migrating to-and-from, Ningaloo Reef. SMP12 is regarded as complementary to SMP8 which will detect potential impacts to whale sharks from visual surveys of whale sharks wherever they may occur in relation to a spill.

As per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162), Santos' MSP provides the following scientific monitoring services to Santos:

+ 24/7 monitoring support accessed through 24 hr call out number;
+ provision of a suitably trained Monitoring Coordination Team including a Monitoring Coordinator, Monitoring Operations Officer, Planning and Logistics Officer and Safety Officer;
+ provision of Technical Advisers and Field Teams (staff and contractors) for first strike deployments;
+ maintenance of standby monitoring equipment;
+ monthly personnel capability reports;
+ provision and review of Scientific Monitoring Sub-plans;
+ provision and review of Standby Service Manual (EA-00-RI-10162) and associated response activation forms; and
+ participation in audits, workshops, drills and exercise to facilitate readiness.

Appendix Q provides an overview of Santos' 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 Operations.

17.7 Activation

The SMP Activation Process is outlined in **Appendix P.** SMPs are activated as per the initiation criteria for each as outlined in **Appendix O**. The SMP Activation Form is available on the Santos ER SharePoint and IMT Environment Unit Leader folder.

The Santos IMT Environment Unit Leader with support from IMT Environment Unit members is responsible for activating the primary MSP. The Santos Environment Team will assist the MSP Monitoring Coordination personnel and relevant Technical Advisers in defining the monitoring study design, monitoring locations and field methodologies based on Operational Monitoring information (e.g. spill modelling and aerial surveillance information), relative location of sensitive receptors to the spill and the timing of the spill with respect to seasonality of sensitive receptors.

This process will identify monitoring operational objectives and resourcing/ mobilisation requirements which the Environment Unit Leader will feed back to the IMT for approval. A pre-approved Purchase Order (PO) for first strike operational and scientific monitoring, which includes a contingency provisional initiation budget, is in place between Santos and the MSP, which ensures that the MSP can commence work immediately upon notification. A standard Risk Assessment (RA) for monitoring activities has also been pre-completed and approved by the MSP and Santos, enabling personnel to be in field and on-task as rapidly as possible.

Mobilisation times for the minimum resources that are required to commence initial scientific monitoring operations are listed in **Table 17-3**.

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

Table 17-3: Scientific monitoring – first strike response timeline

Task	Time from activation of SMP
Monitoring Service Provider commences activation process once initial notification form is received from Santos	30 mins
Santos IMT approve initial monitoring action plan	<24 hours of monitoring action plan submission from MSP
Santos to mobilise sampling platforms to deployment location	72 hours from monitoring action plan approval*
SMP teams and monitoring equipment mobilised to deployment locations	72 hours from monitoring action plan approval*
Minimum Resource Requirements	
Initial resourcing requirements will be dependent upon the number of SMPs activated and the requirement for post spill baseline data to be collected. First strike personnel requirements for scientific monitoring field teams at Protection Priority areas are presented in **Appendix Q**. + Suitable vessels for on-water monitoring or transfer of personnel to remotes areas/islands + Vehicle/s as required + Helicopter for aerial surveys as required + Scientific monitoring personnel for first strike teams (refer **Appendix Q**) + Scientific monitoring equipment as detailed in the relevant SMP	

* Refer to further details of the response timeframes in Appendix P: Oil Spill Scientific Monitoring Activation and Response Process.

17.8 Environmental Performance

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

Table 17-4: Environmental performance – scientific monitoring

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement criteria**
Scientific Monitoring	**Response preparedness**		
	Maintenance of Monitoring Service Provider contract for scientific monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity	Contract with monitoring service provider

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement criteria**
	Pre-approved purchase order for first strike operational and scientific monitoring with Monitoring Service Provider	Pre-approved purchase order is in place with Monitoring Service Provider	Pre-approved purchase order
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Conduct periodical review of existing baseline data sources across the Santos combined EMBA	Regular review of baseline data	Baseline data review report
	Water quality monitoring vessels	Maintenance of vessel specification for water quality monitoring vessels within Santos Vessel Requirements for Oil Spill Response (7710-650-ERP-0001)	Vessel specification
	Oil sampling equipment	Oil sampling kits located at Exmouth and Varanus Island	Evidence of deployment to site
	Pre-completed risk assessment for operational and scientific monitoring activities	Pre completed and approved risk assessment is in place with the Monitoring Service Provider for operational and scientific monitoring activities.	Monitoring Service Provider pre-completed and approved risk assessment
	Response implementation		
	Activate Scientific Monitoring Plans	Initiation criteria of SMPs will be reviewed during the preparation of the initial IAP and subsequent IAPs; and if any criteria are met, relevant SMPs will be activated	Incident Action Plan and Incident Log
		If any SMPs are activated, the subsequent activation of MSP is to follow the activation as per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Incident Log
		MSP shall commence activation process within 30 mins of initial notification form being received from Santos	Monitoring Service Provider records

Environmental Performance Outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response Strategy	**Control Measures**	**Performance Standards**	**Measurement criteria**
		Santos personnel to support MSP through the provision of operational monitoring information and relative location of sensitive receptors to the spill	Incident Log and Monitoring Service Provider records
	Mobilisation of minimum requirements for initial scientific monitoring operations	Minimum requirements mobilised in accordance with **Table 17-3**	Incident log
		Source monitoring vessel(s) with specifications in accordance with Section 5.2 of Santos Vessel Requirements for Oil Spill Response (7710-650-ERP-0001)	Incident log

18 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 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.

19 Oil Pollution Emergency Plan Administration

19.1 Document Review and Revision

In line with regulatory requirements, this document shall be reviewed, updated and submitted to DEMIRS 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 Management of Change Procedure (EA-91-IQ-10001). This could include changes required in response to one or more of:

+ when major changes have occurred that affect oil spill response coordination or capabilities
+ changes to the Environment Plan that affect oil spill response coordination or capabilities (e.g. a significant increase in spill risk)
+ following routine testing of the OPEP if improvements or corrections are identified
+ after a Level 2/3 spill incident.

The extent of changes made to the OPEP and resultant requirements for regulatory resubmission will be informed by the relevant State and Commonwealth regulations, i.e. the OPGGS (E) Regulations, P(SL)(E) Regulations and PP(E) Regulations.

19.2 OPEP Custodian

The custodian of the OPEP is Santos Senior Oil Spill Response Coordinator.

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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 A-1**).

Table A-1: Characteristics of Marine Diesel

Hydrocarbon	Initial density (kg/m^3)	Viscosity (cP) @ 25oC	Component	Volatiles (%)	Semi-volatiles (%)	Low volatility (%)	Residual (%)
			Boiling Points (°C)	<180	180–265	265–380	>380
Diesel	836.8	4.0	% of total	6	34.6	54.4	<5

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, refer to:

- Varanus Island Hub Operations EP (EA-60-RI-00186) (State waters);
- Varanus Island Hub Operations Environment Plan for Commonwealth Waters (John Brookes, Greater East Spar and associated Facilities) (EA-66-RI-10003);
- Spartan Development EP Addendum (EA-60-RI-10003.02) to the Varanus Island Hub Operations Environment Plan for Commonwealth Waters;
- Halyard-2 Drilling and Completion Project EP (9887-650-REP-0001); and
- Campbell Bridging Document (BD) to the VI Hub Asset Removal Operations (ARO) EP (7935-650-EIS-0001).

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 A-2**). HFO is a manufactured blend of hydrocarbons largely composed of low-volatile and persistent hydrocarbons to which a small proportion of higher volatility components are added. The oil has a low percentage of volatile and semi-volatile components (a total of < 6%). Approximately 11% of the volume has low volatility (boiling point between 265 and 380°C), that would require weeks to evaporate. A further 83% is composed of non-volatile components (boiling point greater than 380° C), which will not evaporate under typical environmental conditions that occur on the North West Shelf. The soluble aromatic hydrocarbons represent a low proportion of the volume of HFO, at approximately 2.2%.

HFO has high viscosity (> 3000 cSt) when fresh and the viscosity will rise through evaporation of lighter components and, consequently, will not spread as rapidly as less viscous oil types. 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 A-2: Characteristics of HFO

Hydro-carbon	Initial density (g/cm^3) @ 15°C	Viscosity (cP) @ 25°C	Volatiles (%)	Volatiles (%)	Semi volatility (%)	Low volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180	180–265	265–380	>380	Of whole oil < 380 °C BP
Heavy Fuel Oil	0.9749	3180	% of total	1.0	4.9	11.3	82.8	2.2
				Non-persistent			Persistent	

Source: APASA (2013b)

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 A-1**. 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.

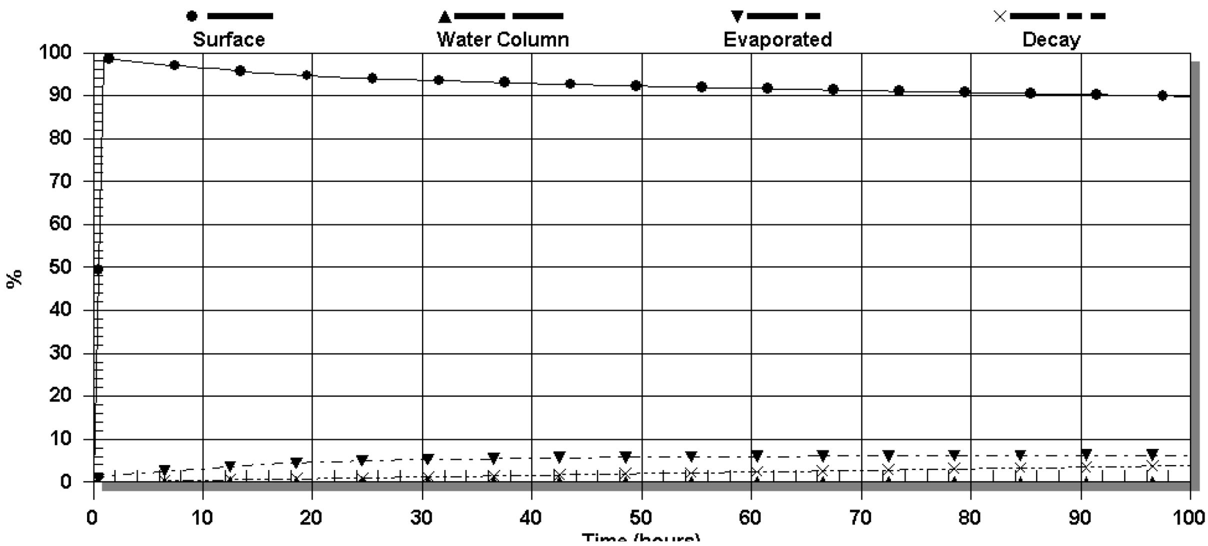


Figure A-1: Proportional mass balance plot representing the weathering of Heavy Fuel Oil spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

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 A-3. 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 A-4, 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 A-3: 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

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

Table A-4: Characteristics of Harriet Crude

Oil Name	Initial density (g/cm^3) (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 knots) at 27 °C water temperature and 25 °C air temperature is shown in **Figure A-2**. 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.

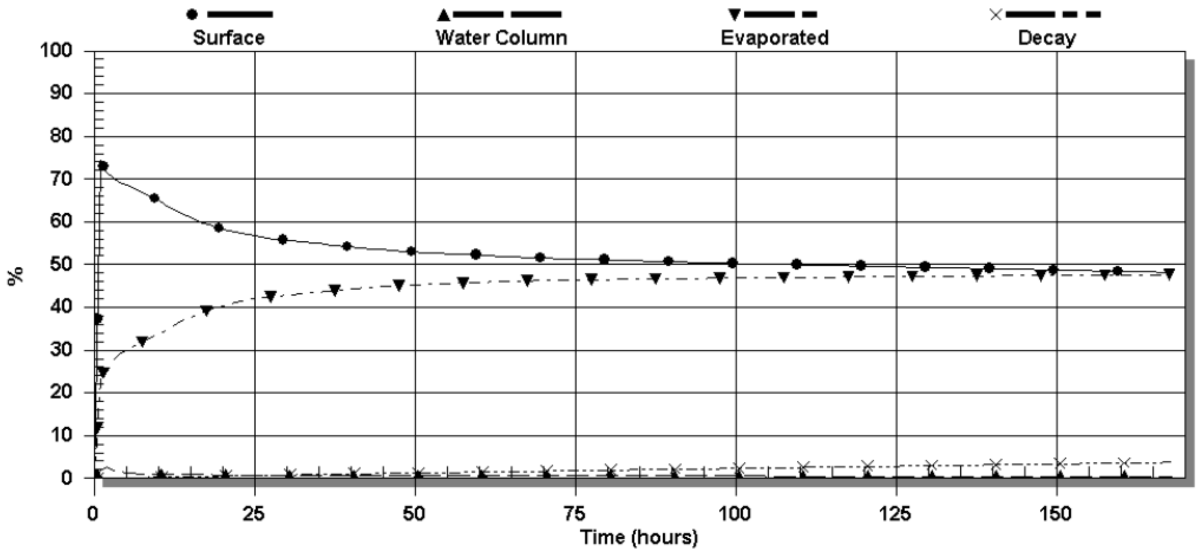


Figure A-2: Proportional mass balance plot representing the weathering of Harriet Crude spilled onto the water surface as a one-off release (50 m^3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Agincourt – 1 crude oil

No data on aromatics is available for Agincourt -1 Crude (**Table A-5**), 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 A-5: Characteristics of Agincourt–1 Crude

Oil Name	Initial density (g/cm^3) (15 °C)	Vis-cosity (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 knots) at 27 °C water temperature and 25 °C air temperature is shown in **Figure A-3**. 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.

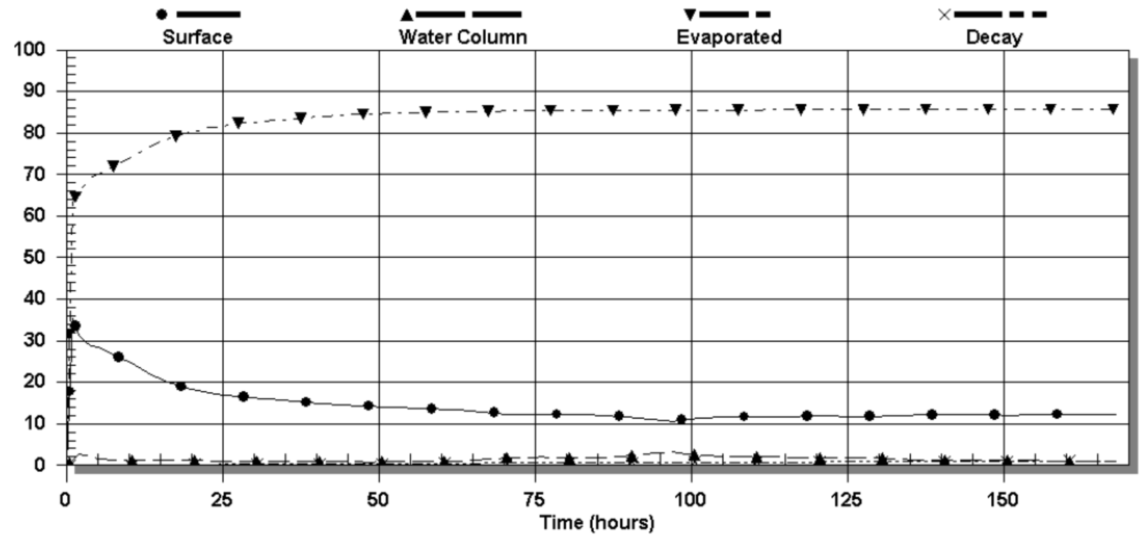


Figure A-3: Proportional mass balance plot representing the weathering of Agincourt-1 Crude spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

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 A-6**. 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 A-6.** 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 A-6**). Full assay date for Linda condensate is included in **Table A-6**.

Table A-6: Characteristics of Brunello-1 and Linda Condensates

Oil Name	Initial density (g/cm^3) (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 knots) at 27 °C water temperature and 25 °C air temperature is displayed in **Figure A-4**. 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.

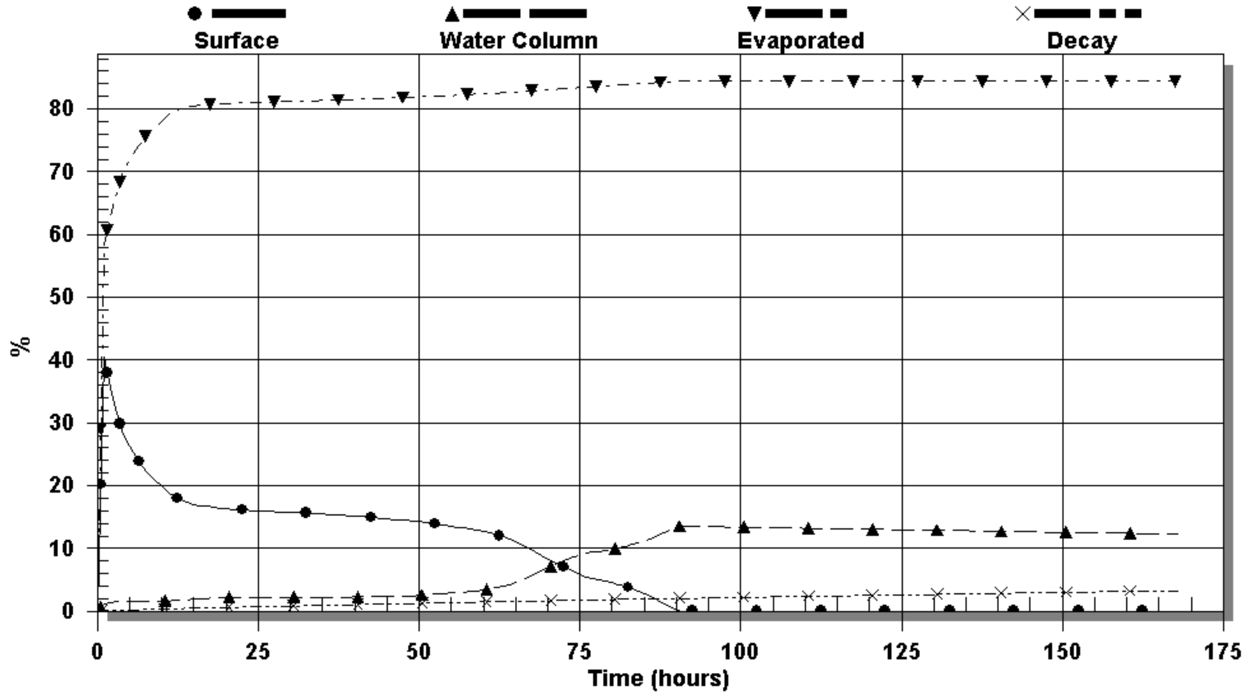


Figure A-4: Proportional mass balance plot representing the weathering of Brunello-1 Condensate spilled onto the water surface as a one-off release (50 m^3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

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 A-7**. 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 A-6**. 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 A-7: Characteristics of John Brookes condensates

Condensate	Initial density (g/cm^3) (15 °C)	Viscosity (cP) (20 °C)		Volatiles	Semi-volatiles	Low volatility	Residual	Aromatics
			Boiling Points (°C) and Carbon (C) numbers	<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 A-5**. 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 A-6**. 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.

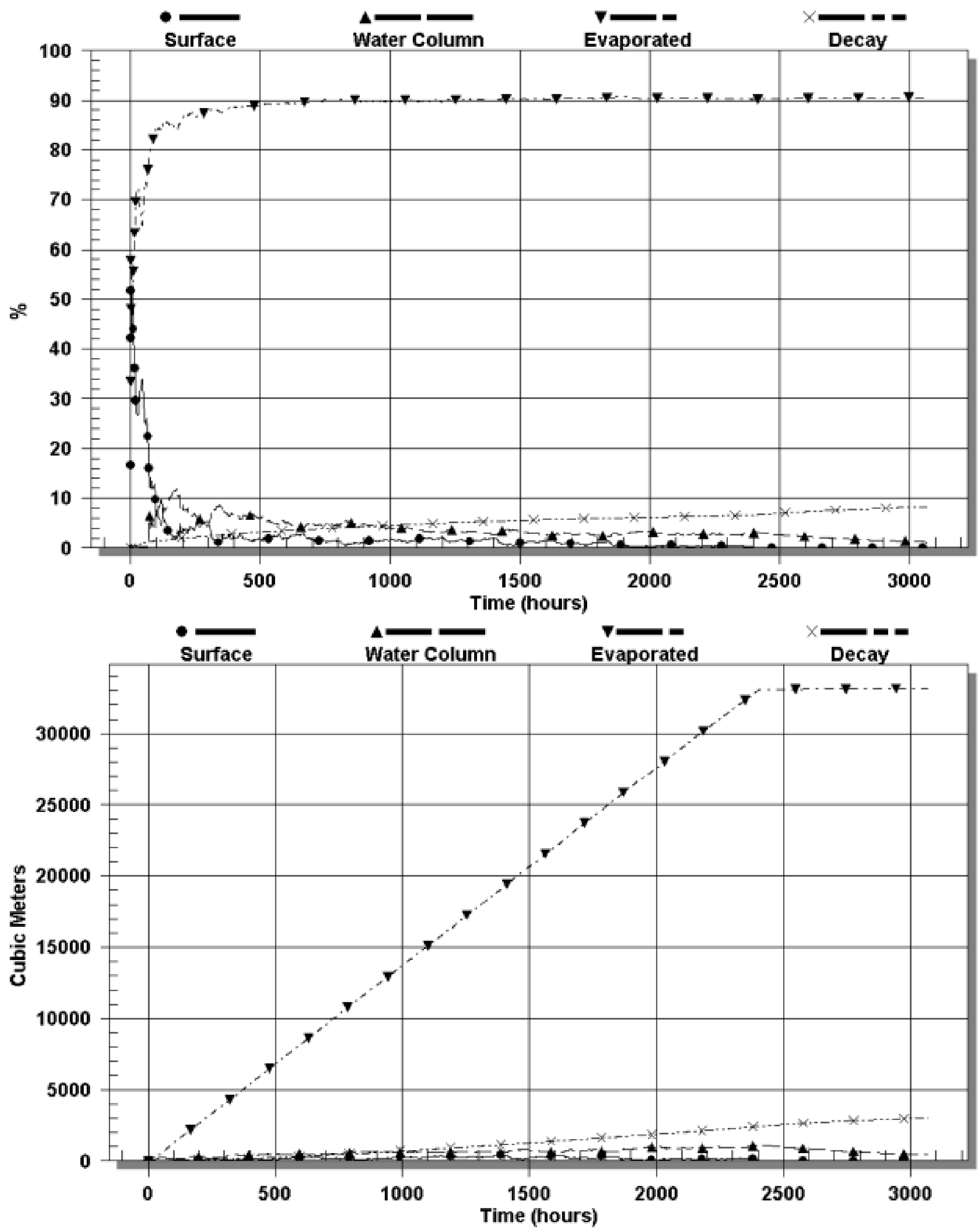


Figure A-5: Predictions for the partitioning of oil mass over time through weathering processes for a 39,011m^3 surface release of John Brookes Condensate at a constant rate over 100 days, as percentage (top) and by volume (bottom). Predictions are based on examples of time varying environmental conditions.

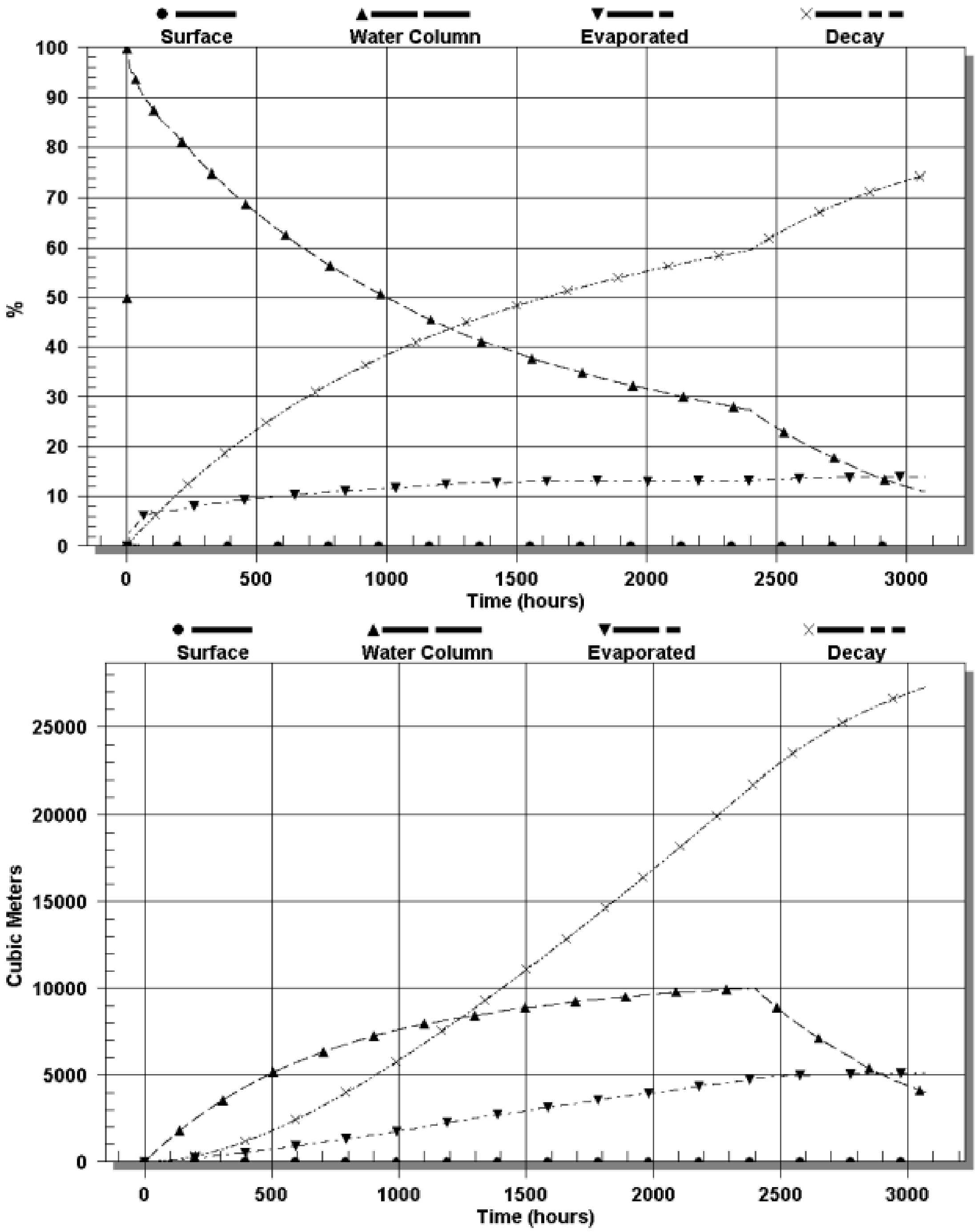


Figure A-6: Predictions for the partitioning of oil mass over time through weathering processes for a 39,011m^3 subsea release of John Brookes Condensate at a constant rate over 100 days, *as percentage (top) and by volume (bottom). Predictions are based on examples of time-varying environmental conditions*

Halyard condensate

Characteristics of Halyard-1 Condensate (**Table A-8**) were obtained from assay. The data indicates that Halyard-1 Condensate is highly volatile, with approximately 64% of the oil volume expected to evaporate within the first 12 hours if exposed to the atmosphere. A further 21% has moderate volatility and will evaporate over the first 24 hours, while another 15% will evaporate over a few days. This condensate contains a very low proportion of persistent components (0.05%). 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 A-8: Characteristics of Halyard-1 Condensate

Oil Name	Initial density (g/cm3) (15 °C)	Viscosity (cP) (20 °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	0.771	1.5	% of total	64.3.	20.7	15	0.05	15.2

Predictions for the fate of a continuous surface release of Halyard-1 Condensate at the surface under representative ambient (variable wind) conditions are shown in **Figure A-7**. The results indicate that after 24 hours 19% of the condensate mass has entrained and a further 77% is shown to have evaporated, leaving only a small proportion of the condensate floating on the water surface (<0.1%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves. Given the proportion of entrained condensate and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

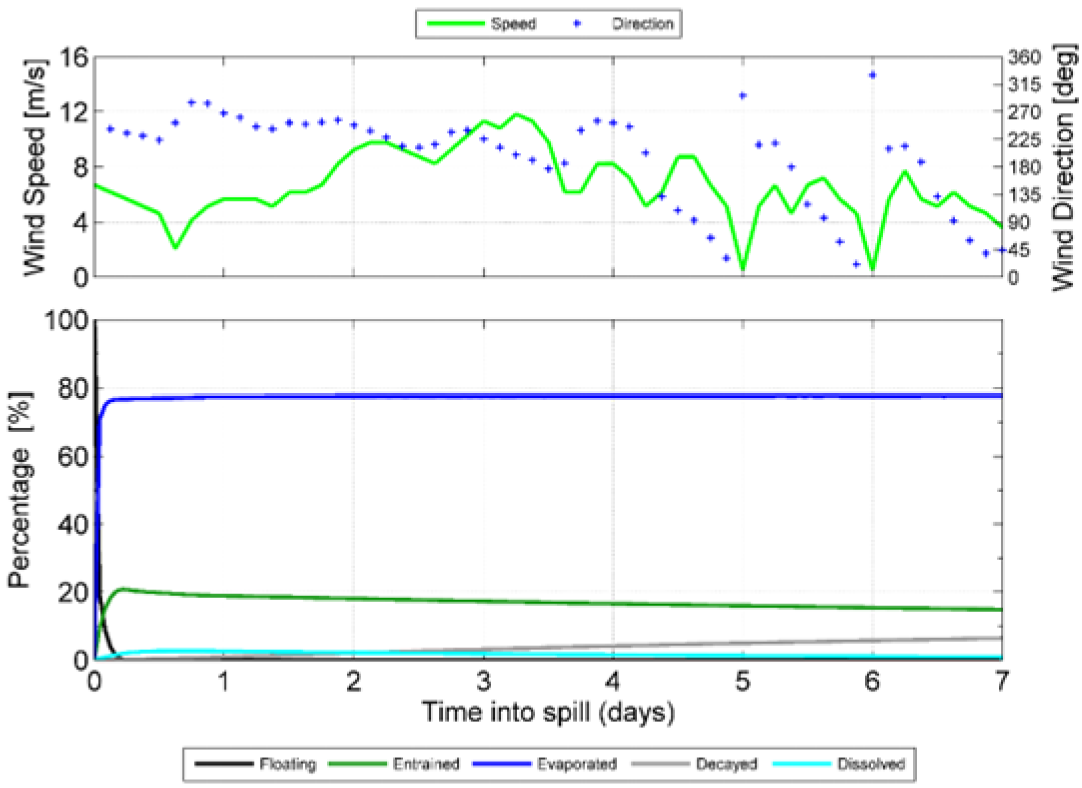


Figure A-7: Prediction for the partitioning of oil mass over time through weathering processes (% of total mass) of Halyard-1 Condensate

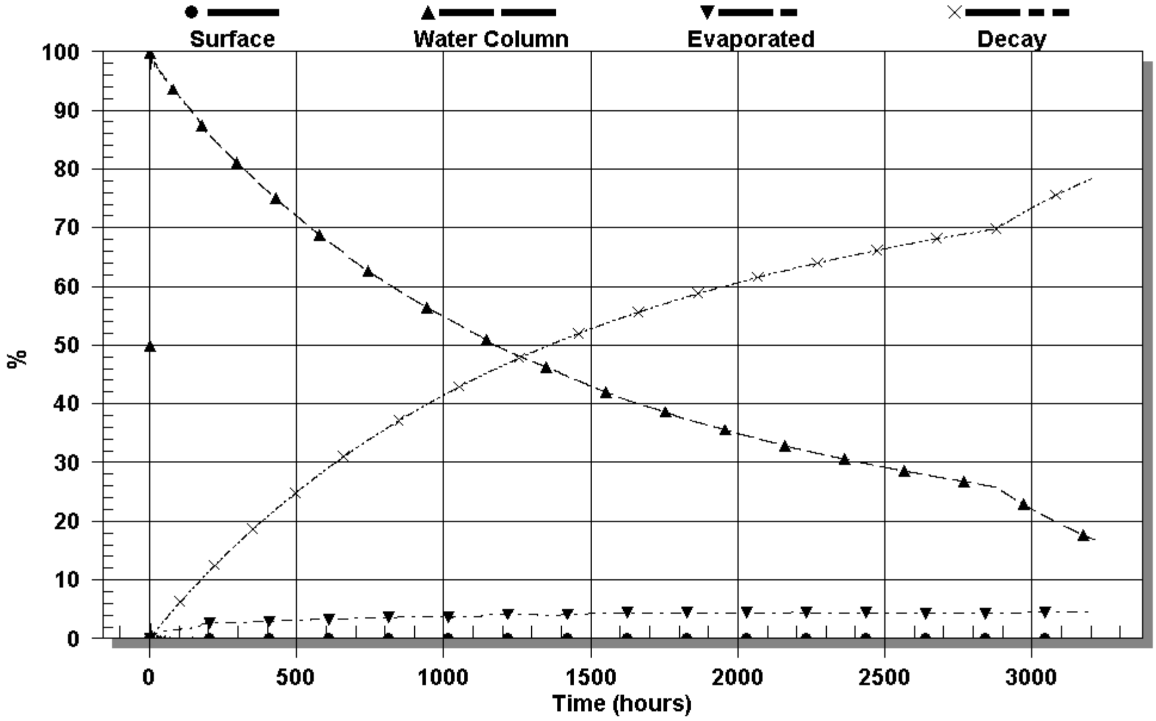
East Spar condensate

The characteristics of East Spar condensate are presented in **Table A-9**. 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 A-9**).

Table A-9: Characteristics of East Spar condensate

Initial density (g/cm^3) (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 A-8**. 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 m3 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.



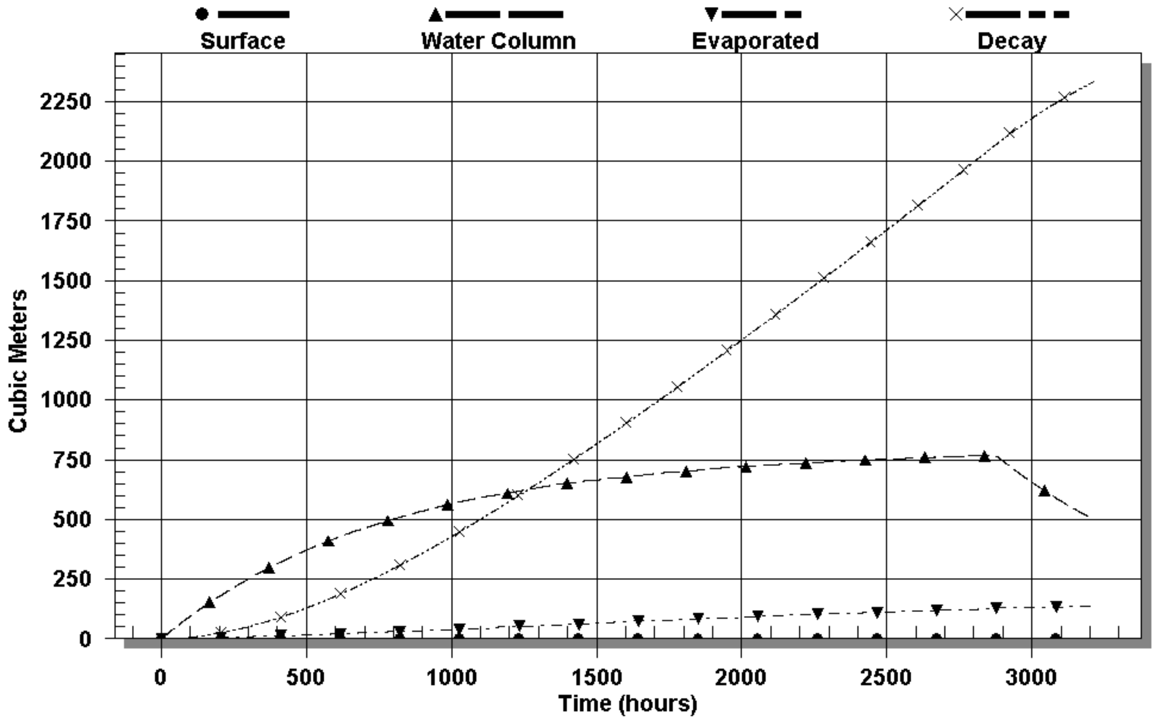


Figure A-8: Predictions for the partitioning of oil mass over time through weathering processes for a worst-case 3,393m^3 seabed release of East Spar Condensate at a constant rate over 120 days, as percentage (top) and by volume (bottom). Predictions are based on examples of time varying environmental conditions.

Spartan Condensate

The characteristics of Spartan condensate are presented in **Table A-10**. This condensate shows greatest proportion of volume (approximately 90%) 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 14.9% of total volume of the condensate (**Table A-10**).

Table A-10: Characteristics of Spartan 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	
0.797	0.62	% of total	73.2	16.8	6.7	3.3	14.9
		% aromatics	13.3	1.3	0.3		

Predictions for the fate of a worst-case subsea release of Spartan condensate over 77 days under representative ambient conditions are shown in **Figure A-9**. The results indicate that approximately 90% of the surface slick is predicted to evaporate in the first 24 hours, with approximately less than 9% remaining on the sea surface after seven days.

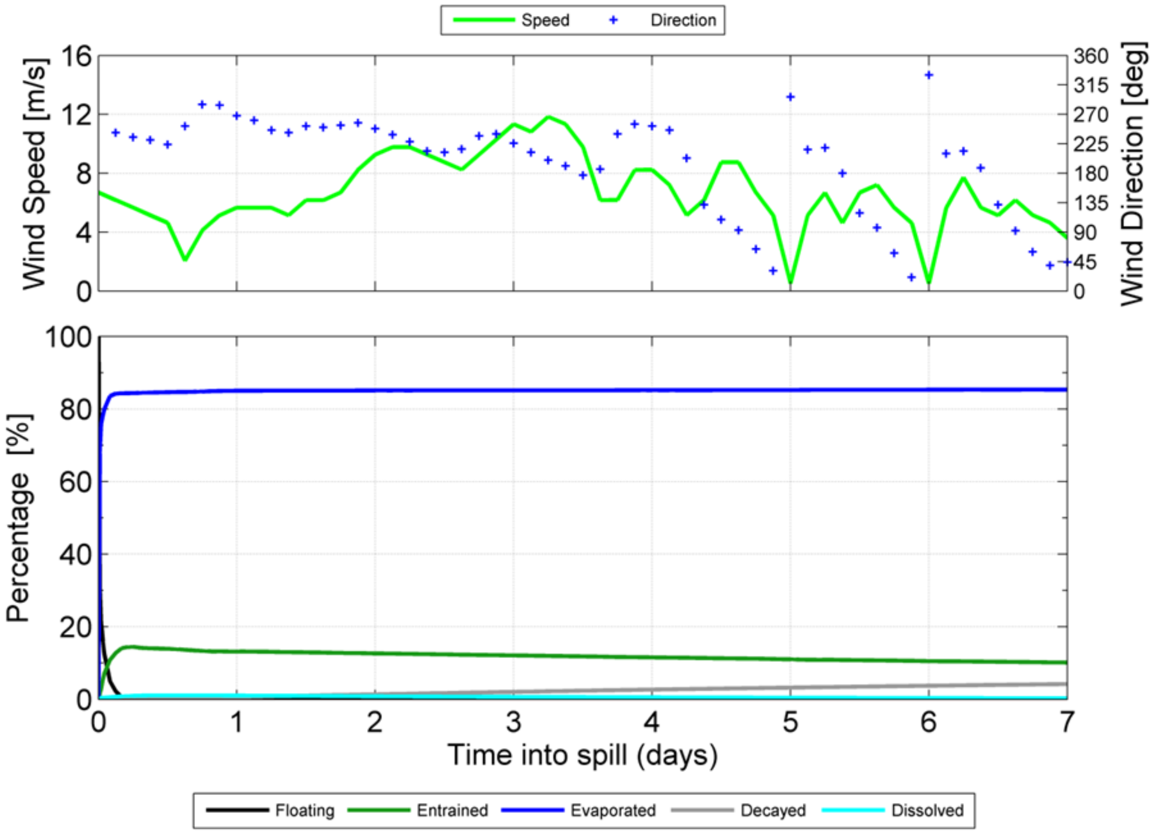


Figure A-9: Simulated weathering of Spartan condensate for variable wind speeds (RPS, 2021b)

Varanus Island Blend crude

Characteristics of Varanus Island Blend crude (**Table A-11**) 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 A-11: 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 A-10**. 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.

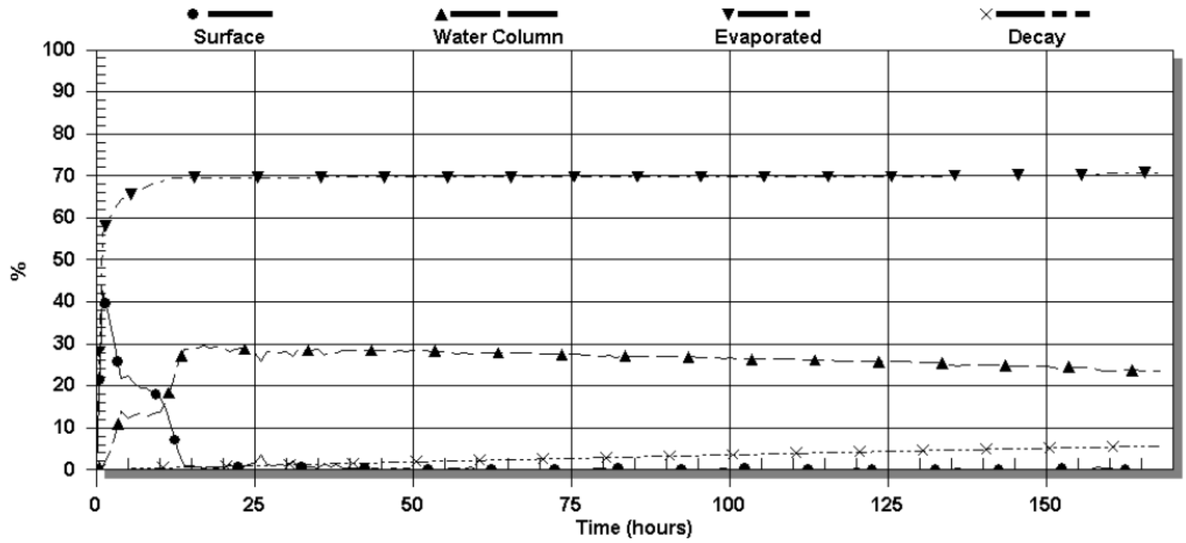


Figure A-10: Proportional mass balance plot representing the weathering of Varanus Island Blend Crude spilled onto the water surface as a one-off release (50 m3 over 1 hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Appendix B: Oil Spill Response ALARP Framework & Assessment

ALARP Assessment Framework

Rationale

As part regulatory approval requirements for petroleum activities, the Environment Plan (EP) and/or Oil Pollution Emergency Plan (OPEP) must demonstrate that through the implementation of all reasonable control measures, environmental risks have been reduced to a level that is As Low As Reasonably Practicable (ALARP).

With respect to hydrocarbon spill risk and response planning, this includes an assessment to demonstrate that the oil spill response control measures are reducing risk to a level that is ALARP.

This ALARP Assessment Framework provides a process to facilitate the identification of all existing and potential spill response control measures, the selection or rejection of which are supported by reasoned arguments.

Guidance Documents

Guidance documents used in the preparation of this framework include:

+ Oil Spill Risk Assessment and Response Planning Procedure SO-91-II-20003;
+ NOPSEMA Guidance Note ALARP N-04300-GN0166, August 2022;
+ NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020;
+ NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721, December 2022;
+ NOPSEMA Guidance Note Risk Assessment GN0165, June 2020; and
+ NOPSEMA Oil Pollution Risk Management GN1488, July 2021.

Overview

The ALARP Assessment Framework uses activity specific information to systematically assess existing and potential control measures and ensure that all practicable control measures are identified and documented.

When selecting controls to reduce risk it is good practice to apply a preferential order; elimination, substitution, prevention, reduction and mitigation. In the context of this ALARP Assessment Framework for oil spill response, all control measures are response strategies to reduce the impacts of an unplanned event that has already occurred. All source control response measures may be classed as ‘reduction’ in the hierarchy of controls with all other response measures classed as ‘mitigation’.

The ALARP Assessment Framework is shown in Figure B-1.

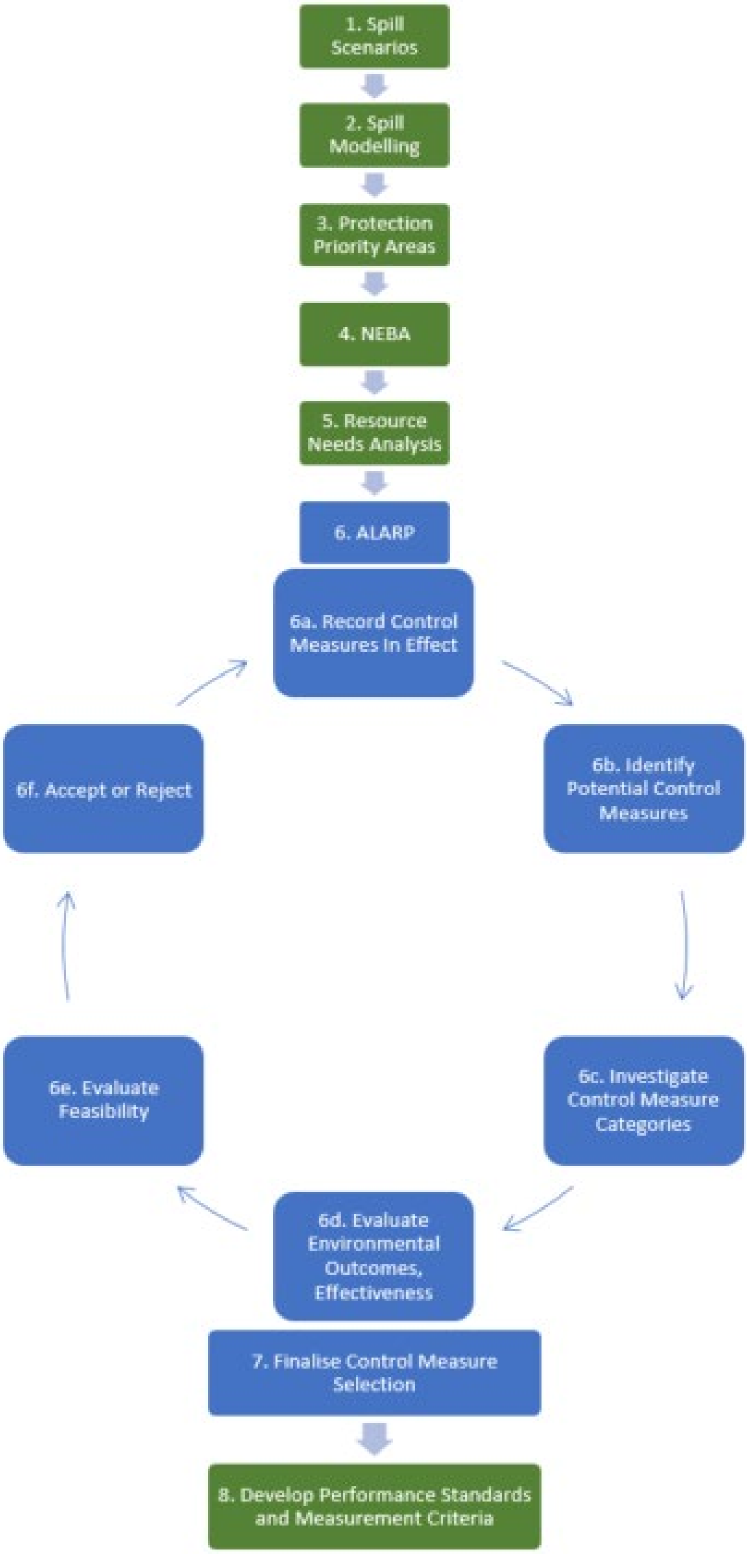


Figure B-1: ALARP Assessment Framework

In **Figure B-1**, Steps 1 to 5 (in GREEN) denote input information into the ALARP Assessment Framework. This information comprises:

1. Spill Scenarios: this step will involve assessing all possible spill scenarios from the activity and identifying the worst-case credible scenarios as a basis for pollution response planning.

2. Spill Modelling: a quantitative spill modelling assessment is conducted for the worst-case credible scenarios identified in Step 1.
3. Protection Priority Areas: The environment that may be affected (EMBA) is the largest area within which impacts from hydrocarbon spills associated with the activity could extend. The EMBA is predicted using spill modelling results from Step 2. Protection Priority Areas are locations of high ecological value within the EMBA that would be targeted in response. Selection of Protection Priority Areas is detailed in the Oil Spill Risk Assessment and Response Planning Procedure SO-91-II-20003
4. NEBA: Net Environmental Benefit Analysis (NEBA) is used to select the most effective response strategies to protect the Protection Priority Areas identified in Step 3.
5. Resource Needs Analysis: For the response strategies identified through NEBA, the worst-case resource, timing, and location requirements are determined, using quantitative spill modelling information where applicable. An Implementation Guidance is then developed to detail what arrangements and actions are required to be initiated by the IMT to meet the incident requirements up to a worst-case incident.

Through the development of the Implementation Guidance, it may be possible to identify resource, timing and location requirements that could be improved. These areas of improvement should be noted in the ALARP so that additional, alternative or improved control measures can be considered in this context.

A detailed ALARP Assessment Framework for the evaluation of control measures is shown in Figure B-1, Step 6 (in BLUE). Criteria and definitions used to evaluate control measures are shorn in **Table B-1**.

6a) Record Control Measures In Effect: the spill response control measures currently in place for Santos Offshore are listed here. The environmental outcomes and effectiveness of the in-effect control measures are noted, using the Resource Needs Analysis to assess whether there are any areas of improvement. Environmental outcomes include potential harmful effects of control measures.

6b) Identify Potential Additional Control Measures: potential control measures are identified, with a focus on any control measures that address areas of improvement identified in Step 6a.

6c) Investigate Control Measure Categories: in-effect and potential control measures from Steps 6a and 6b are classified as either additional, alternative or improved, and as either people, system, equipment or procedures. This step serves as a prompt to ensure that potential control measures from all categories are explored.

6d) Evaluate Environmental Outcomes, Effectiveness: the environmental outcomes and effectiveness are assessed for all control measures identified and described through Steps 6a, b and c.

6e) Evaluate Feasibility: time, cost and effort required for implementation are assessed for all control measures identified and described through Steps 6a, b and c.

6f) Accept or Reject: the potential control measure will be accepted or rejected on the basis of environmental outcomes and effectiveness described in Step 6d and whether cost is grossly disproportionate, as described in Step 6e.

When evaluating potential control measures, implementation plans of in-effect control measures are carefully considered to ensure that any accepted control measures will equal or improve Santos capacity to meet resource needs. Potential control measures are also considered within the context of current Santos response arrangements to determine if synergies or resource conflicts might occur.

As control measures are evaluated for selection or rejection, they can be compared with industry good practise to ensure that all practicable control measures were implemented. Where unique circumstances exist and further analysis is required, a different evaluation technique may be used, such as technical analysis, detailed cost benefit analysis or combination of approaches.

New information on risks, impacts and response strategies obtained through analysis of operations, exercises and scheduled documentation reviews can be incorporated into the ALARP Assessment Framework cycle in a process of continual improvement.

In Figure B-1, Steps 7 and 8 show the conclusion of the ALARP Assessment Framework:

7. Finalised Control Measure Selection: outputs from the ALARP Assessment shown in Step 6 comprise finalised control measures (in BLUE).
8. Develop Performance Standards and Measurement Criteria: for each control measure finalised in Step 7, performance standards and measurement criteria are then developed and documented in the OPEP (in GREEN).

Performance standards for all accepted control measures should be written to enable the operator to measure, monitor and test effectiveness. Only the key aspects of any given control will require performance standards and these may include the various measures of effectiveness; functionality, availability, reliability, survivability, dependency and compatibility. Parameters set in the performance standard should be 'SMART'; specific, measurable, appropriate, realistic and timely.

Corrective action based on deviations or trends in performance should be taken by amending either the performance standard or the control measure, as appropriate.

Criteria and Definitions

Standardised criteria and definitions are used to bring consistency to the ALARP assessment across diverse activities and response strategies. Criteria and definitions are shown in **Table B-1**.

Table B-1: Criteria and Definitions of ALARP Assessment Framework

Strategy	Response Strategy
Control Measure	Aspect of Response Strategy being evaluated Description of the control measure that is In Effect or description of the potential control measure
In Effect, Alternative, Additional, Improved	In Effect control measures are already in place. Alternative control measures are evaluated as replacements for the control already in effect. Additional control measures are evaluated in terms of their ability to reduce an impact or risk when added to the existing suite of control measures. Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures. Adapted from NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721 Revision 6 – November 2019
Control Measure Category	A range of different types of controls generally provide effective protection as they provide independence and multiple layers of protection. The OPGGS(S) Regulations refer to technical and 'other' controls where technical control measures involve hardware like shutdown valves and alarms. 'Other' control measures include administrative and procedural control measures such as inductions, a drug and alcohol policy or an inspection regime.

Strategy	Response Strategy
	Industry practice has further developed this concept of a range of different types of controls based on a POiSTED framework to assess organisational capability: People – personnel System – organisation, information/communications, support facilities, training/ competency Equipment – equipment Procedures – doctrine Santos aims to implement a range of different types of controls where possible.
Environmental Outcomes	Assessment of environmental benefits, particularly those over and above those environmental benefits documented in the Control Measure that is in effect. Environmental impacts of the Control Measure are also considered here.
Effectiveness	The effectiveness of a Control Measure in reducing the risk to ALARP is evaluated using the following six criteria. **Functionality** The functional performance of a control measure is what it is required to do. How does the control perform in order to achieve the required risk reduction? **Availability** Probability that the control measure will be available when required and has not failed or is undergoing a maintenance or repair. **Reliability** The reliability of a control measure is the probability that at any point in time it will operate correctly for a further specified length of time. Reliability is all to do with the probability that the system will function correctly and is usually measured by the mean time between failure. **Survivability** Whether or not a control measure is able to survive a potentially damaging event such as fire or explosion is relevant for all control measures that are required to function after an incident has occurred. To achieve their purpose, oil spill response control measures should have high survivability. However, some control measures, such as those involving equipment deployment from an FPSO would have low survivability in an incident that involves an FPSO explosion or fire. **Dependency** The dependency of the control measure is its degree of reliance on other systems in order for it to be able to perform its intended function. If several control measures can be disabled by one failure mechanism (common mode failure), or the failure of one control measure is likely to cause the failure of others, then the control measures are not independent and it may not be appropriate to count such measures as separate. Several control measures are reliant on equipment, people and vessels, hence have high dependence. **Compatibility** Whether or not a control measure is compatible takes into account how alternative control measures may interact with other controls and the rest of the facility, if introduced. Consideration should be given to whether new control measures are compatible with the facility and any other control measures already in use. Adapted from NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020

Strategy	Response Strategy
Feasibility	Feasibility describes the time, cost and/or effort required to implement the Control Measure.
Accept/ Reject	Outcome of assessment and key reasons for the decision

Varanus Island Hub Operations Oil Spill Response ALARP Assessment Summary

Alternative, Additional and Improved options have been identified and assessed against the base capability described for each of the relevant response strategies (**Section 8** through **to Section 17 and relevant appendices**).

Table B-2 provides a summary of the ALARP assessment conducted for Halyard-2 drilling and completion activity (source control and SSDI). Detailed ALARP assessment worksheets are presented in **Table B-5**.

Table B-3 provides a summary of the ALARP assessment conducted for VI operations and Spartan Development drilling source control. Detailed ALARP assessment worksheets are presented in **Table B-6**.

Table B-4 provides a summary of the ALARP assessment for all other response strategies (Monitoring and evaluate, containment and recovery, mechanical dispersion, protect and deflect, shoreline clean-up, oiled wildlife, waste and scientific monitoring), noting that the VI operations worst case spill scenarios of HFO and VI crude blend drive the ALARP considerations for these response strategies. The inclusion of the Halyard-2 Drilling and Completion Project drilling activities did not result in worst case scenarios (such as shoreline accumulation) that would require additional resources above and beyond those already identified. Detailed ALARP assessment worksheets are presented in **Table B-7**.

Table B-2: ALARP Assessment Summary – Source Control and SSDI: Halyard-2 Drilling and Completion Project

ALARP Assessment Summary –Halyard-2 drilling and completion Source Control (refer worksheet for further detail in Table B-5)
The Control Measures in place for relief well drilling represent industry best practice and are considered to reduce the timeframe for drilling a relief well to as low as reasonably practicable (ALARP) in the context of the risk of an uncontrolled well release during Halyard-2 drilling and completion. Potential Control Measures were identified and assessed by the Santos Drilling & Completions department representatives. The drilling of a relief well is considered to be an effective control and relief well planning conducted in the area has demonstrated that relief well drilling within 77 days can be implemented using MODUs, equipment and specialist personnel that Santos has arrangements to gain access to. The Control Measures in place for emergency BOP activation represent industry best practice and are considered to reduce the timeframe for BOP activation to ALARP in the context of a LOWC incident. The use of a subsea BOP is considered to be an effective source control and the emergency BOP activation procedures ensure timely activation of the BOP. Santos has arrangements in place to enable access to a capping stack as a secondary source control strategy and would only be used where there is suitable vertical access over the wellhead. These arrangements also include trained personnel for the mobilisation, deployment and operation of the capping stack. Limiting factors for the deployment of a capping stack involve safety and technical constraints, metocean conditions, location of capping stacks and access to a suitable capping stack capable vessel. Santos assessed the feasibility of maintaining its own capping stack and having suitable deployment vessel/crew on standby to deploy a capping stack. Given the low likelihood of a blowout event, the significant upfront costs involved and the presence of a more effective primary control strategy (relief well drilling) the costs are considered disproportionate to the level of risk reduction.

Sixteen additional Control Measures were identified and assessed (refer worksheet for further detail in **Table B-5**).
No additional, alternative or improved Control Measures were accepted as reasonably practicable. Sixteen Control Measures were rejected as grossly disproportionate. Rejected response strategies were: + Contract source control personnel through a provider in addition to existing arrangements + Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC + MODU on standby at Halyard-2 drilling location + Having a dedicated relief well MODU on contract during the Halyard-2 drilling and completion campaign. + Use of two drilling rigs during the Halyard-2 drilling campaign that drill simultaneously so that one rig could act as a relief well drilling rig for the other. + Time Halyard-2 drilling campaign to align to other Santos drilling activity so that nearby drill rig could be used as a relief well drilling rig. + Schedule Halyard-2 drilling campaign to avoid cyclone season + Pre-drill riserless intervals for a potential relief well before drilling the main well + Install a mudline closure device + Alternative BOP design (additional sealing rams installed) + Dedicated BOP Intervention vessel equipped with ROV tooling package in field + Purchase and maintain own capping stack in Dampier + Incentivise a vendor to set up a capping stack in Dampier + Purchase and maintain own capping stack and have suitable deployment vessel/crew on standby with pre -approved Safety Case to deploy capping stack + Transport WWC capping stack via air + Use of lightweight Rapid Cap to be mobilised via air from Houston, USA. + Preposition WWC capping stack standby crew in Perth + Deploy Offset Installation Equipment (OIE) to cap well when direct vertical access is not possible - to allow the installation of a cap directly onto a subsea wellhead. Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in **Section 8.7**. The key performance requirements for relief well drilling are the maintenance tracking, access and relief well planning arrangements (during times of maintaining preparedness) and the timely mobilisation of resources (during a response). These key areas of effectiveness are reflected in the Performance Standards.
ALARP Assessment Summary –Halyard-2 drilling and completion Subsea Dispersant Injection (SSDI) (refer worksheet for further detail in Table B-5)
SSDI would be employed as a secondary strategy for a subsea LOWC associated with the Halyard-2 Drilling and Completion Project (Halyard-2 well, drilled with a semi-submersible MODU). SSDI would only be executed if it was determined to have a net environmental benefit in consideration of enhancing safety for source control personnel through VOC reduction and environmental benefits associated with a reduction in surface oil versus potential detrimental environmental impacts (such as increased toxicity and reducing the opportunity for evaporation). Control measures are in place for a rapid mobilisation of the SFRT, personnel and dispersants to Dampier, however the key limiting factor for deployment is suitable SFRT capable vessels which may take considerably longer to mobilise (7-10 days). A Control Measure involving the positioning of SFRT vessels on standby at a regional port in order to reduce deployment time was assessed but was found to be disproportionate in

terms of costs to the reduction in risk gained. Dispersant available with the AMOSC SFRT package would be sufficient to supply dispersant for the duration of operations.
Six additional Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable.
Six Control Measures were rejected as grossly disproportionate: + Purchase of Santos SFRT to be located in Exmouth or Dampier + Relocate AMOSC SFRT to Dampier + Subsea bladder dispersant system positioned next to well site + Enable improved vessel access by contracting a suitable, dedicated vessel on standby + Access to additional dispersant stockpile owned by Santos + Rent dispersant stockpiles and place in Dampier
Performance Standards and Measurement Criteria that have been developed for the in effect Control Measures are shown in **Section 8.7.**

Table B-3: ALARP Assessment Summary – Operations and Spartan Development Source Control

ALARP Assessment Summary – Operations and Spartan Development drilling Source Control (refer worksheet for further detail in Table B-6)
The Control Measures in place for relief well drilling represent industry best practice and are considered to reduce the timeframe for drilling a relief well to as low as reasonably practicable in the context of the risk of an uncontrolled well leak from during development drilling (Spartan development) or during VI Hub Operations. Potential Control Measures were identified and assessed by the Santos Drilling & Completions Department representatives. The drilling of a relief well is considered to be an effective control and relief well planning conducted in the area has demonstrated that a MODU will be on site for relief well drilling by day 33 from the start of a well release. Relief well drilling can be completed within 77 days using MODUs, equipment and specialist personnel that Santos has arrangements to gain access to. Thirteen additional Control Measures were identified and assessed (refer worksheet for further detail in **Table B-6**). Two additional Control Measures were accepted as reasonably practicable. Accepted response strategies were: + Direct surface intervention via well control experts + Pre purchase of relief well drilling supplies Eleven Control Measures were rejected as grossly disproportionate. Rejected response strategies were: + Contract source control personnel through a provider in addition to existing arrangements + Wild Well Control on standby in Perth during drilling operations to respond immediately to a LOWC + MODU on standby at activity location during Spartan development drilling + Having a dedicated relief well MODU on contract during Spartan development drilling + Use of two drilling rigs during Spartan development drilling campaign that drill simultaneously so that one rig could act as a relief well drilling rig for the other. + Time Spartan development drilling campaign to align to other Santos drilling activity so that nearby drill rig could be used as a relief well drilling rig. + Schedule Spartan development drilling campaign to avoid cyclone season + Pre-drill riserless intervals for a potential relief well before drilling the main well + Use of semi-submersible drilling rig to drill the Spartan well

- Install a mudline closure device
- Alternative BOP design (additional sealing rams installed)

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the **Section 8.7** The key performance requirements for relief well drilling are the maintenance tracking, access and relief well planning arrangements (during times of maintaining preparedness) and the timely mobilisation of resources (during a response). These key areas of effectiveness are reflected in the Performance Standards.

Table B-4: ALARP Assessment Summary – Monitor and Evaluate, Containment and Recovery, Mechanical Dispersion, Shoreline Protection and Deflection, Shoreline Clean-up, Oiled Wildlife, Waste Management and Scientific Monitoring

ALARP Assessment Summary – Monitor and Evaluate (refer worksheet for further detail in Table B-7)

Various, independent inputs from multiple service providers are used to build a detailed Common Operating Picture in the incident. Areas of improvement for monitor and evaluate activities were the availability of aerial observers and SCAT trained personnel in initial 24 hours of incident and availability of vessels for water quality monitoring. One potential Control Measure sought to make trained aerial observers available from Day 1 of a response, rather than Day 2, however an assessment of the Control Measure found that the cost was grossly disproportionate to the benefit. No potential Control Measures were identified to improve availability of SCAT trained personnel in the initial 24 hours of incident. A potential control measure to improve the availability of vessels for water quality monitoring by implementing more detailed vessel tracking parameters was evaluated and accepted. In total, nine additional potential Control Measures were identified and assessed. Five were rejected as cost was grossly disproportionate to the reduction in risk, whilst four were accepted as reasonably practicable.

Nine additional potential Control Measures were identified and assessed.

Four additional Control Measures were accepted as reasonably practicable. The accepted measures were:

- Determine required vessel specifications and improve accuracy of Vessel Tracking System
- Purchase of First Strike Oil sampling kits to be positioned at Exmouth and VI
- Maintain a list of providers that could assist with fauna aerial observations; e.g. whale shark spotting planes
- Just-In-Time training to train personnel for spill response roles

Five additional Control Measures were rejected as grossly disproportionate. Rejected control measures were:

- Purchase of oil spill modelling system and internal personnel trained to use system
- Purchase additional satellite tracking buoys
- Ensure trained aerial observers based at strategic locations such as Exmouth (North Ningaloo Coast, Muiron Islands), Karratha and Port Headland
- Trained monitoring specialists on site
- Ensure trained marine mammal/fauna observers based at strategic locations such as Port Hedland and Karratha

Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, focus on maintaining access to equipment and personnel through contractual arrangements with vessel providers, aircraft providers, aerial observers, UAV providers, tracking buoys, oil spill trajectory modelling providers, satellite imagery providers water quality monitoring providers and spill responders. Additional key areas for effectiveness during preparedness are following relevant procedures such as the Protected Marine Fauna Interaction and Sighting Procedure, and limiting environmental impacts from response activity through personnel and vehicle management. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence monitor and evaluate operations. These key areas of effectiveness have been represented in Performance Standards for monitor and evaluate operations.

ALARP Assessment Summary – Containment and Recovery (refer worksheet for further detail in Table B-7)

Containment and recovery is just one of the many response options available in the oil spill response toolbox. It is more effective when a sufficient oil thickness can be achieved by the containment booms (minimum of 50 g/m²) and weather and sea-state conditions are suitable for safe operations within daylight hours.

For VI Hub Operations, containment and recovery is not considered a suitable option for Marine Diesel or Condensate but could be suitable for VI crude blend and HFO.

From an operational perspective, the window of opportunity for containment and recovery as a response option is severely restricted by the dominant metocean conditions with wind speeds exceeding 12 knots for over 40% of the time during winter and around 20 to 30% of the time during summer months. Additionally, currents are above 0.75 knots for a significant portion of the year (RPS, 2021). Also, experience from spill incidents has shown that the efficiency of containment and recovery operations can vary widely depending on operational and environmental constraints and is usually limited between 5% and 10% of initial spilled volumes. The Macondo incident in 2009 (Gulf of Mexico) had an estimated containment and recovery rate of approximately 4% of the total volume of oil spilled, and the MV Erika oil tanker spill in 1999 (Atlantic Ocean) had an estimated containment and recovery rate of 6%. The Montara well blowout of 2009 had a higher recovery rate due to calm metocean conditions – 10% of the total oil spilled (IPIECA, 2015c). For the response capability assessment for containment and recovery operations, a 15% oil recovery target is assumed, which is considered highly conservative given the oil properties, dominant metocean conditions in the location and the low efficiency of containment and recovery operations as observed in past spill incidents.

Santos has access to suitable offshore booms and offshore skimmers for a potential spill through several arrangements including AMOSC and AMSA. The total number of offshore booms and skimmers available to Santos under existing arrangements are detailed in **Table 11-4** which demonstrates availability of offshore booms and skimmers to meet a 15% oil recovery target for the worst-case containment and recovery scenario identified. Access to offshore boom and skimmers is not considered a limiting factor as the quantity of equipment available to Santos through existing arrangements exceed the response need identified for containment and recovery operations in the OPEP.

Santos also has access to temporary storage options for recovered oil for sustained containment and recovery operations in the event of an incident. The temporary offshore storage resources available detailed in **Table 11-4** meets the storage requirements identified for each containment and recovery unit (33 m3 per unit x 2 units = 66 m3 per day).

SIMOPS will be implemented to ensure safe operations and avoid conflict in areas where vessels and aircrafts are working in close proximity.

Five additional potential Control Measures were identified and assessed.

One additional Control Measure was accepted as reasonably practicable. The accepted control measure was:

+ Define containment and recovery vessel specifications and input this information to improve vessel tracking.

Four additional Control Measures were rejected as grossly disproportionate. Rejected control measures were:

+ Purchase additional offshore booms and skimmers ancillary equipment to be owned by Santos
+ Access to additional vessels by contracting vessels to remain on standby for containment and recovery
+ Train additional Santos personnel for containment and recovery operations
+ Just-In-Time training to train personnel for spill response roles

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to suitable vessels, equipment and personnel through contractual arrangements and the tracking of suitable vessels. During response, a key area for increasing effectiveness is the rapid mobilisation of first strike resources so that operations can be undertaken when oil concentration is at its highest. Given effectiveness of this strategy increases with oil concentration and decreases under high wind/sea state conditions, the consideration of these factors within an operational NEBA (SIMA) is considered a key control for maintaining effectiveness as well as the use of aerial surveillance to inform areas of operation of highest oil concentration. Waste storage may be a limiting factor for ongoing containment and recovery operations, so a key area for increasing effectiveness will be the application for approval for decanting wastewater from liquid oil waste storage tanks onboard vessels. These key areas of effectiveness have been represented in Performance Standards for containment and recovery operations.
ALARP Assessment Summary – Mechanical Dispersion (refer worksheet for further detail in Table B-7)
Mechanical dispersion is a secondary strategy that could be undertaken by vessels undertaking primary response strategies without the requirement for additional equipment, and no areas of improvement were identified. The use of mechanical dispersion in a response would be assessed as part of an operational NEBA. No potential additional Control Measures were identified and assessed. Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures during a response are around the development of an operational NEBA to confirm suitability and environmental benefit, and the mobilisation of vessels. These key areas of effectiveness are reflected in the Performance Standards.
ALARP Assessment Summary – Protect and Deflect (refer worksheet for further detail in Table B-7)
Large quantities of various types of nearshore booms and skimmers from Exmouth and Fremantle ensures that equipment is in place to implement this response strategy within 24 hrs in a wide range of metocean conditions. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services, followed by AMOSC staff and AMOSC Core Group from Perth. These regional and state resources ensure that equipment and personnel are not a limiting factor in this response strategy. An area of improvement is availability of shallow draft vessel. A review of Control Measures associated with vessels identified that improvement could be made by adding a provision for shallow draft boom tow vessels in existing Master Service Agreements with vessel providers. Six additional potential Control Measures were identified and assessed. Two additional Control Measures were accepted as reasonably practicable. The accepted response strategies were: + Provision for shallow draft boom to vessels added to Master Service Agreement + Just-In-Time training to train personnel for spill response roles Four additional Control Measures were rejected as grossly disproportionate. Rejected control measures were: + Santos to purchase additional shoreline and nearshore booms and ancillary equipment + Access to additional shallow draft boom tow vessels owned by Santos + Ensure trained personnel based at strategic locations such as Port Hedland, Karratha or Exmouth + Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence protection and deflection operations and the preparation of an

operational NEBA for each operational period that takes into account protection priorities and the ongoing effectiveness of the response strategy. These key areas of effectiveness have been represented in Performance Standards for protection and deflection operations.
ALARP Assessment Summary – Shoreline Clean-up (refer worksheet for further detail in Table B-7)
Regional and Fremantle stockpiles and locally available supplies provide a range of shoreline clean-up equipment can be accessed to suit most beach types / required clean-up operations. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services or vessels, followed by AMOSC staff and AMOSC Core Group from Perth. Equipment and trained personnel are not expected to be limiting factors for this response strategy. The availability of labour hire personnel for initial stages of a response was identified as an area of improvement. Control Measures that were evaluated to improve the availability of labour hire was either not feasible or the cost was grossly disproportionate to the reduction in risk. The availability of shallow draft vessels in initial stages of a response was also identified as an area or improvement. A review of control measures associated with vessels identified that improvements could be made by adding a provision for shallow draft boom tow vessels in existing Master Service Agreements with vessel providers. Waste management may be a limiting factor for ongoing shoreline clean-up operations and further information is shown in the ALARP assessment for Waste. Nine additional potential Control Measures were identified and assessed. Two additional Control Measures were accepted as reasonably practicable. The accepted control measure was: + Provision for shallow draft vessels added to Master Service Agreement + Just-In-Time training to train personnel for spill response roles Seven Control Measures were rejected as grossly disproportionate. Rejected control measures were: + Mechanical mobile plant equipment for clean-up pre purchased and positioned at strategic locations such as Port Hedland, Karratha or Exmouth + Pre-purchase and storage of additional equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at strategic locations such as Port Hedland, Karratha or Exmouth + Access to additional shallow draft vessels owned by Santos to transport personnel to key sensitive areas on offshore islands such as Muiron Islands + Access to additional team leaders that are locally based at strategic locations (Port Hedland, Karratha or Exmouth) or can be mobilised within short time frames + Faster access to clean-up personnel via Perth based labour hire contractor + Faster access to clean-up personnel via locally based labour hire companies or emergency response organisations + Faster access to clean-up personnel via Santos employment of local personnel – Port Hedland, Karratha or Exmouth Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to suitable equipment and personnel through contractual arrangements. During response, a key area of effectiveness is the rapid mobilisation of equipment and personnel and preparation of a Shoreline Clean-up Subplan and NEBA to ensure that impacts from response activities are minimised and operations are conducted in accordance with protection priorities as confirmed by the Control Agency.
ALARP Assessment Summary – Oiled Wildlife (refer worksheet for further detail in Table B-7)
Oiled wildlife equipment including first strike kits and containers can be mobilised from regional locations and Perth. Further equipment is available through national or international resources to implement a timely and sustained response adequate for the scale of worst-case oiled wildlife operations identified in the OPEP. The availability of trained personnel in the initial stages of an incident is a limiting factor for this response strategy. Control Measures around the provision of trained personnel were reviewed to identify that trained

Santos personnel could be based not just in the Perth Office but also at VI and DC facilities. Potential Control Measures around additional responders through pre-hiring or contracts with additional service providers were investigated but were found to be not beneficial and/or the cost was grossly disproportionate to risk reduction. An additional area of improvement is clarity for how Santos will integrate with Control Agencies OWR. It has been identified that additional planning captured in a Santos Oiled Wildlife Response Framework (7700-650-PLA-0017) is a practicable control measure to ensure that resources are deployed in a coordinated approach. Two additional potential Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable. Two Control Measures were rejected as grossly disproportionate. Rejected control measures were: + Pre-hire and/or prepositioning of staging areas and responders + Direct contracts with service providers Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, the mobilisation of requirements for initial oiled wildlife response operations and the management of the oiled wildlife response in accordance with the WA Oiled Wildlife Response Plan are both key elements for achieving this strategy and they are represented as a Performance Standards.
ALARP Assessment Summary – Waste (refer worksheet for further detail in Table B-7)
The Santos contract with the waste service provider has provisions for waste management operations of the scale estimated to be required in worst-case scenarios detailed in the OPEP. Further detail is captured in the Waste Management Plan – Oil Spill Response Support (7715-650-ERP-0001). The waste service provider can mobilise waste receptacles from Karratha within 12 hrs. Given the waste service provider arrangements and preplanning already undertaken, waste storage facilities, road transport and logistics are not expected to be limiting factors in the response. For these components, potential Control Measures were identified and evaluated but were found to either make no improvement in capability or cost was grossly disproportionate. An area of improvement is the availability of vessels required for waste transport at sea. One potential Control Measure to address this area of improvement was identified and assessed but cost was grossly disproportionate to risk. No other potential control measures were identified. Three potential additional Control Measures were identified and assessed. No Control Measure was accepted as reasonably practicable. Three Control Measures were rejected as grossly disproportionate. Rejected control measures were: + Maintain contracts with multiple service providers + Procure temporary waste storage for Santos stockpile + Contract additional vessels on standby for waste transport Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to waste management equipment and services through contractual arrangements. During response, a key area for increasing effectiveness is the timely mobilisation of requirements for initial response operations and defining critical management and reporting services to be provided by the waste service provider. These key areas of effectiveness are captured in the Performance Standards.
ALARP Assessment Summary – Scientific Monitoring (refer worksheet for further detail in Table B-7)
Oil spill scientific monitoring will be conducted on behalf of Santos by a contracted monitoring service provider as detailed in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) and the relevant Scientific Monitoring Programs. An area of improvement is the availability of vessels in the initial stages of response. To address this area of improvement, a potential Control Measure around more

detailed vessel tracking was assessed and accepted. Additionally, three potential Control Measures were identified and assessed. One Control Measure, the purchase and standby of scientific monitoring resources was found to be grossly disproportionate in cost in comparison to the reduction in risk. Two potential Control Measures relating to improved record keeping for scientific monitoring consumable requirements and suppliers and the provision of water quality sampling kits to be located at strategic regional locations were both found to be reasonable and practicable, both were adopted.

Four additional potential Control Measures were identified and assessed.

Three additional Control Measure were accepted as reasonably practicable. The accepted control measures were:

+ Maintain equipment list and list of suppliers for implementation of Scientific Monitoring Plans
+ Oil sampling kits for scientific monitoring personnel to be positioned at Varanus Is. And Exmouth
+ Determine required vessel specifications required for Scientific Monitoring implementation and improve accuracy of Vessel Tracking System

One Control Measure was rejected as grossly disproportionate. The rejected control measure was:

+ Scientific monitoring personnel, plant and equipment on standby at the operational location

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in the OPEP. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements, regular reviews of monitoring service provider capability and reviews of existing baseline data. During response, a key area for effectiveness is the mobilisation of requirements to commence scientific monitoring and ensuring relevant approved manuals and plans are followed. These key areas of effectiveness are reflected in the Performance Standards.

Varanus Island Hub Operations Oil Spill Response ALARP Assessment Worksheets

Alternative, Additional and Improved options have been identified and assessed in:

+ **Table B-5** for Halyard-2 Drilling and Completion Project Source Control and SSDI
+ **Table B-6** for VI Operations and Spartan Development drilling source control
+ **Table B-7** for Monitor and evaluate, containment and recovery, mechanical dispersion, shoreline protection and deflection, shoreline clean-up, oiled wildlife, waste and scientific monitoring (applicable to all worst-case hydrocarbon spill scenarios)

Controls highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practicable. Control measures that have been included are highlighted in green and performance standards included in the relevant response strategy section in the OPEP.

Table B-5: Detailed ALARP Assessment Worksheets – Halyard-2 Drilling and Completion Project Source Control and SSDI.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Source Control – Adopted controls and standards are found in Section 8.3							
Relief well drilling	Santos Drilling and Completions Source Control Team mobilised within 24 hours. Well Control Specialists mobilised within 72 hours. Contract/ MOUs for source control personnel. APPEA MoU for mutual assistance for relief well drilling.	In effect	People	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts. Limit/prevent hydrocarbon contacting sensitive receptors	This primary source control measure provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Cost of contracts/ MOUs	**In effect**
	Contract source control personnel through an alternative provider in addition to existing arrangements	Additional	People	No environmental benefit if additional services are surplus to requirements	Improved availability and reliability	Significant additional cost in maintaining two contracts for the same service	**Reject** No environmental benefit in having access to personnel surplus to requirements
	Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC	Additional	People	No environmental benefit as WWC personnel are available to provide support within 72 hours which will coincide with starting to commence sourcing of relief well MODU	No change to effectiveness or reliability as WWC personnel available within a rapid timeframe under existing arrangements.	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required	**Reject** No environmental benefit in having access to personnel surplus to requirements
	Source Control Planning and Response Guideline (DR-00-OZ-20001).	In effect	Procedure	Provides a set process top follow in the planning and mobilisation for relief well drilling by Santos Source Control Team thereby reducing the timeframe and increasing the effectiveness of relief well drilling.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort in updating and maintaining document	**In effect**
	Suitable relief well MODU confirmed to be technically suitable prior to drilling	In effect	Procedure	Identification of a suitable MODU prior to drilling would decrease the time spent searching for a suitable MODU in the event of a spill, reducing mobilisation times for MODU thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Regular monitoring of MODU capability Register to ensure preferred MODU remains available throughout the activity	In effect	Procedure	By monitoring MODU availability in the region, it will be possible to gain an understanding of which MODU may be rapidly available for relief well operations. This could reduce mobilisation times for MODU thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	MODU on standby at activity location during Halyard-2 well drilling.	Improved	Equipment	Reduce mobilisation times of MODU to drill relief well thus reducing hydrocarbon released to the environment. Instead of base timeframe for the drilling of a relief well of 77 days, relief well potentially could be drilled in 43 days (77 days less the 34 days required for MODU to be ready to spud/commence relief well operations).	Reduction in spill duration by 34 days, resulting in less hydrocarbon exposure and reduced shoreline loading volumes.	The cost of having a MODU contracted, crewed and holding a valid NOPSEMA Safety Case and WOMP to be on standby would cost between ~550kUSD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. This cost would be paid regardless if there is a loss of containment or not.	**Reject** Likelihood of LOWC is considered unlikely and the cost of having a second MODU on standby at location is considered grossly disproportionate to the environmental benefit. It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this MODU in the event a relief well was required when the event occurred. It is conceivable that to cover a 50 day well activity (for example) with a relief well MODU on standby cost over the same duration would be in the order 28 MUSD, depending on where the MODU were mobilised from/to and the market at the time.
	Having a dedicated relief well MODU on contract.	Improved	Equipment	Provides for rapid mobilisation of relief well MODU to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Significant commercial effort required to align two MODUs that are not contracted. Possible that market may not be able to supply this demand.	**Reject** In order to perform this, the MODU will need to be contracted, crewed and hold a valid NOPSEMA Safety Case. This could cost ~550kUSD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this MODU in the event a relief well was required when the event occurred. It is conceivable that to cover a 50 day well activity (for example) with a relief MODU on standby cost over the same duration would be in the order of ~28MMUSD, depending on where the MODU were mobilised from/to and the market at the time. Given there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the reduction in risk is grossly disproportionate to the cost and effort required to perform it.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Use of two drilling rigs during Halyard-2 drilling campaign that drill simultaneously so that one rig could act as a relief well drilling rig for the other	Improved	Equipment	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Considered not feasible - Halyard Infill drilling is a single well campaign	**Reject.** Similar reason to the above - would have to move in a rig to make this happen. MOU gives Santos sufficient access to relief well MODUs. Single well campaign.
	Time Halyard-2 drilling campaign to align to other Santos drilling activity so that nearby drill MODU could be used as a relief well drilling MODU	Improved	Equipment	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Considered not feasible as other MODUs contracted for other projects are focused on those projects; it is not feasible to assume that another Santos contracted MODU could safely temporarily suspend well operations to be available to transfer to a relief well programme in an acceptable timeframe. In addition, there are no concurrent Santos drilling activities expected in the region until mid-2024,	**Reject** No other concurrent Santos drilling activities expected in the region until mid-2024 **[HOLD: Santos to confirm]**
	Schedule Halyard-2 drilling campaign to avoid cyclone season	Alternative	Procedure	Drilling the well in cyclone season does not increase the likelihood of a loss of containment. This will be verified by NOPSEMA in the accepted WOMP, where the plan to suspend the well during a cyclone will be assessed.	Does not alter the effectiveness of the response strategy.	Having to mob and de-mob a MODU to guarantee the well could be drilled outside of cyclone season would be a >5MM USD cost increase.	Reject There are no additional risks associated with cyclone season on a loss of well control. The barriers installed for cyclone suspension are independent of metocean conditions. Adjusting the timing would preclude the ability to drill for 6 months of the year, materially reducing the MODUs available to do the work. Having to mob and de-mob a MODU to guarantee the well could be drilled outside of cyclone season would be a >5MM USD cost increase, which is disproportionate to the benefit gained.
	Pre purchase of relief well drilling supplies	In effect	Equipment	Relief well drilling supplies such as casings and well head equipment could potentially reduce relief well drilling times	Increase in availability	Cost of purchase, maintenance and storage of supplies	**Adopt** Offshore D&C commit to having long lead equipment for a relief well at our disposal as part of our WOMP commitments for each well we drill.
	Relief well design assessment to identify and screen relief well spud locations prior to drill campaign	In effect	Procedure	Reduce time taken to plan and execute relief well, and reduce environmental impacts	Improved availability and reliability	Effort required to conduct relief well assessment	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Pre-drill riserless intervals for a potential relief well before drilling the main well	Additional	Equipment Procedure	Could reduce relief well drill duration by 10 days. However, this activity would result in drill cuttings/discharges being released to the marine environment and noise emissions regardless if a LOWC were to occur or not.	Detailed relief well designs will be re-evaluated and revised for an actual LOWC event. There will be several locations for the relief well identified before an incident, with the optimal location selected after a LOWC incident, based on real-time information (i.e. prevailing weather). A pre-drilled relief well top-section might result in having to use a sub-optimal design and location. It is not industry practice, and such a pre-drilled riserless interval may adversely affect functionality and reliability of this response strategy.	The pre-drilling activity itself would require approximately 10 days and a complete rig move to perform, costing approximately 7MM USD. Once the main well was completed, the partially completed relief well would need to be abandoned, at a further cost of 7MM USD.	**Reject** This option may result in a sub-optimal relief well location being used. There is minimal environmental benefit gained for the grossly disproportionate costs associated with this option.
	Install a mudline closure device (MCD)	Improved	Equipment	Provides a pre-installed safety barrier at the seabed	MCD augments the existing BOP safety system, located below the BOP and above the wellhead, and provides two additional sets of rams with an independent control system. Provides an additional level of safety, in addition to the subsea BOP.	Feasible, however BOP has sufficient functionality for a conventional pressure moored semi-submersible MODU. There are no known hazards to consider where mudline closure device has been used to prevent/mitigate specific hazards.	**Reject** - cost is grossly disproportionate to the any negligible environmental benefit that may be gained.
Blowout Preventer - Emergency Activation	BOP function testing	In effect	People	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment ensures timely activation of the BOP.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort required to conduct BOP function test	**In effect**
	Access to ROV capability for BOP hot- stab intervention maintained with MODU ROV contractor throughout the activity	In effect	Equipment	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts. BOP closed within 4-5 days.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Cost of contract	**In effect**
	Dedicated BOP Intervention vessel equipped with ROV tooling package in field	Alternative	Equipment	BOP closed within 1-2 days (depending upon daylight hours available) reducing release of hydrocarbons by 2-3 days.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Costs associated with having an additional dedicated BOP intervention vessel on contract $50-60K USD/day.	**Reject** Removes limitation of having to wait 2-3 days for a suitable vessel. However, the cost of having a vessel on standby is a fixed cost, regardless of if a spill were to occur or not. The time saving of 2-

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
							3 days is not proportionate to the expense incurred.
	Alternative BOP design (additional sealing rams installed)	Improved	Equipment	Reduces likelihood of a WCD event	Adds another layer of redundancy in BOP	Could be done. Require modifications to MODU, BOP and BOP control system to implement. Expected cost 3MM USD and time in shipyard or port to install.	**Reject.** Santos commits to using BOP equipment that is fully complaint with API Std 53, which specifies number and type of rams to be installed in the BOP for a given application. This will be a commitment in the SCR and the WOMP. Additional cost doesn't significantly reduce risk and BOP equipment will be fully compliant with industry standards.
Surface Well Kill	Direct Surface Intervention Via Well Control Experts	In effect	Procedure	Reduce time taken to control source and reduce environmental impacts	1) Effectiveness of intervention of this type needs to be assessed at the time given that personnel safety considerations may preclude this control measure. 2) Mobilisation procedure for personnel as per Source Control Planning and Response Guideline (DR-00-OZ-20001) 3-4) Contracts and MoUs for well control personnel (WWC)	Ability to implement and effectiveness of this control can only be determined at the time of an incident.	**Adopt** Santos has a standing agreement with Wild Well Control for call-out of well control experts. Arrangements already in place to access resources (Source Control Planning and Response Guideline (DR-00-OZ-20001), Contracts) but this control will be applied opportunistically and will be dependent upon safety constraints.
Capping stack	Capping stack is applicable as a secondary strategy for subsea wells (Halyard-2 Drilling and Completion Project) and BOPs to be used. Santos has access to two Wild Well Control capping stacks (Singapore and Aberdeen). Singapore capping stack- Assembly and ready to mobilise will take approximately 6 days + 9 days to mobilise to incident (total= 15 days)	In effect	Equipment	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	Provides functionality, availability, reliability, survivability, compatibility and independence. Would only be used where there is suitable vertical access over the wellhead.	Cost of contract	**In effect**
	Santos to purchase and maintain its own capping stack in Dampier	Alternative	Equipment	This is unlikely to provide any reduction in timeframes due to vessel access being the key time driver. In order for this to be effective, a suitable vessel would need to be on standby (with personnel) to realise benefit of capping stack in Dampier.	A capping stack positioned in Dampier or Karratha would need to be disassembled and stored at a suitable location as there is no suitable locations to store a fully assembled capping stack. Unpacking the containers, assembly and testing of the capping stack is estimated to take 4-5	USD20 million to procure and USD 2.8 million per year to maintain	**Reject** Given access to the capping stack is in Singapore, there is no significant benefit in having a dedicated capping stack available in Dampier. Critical path time will most likely be sourcing and the availability of a suitable vessel, which is most likely to be in SE Asia i.e. the vessel would have to be made available and mobilised to Australia for any response regardless of capping stack

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Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
					days, but the limiting factor will be the availability of a suitable vessel.		location. Therefore, the additional cost in owning and maintaining a dedicated stack is unlikely to provide any significant environmental benefit.
	Incentivise a vendor to set up a capping stack Dampier	Alternative	Equipment	This is unlikely to provide any reduction in timeframes due to vessel access being the key time driver. In order for this to be effective, a suitable vessel would need to be on standby (with personnel) to realise benefit of capping stack in Dampier	This would result in needing to moving an existing stack away from a shared logistics hub, such as Singapore. This could potentially affect other operators sharing this contracted resource. In addition, there is no local expertise available on standby in Dampier/Karratha to conduct maintenance or commence assembly operations if the capping stack was required.	Pay full time rental as a sole beneficiary.	**Reject** Critical time path will be sourcing and availability of a suitable vessel, which is most likely to be in SE Asia. Therefore, the additional cost in requesting a vendor to set up an existing capping stack in Singapore is unlikely to provide any significant environmental benefit.
	Purchase and maintain own capping stack and have suitable deployment vessel/crew on standby with pre - approved Safety Case to deploy capping stack	Alternative	Equipment People	Some debris removal may be required prior to capping stack installation. The SFRT would not be onsite until day 8-9 and then debris removal may take 1-2 days (depending on extent of damage). This option would therefore reduce capping stack deployment time by 4- 6 days and potentially reduce volume of oil contacting sensitive receptors.	A capping stack positioned in Dampier or Karratha would need to be disassembled and stored at a suitable location as there are no suitable locations to store a fully assembled capping stack. Unpacking the containers, assembly and testing of the capping stack is estimated to take 4-5 days, but the limiting factor will be the availability of a suitable vessel. Purchasing a capping stack would also require training of personnel to maintain and install the stack, if it was required to be used. However, these personnel may not have the depth of experience that existing specialist personnel have whom are available through	Costs in addition to capping stack: purchase/ maintenance costs are $80k USD per day for vessel/crew plus training costs for personnel.	**Reject** Based on an activity of ~50 days the costs of vessel/crew hire would be in the order of $4M additional to capping stack purchase/maintenance costs and not including for mobilisation costs. capping stack deployment is a secondary source control strategy, is contingent on safety and technical considerations, and may not be effective in controlling the source. Given the low likelihood of a blowout event, the significant upfront costs involved and the presence of a more effective primary control strategy (relief well drilling) the costs are considered disproportionate to the level of risk reduction.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
					WWC, reducing the reliability and compatibility of this alternative.		
	Transport WWC capping stack via air	Alternative	Equipment	The mobilisation time of the capping stack intervention system via airfreight is unlikely to provide a reduction in mobilisation time. The capping stack would need to be mobilised and flown into Perth (3-5 days) as regional airports do not have the required unloading equipment for the containers. Following this the containers would need to be transported to Dampier via sea (preferred - 6-8 days) or road (8+ days). Therefore, this option is not expected to result in a significant environmental benefit.	Air transportation of the capping stack requires it to be disassembled, which may affect the functionality of the stack if any components are damaged. The process of disassembly, packing, transport, unpacking and reassembly introduces a risk of damage to equipment, especially the metal pressure sealing surfaces associated with the high pressure connections of capping stacks. While the metal sealing rings have the strength to withstand very high pressures, they require a very smooth sealing surface to form a pressure seal. Mechanical handling of sealing components during capping stack disassembly risks damage to the smooth sealing surfaces and could result in additional time necessary to prepare the capping stack for deployment. Individual pressure sealing equipment elements must be packed separately. Damage to	Cost of contracting Boeing 747 or Antonov 124 to transport the containers to Perth.	**Reject** The risk associated with damaging equipment from airfreighting the capping stack and the minimal improvement in mobilisation time (13 days v's 15 days) is considered disproportionate to the incremental environmental benefit.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
					sealing surfaces may render the capping stack unusable until repairs can be undertaken at a certified machine shop. Therefore, air transportation adds an element of risk to the reliability of this alternative.		
	Use of lightweight Rapid Cap to be mobilised via air from Houston, USA.	Additional	Equipment	The mobilisation time of the rapid cap would take approximately 10+ days, not resulting in any significant environmental benefit.	Airfreighting this cap in from Houston would not lead to any significant reduction in the estimated response time (10 days v's 15 days for preferred alternative of shipping Singapore stack). This is due to debris clearance taking 10+ days. Use of the Rapid Cap would only mitigate very specific cases (e.g. no debris) and industry experience indicates debris removal is likely for catastrophic failures. Although this lightweight cap only requires a lighter construction vessel with lesser specification on the crane and heave compensation, it is most likely this vessel will still need to be sourced from SE Asia.	Cost of having an additional contract for another capping stack.	**Reject** The mobilisation time of the rapid cap would take approximately 10+ days as the critical time path is likely to be debris clearance. The cost of having another contract with another equipment provider is disproportionate to the minimal environmental benefit gained.
	Deploy Offset Installation Equipment (OIE) to cap well when direct vertical access is not possible - to allow the installation of a cap directly onto a subsea wellhead	Additional	Equipment	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	The OIE has not been deployed to control a flowing well, is reliant on multiple vendors providing the equipment, and is currently unproven technology, so for these reasons it provides no improvement to functionality, reliability, survivability or independence.	The OIE is located in Trieste (Italy) and would take 45 to 65 days to arrive in Dampier (influenced by weather, customs, quarantine, vessel availability, site conditions at field, and well configuration). Given the OIE is unproven technology, it is unknown if any attempts to use the OIE would affect the primary source control strategy of drilling a relief well.	**Reject.** Based on predicted timeframes, the OIE is only marginally quicker at controlling the well than drilling a relief well. Given there is uncertainty as to whether OIE installation could affect relief well operations (as it has never been used on a flowing well), the risks associated with use of the OIE are not proportionate to the incremental environmental benefits gained.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	The location of suitable vessels (required vessel specs. and Safety Case approval) for capping stack deployment are monitored monthly.	In effect	Procedure	Timely access to a suitable vessel could reduce mobilisation times for the capping stack thus reducing volume of hydrocarbons released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Suitable capping stack deployment vessel is confirmed to be available prior to activity	In effect	Procedure	Timely access to a suitable vessel could reduce mobilisation times for the capping stack thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Wild Well Control staff available via contract to assist with the mobilisation, deployment, and operation of the capping stack and well intervention equipment	In effect	People	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of contract	**In effect**
	Preposition WWC capping stack standby crew in Perth	Additional	People	No environmental benefit as WWC personnel are available to provide support within 72 hours.	No change to effectiveness or reliability as WWC personnel available within a rapid timeframe under existing arrangements.	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required.	**Reject** No environmental benefit in having access to personnel surplus to requirements
Subsea First Response Toolkit (SFRT)	AMOSC SFRT stored at Oceaneering yard in Jandakot and can be transported to Dampier. It is estimated this would take 10 hours to arrange and up to 7 days to load and transport to Dampier, depending on the time of the year. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier within 9 days of call-out. Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 12 from call out.	In effect	Equipment	May improve capability to perform subsequent source control measures (e.g. capping stack). Equipment needed to clean the area around the wellhead, enable intervention and prepare for relief well drilling and safe installation of a well capping or containment device.	Provides functionality, availability, reliability, survivability, compatibility and independence. Availability - whilst the SFRT takes several days to mobilise to site and conduct initial surveys, this timeframe is considered reasonable given the technical nature of this equipment.	Cost of AMOSC membership for SFRT	**In effect**
	Oceaneering personnel contracted for the deployment of the SFRT.	In effect	People	Equipment needed to clean the area around the wellhead, enable intervention and prepare for relief well drilling.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Cost of Oceaneering contract for personnel	**In effect**
	Level 2: Suitable vessel sourced through Santos contractors. Vessel requirements outlined in Santos Source Control Planning and Response Guideline (DR-00- ZF-1001).	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and	Cost of existing contracts with vessel providers	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
					independence. Area of improvement; early vessel availability		
Source Control - Vessel Collision	Vessel Spill Response Plan (SOPEP/SMPEP)	In effect	Procedure	Provides a set process to follow in the planning and mobilisation for spill response actions by the Vessel Contractor thereby reducing the timeframe and increasing the effectiveness of spill response.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort required in contractor procedure due diligence.	**In effect**
SSDI – Adopted controls and standards are found in Section 8.3							
Subsea First Response Toolkit (SFRT) The SFRT includes debris clearance equipment and subsea dispersant equipment, including a dedicated dispersant stockpile (500 m³ of Dasic Slickgone NS) and ancillary equipment (e.g., pumps, flying leads, coiled tubing head, dispersant wands).	AMOSC SFRT stored at Oceaneering yard in Jandakot and can be transported to Dampier. It is estimated this would take 10 hours to arrange and up to 7 days to load and transport to Dampier, depending on the time of the year. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier within 9 days of call-out. Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 12 from call out.	In effect	Equipment	SSDI can break-up oil droplets forcing greater entrainment of the oil into the water column below the sea surface. Has ability to reduce volatile organic compounds in the vicinity of a spill, making the area safer for responders.	Provides functionality, availability, reliability, survivability, compatibility and independence. Availability - whilst the SFRT takes several days to mobilise to site and conduct initial surveys, this timeframe is considered reasonable given the technical nature of this equipment.	Cost of AMOSC membership for SFRT	**In effect**
	Purchase of Santos SFRT to be located at Exmouth or Dampier	Improved	Equipment	Reduces mobilisation time between storage and port of deployment (Dampier) by approx. 48 hrs	Improved availability however limited by vessel availability to deploy	Cost of SFRT purchase, storage and maintenance	**Reject** SFRT is estimated to arrive in Dampier only 2-3 days before vessel. Taking into account the significant costs of purchasing and maintaining a Santos-owned SFRT, an improvement of 2-3 days mobilisation time is not considered to provide a proportionate benefit.
	Relocate AMOSC SFRT to Dampier	Improved	Equipment	Reduces mobilisation time between storage and port of deployment (Dampier) by approx. 48 hrs	Improved availability however limited by vessel and personnel availability to deploy	AMOSC unable to alter storage location of SFRT as this could negatively impact other members	**Reject** Positioning of SFRT in Dampier in order to reduce deployment time was assessed but was found to be disproportionate in terms of costs to the reduction in risk gained and may adversely affect other SFRT members and their committed deployment times.
	Subsea bladder dispersant system positioned next to well site	Alternative	Equipment	Subsea dispersant bladder system can be prepositioned and operate remotely if SSDI is determined a suitable strategy via an operational NEBA. Bladder systems are positioned in framed housings next to the well site. Autonomous application could	Possible improved availability and independence, however technical development and procurement would be required as existing components in the market would need to be	Purchase of bladder system on top of SFRT membership as both systems would still be required.	**Reject** Subsea bladder systems are a unproven technology and bring additional risks to the environment and personnel. In addition, the cost of having a subsea bladder system in place is

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				commence by Day 1-2, reducing application times by 7-8 days.	combined to develop this system. Placing bladders adjacent to the well site exposes them to risk of damage from debris in the event of a loss of well control. Additionally, bladder systems require extensive equipment and fluid deployment/recovery operations at each wellsite, exposing personnel to significant additional HES risks. Therefore, the design and development of this technology includes a high degree of uncertainty. Subsea bladders also have limited volume capacity, meaning this alternative would offer a short term application option until SSDI arrives via the SFRT.		a fixed cost, regardless of if a spill were to occur or not.
Subsea dispersant injection - planning	Source Control Planning and Response Guideline (DR-00-ZF-20001).	In effect	Procedure	Provides a set process to follow for the mobilisation of SFRT and suitable vessel by Santos Source Control Team thereby reducing the timeframe and increasing the effectiveness of SFRT.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort in updating and maintaining document	**In effect**
Subsea dispersant injection - vessels	Level 1: Suitable vessel sourced through Santos contractors. Vessel requirements outlined in Santos Source Control Planning and Response Guideline (DR-00-ZF-1001).	In effect	Equipment	Enhances subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**
	Level 2: Suitable vessel sourced through any regional contractors and monitored through WA Vessel Tracking System.	In effect	Equipment	Enhances subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Level 3: Suitable vessel sourced as Vessels of Opportunity.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Enable improved vessel access by contracting a suitable, dedicated vessel on standby	Improved	Equipment	This alternative would result in SSDI commencing on Day 8-9, instead of Day 11-12 as vessel would be in Dampier on standby. Although this would treat released hydrocarbons for an additional 3 days, this would have a negligible reduction in shoreline accumulation volumes at protection priorities.	Improved availability and reliability	Costs associated with having a suitable vessel on contract and standby in Dampier - $50-60K USD/day.	**Reject** Removes bottleneck of having to wait 3 days for a suitable vessel. However, the cost of having a vessel on standby is a fixed cost, regardless of if a spill were to occur or not. The time saving of 3 days is not proportionate to the expense incurred, especially as SSDI is not anticipated to significantly reduce shoreline accumulation volumes if it were applied for an additional 3 days.
Subsea dispersant injection - personnel	Oceaneering personnel for the deployment of the SFRT	In effect	People	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of Oceaneering contract for personnel	**In effect**
Subsea dispersant injection - dispersant stocks	Level 2: Dedicated SFRT dispersant stockpile stored with SFRT at Jandakot (AMOSC, 500m3 Dasic Slickgone NS). Additional dispersant stocks stored at Exmouth (AMOSC, 75m^3 Slickgone NS); Dampier (AMSA, 10m^3 Slickgone NS, 10m^3 Slickgone EW); Broome (AMOSC, 14m^3 Ardrox), Fremantle (AMOSC: 8m^3 Slickgone NS, 27m^3 Corexit 9500; AMSA: 48m^3 Slickgone NS, 52m^3 Slickgone EW). Available within 24 hours.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability exceeds requirements	Costs of contract with AMOSC, Access to National Plan resources through AMSA	**In effect**
	Level 3: Dispersant stocks stored at other national stockpile locations (AMOSC, 137m^3) (AMSA, 255m^3). OSRL dispersant stocks available in Singapore and worldwide (50% of 732m^3 as SLA and 5,000m^3 as a subscriber to the Global Dispersant Stockpile) Mobilisation times depend on location.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability exceeds requirements	Costs of contracts, MOUs with AMOSC and OSRL, access to National Plan resources through AMSA	**In effect**
	Access to additional dispersant stockpiles owned by Santos	Additional	Equipment	No additional environmental benefit if surplus to requirements	Improved availability and reliability	Additional cost for purchase and maintenance of stockpiles	**Reject** Analysis indicates that dispersant supplies accounted for in the OPEP are sufficient. Santos is already subscribing to OSRL stockpiles in excess of 5,000m^3.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Rent dispersant stockpiles and place in Dampier	Additional	Equipment	No additional environmental benefit as existing dispersant stockpiles can be relocated to Dampier and dispersant manufacture can commence in a timeframe where dispersant demand does not exceed supply.	Availability already meets requirements	Additional cost for renting dispersant stockpiles	**Reject** Analysis indicates that timeframes for mobilising and relocating dispersant supplies are sufficient.
Dispersant effectiveness monitoring	To assess the effectiveness of dispersant application, Santos will use the Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to determine the efficacy of subsea dispersant application.	In effect	Procedure	The Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to assist in characterising the nature and extent of subsea or near surface dispersed oil, aid in the validation and accuracy of plume trajectory models and allow for rapid quantification of data to enable the IMT to make decisions about continuation of dispersant application. The IMT assesses the effectiveness of continued dispersant use against an operational NEBA assessment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of contracts to provide monitoring capability	**In effect**

Table B-6: Detailed ALARP Assessment Worksheets – VI Operations and Spartan Development drilling Source Control

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Source Control – Adopted controls and standards are found in Section 8.3							
Relief well drilling	Santos Drilling and Completions Source Control Team mobilised within 24 hours. Well Control Specialists mobilised within 72 hours. Contract/ MOUs for source control personnel. APPEA MoU for mutual assistance for relief well drilling.	In effect	People	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts. Limit/prevent hydrocarbon contacting sensitive receptors	This primary source control measure provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Cost of contracts/ MOUs	**In effect**
	BOP function testing	In effect	people	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment ensures timely activation of the BOP.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort required to conduct BOP function test	**In effect**
	Contract source control personnel through an alternative provider in addition to existing arrangements	Additional	People	No environmental benefit if additional services are surplus to requirements	Improved availability and reliability	Significant additional cost in maintaining two contracts for the same service	**Reject** No environmental benefit in having access to personnel surplus to requirements
	Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC	Additional	People	No environmental benefit as WWC personnel are available to provide support within 72 hours which will coincide with starting to commence sourcing of relief well MODU	No change to effectiveness or reliability as WWC personnel available within a rapid timeframe under existing arrangements.	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required	**Reject** No environmental benefit in having access to personnel surplus to requirements
	Source Control Planning and Response Guideline (DR-00-OZ-20001).	In effect	Procedure	Provides a set process top follow in the planning and mobilisation for relief well drilling by Santos Source Control Team thereby reducing the timeframe and increasing the effectiveness of relief well drilling.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort in updating and maintaining document	**In effect**
	MODU Capability Register is monitored monthly	In effect	Procedure	By monitoring MODU availability in the region, it will be possible to gain an understanding of which MODU may be rapidly available for relief well operations. This could reduce mobilisation times for MODU thus reducing	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
				volume of hydrocarbon released to the environment.			
	Suitable relief well confirmed to available prior to drilling	In effect	Procedure	Identification of a suitable MODU prior to drilling would decrease the time spent searching for a suitable MODU in the event of a spill, reducing mobilisation times for MODU thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Regular monitoring of MODU capability Register to ensure preferred MODU remains available throughout the activity	In effect	Procedure	Monitoring the Register will ensure Santos are aware of any changes in availability of suitable MODUs, enabling Santos to update the Source Control Plan and identify an alternative suitable MODU if the event one changes location.	Provides availability, reliability, compatibility and independence	Effort spent monitoring	**In effect**
	MODU on standby at activity location during drilling campaign	Improved	Equipment	Reduce mobilisation times of MODU to drill relief well thus reducing hydrocarbon released to the environment. Instead of base timeframe for the drilling of a relief well of 77 days, relief well potentially could be drilled in 43 days (77 days less the 34 days required for MODU to be ready to spud/commence relief well operations).	Reduction in spill duration by 34 days, resulting in less hydrocarbon exposure and reduced shoreline loading volumes.	The cost of having a MODU contracted, crewed and holding a valid NOPSEMA Safety Case and WOMP to be on standby would cost between ~550kUSD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. This cost would be paid regardless of whether there is a loss of containment or not.	**Reject** Likelihood of LOWC is considered unlikely and the cost of having a second MODU on standby at location is considered grossly disproportionate to the environmental benefit. It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this MODU in the event a relief well was required when the event occurred. It is conceivable that to cover a 50-day well activity (for example) with a relief well MODU on standby cost over the same duration would be in the order 28MMUSD, depending on where the MODU were mobilised from/to and the market at the time.
	Having a dedicated relief well MODU on contract during drilling campaign.	Improved	Equipment	Provides for rapid mobilisation of relief well MODU to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Significant commercial effort required to align two MODUs that are not contracted. Possible that market may not be able to supply this demand.	**Reject** In order to perform this, the MODU will need to be contracted, crewed and hold a valid NOPSEMA Safety Case. This could cost between ~550k USD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
							It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this MODU in the event a relief well was required when the event occurred. It is conceivable that to cover a 50 day well activity (for example) with a relief MODU on standby cost over the same duration would be in the order ~28MMUSD, depending on where the MODU were mobilised from/to and the market at the time. Given there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the reduction in risk is grossly disproportionate to the cost and effort required to perform it.
	Use of two drilling rigs during activity drilling campaign that drill simultaneously so that one rig could act as a relief well drilling rig for the other	Improved	Equipment	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Considered not feasible to contract and crew and support two rigs to drill two short wells at the same time given that requires: - Double the number of rig crew and service company crew to support the operations for a short time. - Possible inability of the market to supply two MODUs at the same time over a two-month window.	**Reject** Similar reason to the above - would have to move in a rig to make this happen. MOU gives Santos sufficient access to relief well MODUs.
	Time drilling campaign to align to other Santos drilling activity so that nearby MODU could be used as a relief well drilling MODU	Improved	Equipment	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	This would significantly reduce timing (e.g. possibly 20-30 day reduction as not needing to wait for MODU to be sourced and transfer to location. (Check EP for consistency)	**Reject** No other concurrent Santos drilling activities expected in the region until mid-2024.
	Schedule drilling campaign to avoid cyclone season	Alternative	Procedure	Drilling the well in cyclone season does not increase the likelihood of a loss of containment. This will be verified by NOPSEMA in the accepted WOMP, where the plan to suspend the well during a cyclone will be assessed.	Does not alter the effectiveness of the response strategy.	Having to mob and de-mob a MODU to guarantee the well could be drilled outside of cyclone season would be a >5MM USD cost increase.	**Reject** There are no additional risks associated with cyclone season on a loss of well control. The barriers installed for cyclone suspension are independent of metocean conditions. Adjusting the timing would preclude the ability to drill for 6 months of the

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
							year, materially reducing the MODUs available to do the work. Having to mob. and de-mob. a MODU to guarantee the well could be drilled outside of cyclone season would be a >5MM USD cost increase, which is disproportionate to the benefit gained.
	Direct Surface Intervention Via Well Control Experts	Improved	Procedure	Reduce time taken to control source and reduce environmental impacts	1) Effectiveness of intervention of this type needs to be assessed at the time given that personnel safety considerations may preclude this control measure. 2) Mobilisation procedure for personnel as per Source Control Planning and Response Guideline (DR-00-OZ-20001) 3-4) Contracts and MoUs for well control personnel (WWCI)	Ability to implement and effectiveness of this control can only be determined at the time of an incident.	**Accept** Santos has a standing agreement with Wild Well Control for call-out of well control experts. Arrangements already in place to access resources (Source Control Planning and Response Guideline (DR-00-OZ-20001), Contracts) but this control will be applied opportunistically and will be dependent upon safety constraints.
	Pre purchase of relief well drilling supplies	Improved	Equipment	Relief well drilling supplies such as casings and well head equipment could potentially reduce relief well drilling times	Increase in availability	Cost of purchase, maintenance and storage of supplies	**Accept** Offshore D&C commit to having long lead equipment for a relief well at our disposal as part of our WOMP commitments for each well drilled.
	Relief well design assessment to identify and screen relief well spud locations prior to drill campaign	In effect	Procedure	Reduce time taken to plan and execute relief well, and reduce environmental impacts	Improved availability and reliability	Effort required to conduct relief well assessment	**In effect**
	Pre-drill riserless intervals for a potential relief well before drilling the main well	Additional	Equipment Procedure	Could reduce relief well drill duration by 10 days. However, this activity would result in drill cuttings/discharges being released to the marine environment and noise emissions regardless of whether a LOWC were to occur or not.	Detailed relief well designs will be re-evaluated and revised for an actual LOWC event. There will be several locations for the relief well identified before an incident, with the optimal location selected after a LOWC incident, based on real-time information (i.e. prevailing weather). A pre-drilled relief well top-section might result in having to use a sub-	The pre-drilling activity itself would require approximately 10 days and a complete rig move to perform, costing approximately ~7MM USD. Once the main well was completed, the partially completed relief well would need to be abandoned, at a further cost of 6-7MM USD.	**Reject** This option may result in a sub-optimal relief well location being used. There is minimal environmental benefit gained for the grossly disproportionate costs associated with this option.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
					optimal design and location. It is not industry practice, and such a pre-drilled riserless interval may adversely affect functionality and reliability of this response strategy.		
	Use of semi-submersible drilling rig to drill the well	Alternative	Equipment	Use of a semi-submersible drill rig would mean additional source control methods could potentially be employed to control the flow of hydrocarbons. This would include use of a capping stack.	Possibly results in a reduced time to stop flow from the well. Capping stack could potentially be installed in 17-43 days vs a relief well at 77 days.	If a LOWC were to occur from the Spartan well during development well drilling, a subsea capping stack response strategy is not applicable given the petroleum activity will take place from a jack-up MODU. A semi-submersible drilling unit is not suitable for the Spartan drilling activities given the water depths at the well top-hole locations (~50 m); this precludes the use of Dynamically Positioned (DP) drilling units (drill ships and DP semi-submersibles) and moored semi-submersible drilling units. Therefore, under a credible loss of well control event subsea there are no connection points for capping stack installation.	**Reject** - Drilling the well with a semi-submersible over a jack up is rejected as it is not possible to use a semi-submersible rig for the Spartan well.
	Install a mudline closure device	Improved	Equipment	Provides a pre-installed safety barrier at the seabed	MCD augments the existing BOP safety system, located below the BOP and above the wellhead, and provides two additional sets of rams with an independent control system. Provides an additional level of safety, in addition to the subsea BOP.	Not feasible for jack-up drilling. The wellhead and BOP is at surface.	**Reject** based on feasibility
	Alternative BOP design (additional sealing rams installed)	Improved	Equipment	Reduces likelihood of a WCD event	Adds another layer of redundancy in BOP	Could be done. Require modifications to MODU, BOP and BOP control system to implement. Expected cost 3MM USD and time in shipyard or port to install.	**Reject**. Santos commits to using BOP equipment that is fully complaint with API Std 53, which specifies number and type of rams to be installed in the BOP for a given

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
							application. This will be a commitment in the SCR and the WOMP. Additional cost doesn't significantly reduce risk and BOP equipment will be fully compliant with industry standards.
Source Control - Vessel Collision	Vessel Spill Response Plan (SOPEP/SMPEP)	In effect	Procedure	Provides a set process to follow in the planning and mobilisation for spill response actions by the Vessel Contractor thereby reducing the timeframe and increasing the effectiveness of spill response.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort required in contractor procedure due diligence.	**In effect**

Table B-7: Detailed ALARP Assessment Worksheets - Monitor and Evaluate, Containment and Recovery, Mechanical Dispersion, Protect and Deflect, Shoreline Clean-up, Oiled Wildlife, Waste and Scientific Monitoring

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Monitor and Evaluate – Adopted controls and standards are found in Section 9.10							
Oil Spill Trajectory Modelling	Maintain contract with Oil Spill Trajectory Modelling service provider. The service provider will be contacted immediately (within 2 hours) upon notification of a level 2 or 3 spill. Upon activation, the service provider will provide trajectory models within: - 2 hours for OILMAP model for offshore and open ocean; - 4 hours for OILMAP operations for near-shore; and - Detailed modelling service is available for the duration of the incident.	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of contract	**In effect**
	Access to additional spill modelling capability through OSRL	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	An additional service provider ensures redundancy (independence) if for some reason the other service provider was unable to fulfil the function. There is also the possibility of increased functionality associated with improved certainty of the modelling results if both service providers are activated.	Cost of membership	**In effect**
	Purchase of oil spill modelling system and internal personnel trained to use system	Alternative	System, people	This could result in the faster generation of the initial model which may result in an environmental benefit as a consequence of the IMT making operational decisions quicker	Potentially increases availability Decrease in functionality-in house service may not be across technical advances to same extent as contracted service providers	Purchase of system, training of personnel, and on-call roster	**Reject** The cost of purchasing the system, training and having personnel on-call is disproportionate to any potential gains from potentially being able to deliver initial results quicker than the 2-hour turn-around currently guaranteed by the service provider
Tracking buoy	Level 1: Two tracking buoys located on the MODU ready for deployment 24/7. Tracking buoys deployed within 2 hrs.	In effect	Equipment	Tracker buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of equipment	**In effect**
	Level 1. Santos owns and maintains 12x tracking buoys across its NW facilities.	In effect	Equipment	Tracker buoys provide real-time verification data (particularly	Provides functionality, availability, reliability,	Cost of equipment	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				beneficial at night and in conditions limiting aerial surveillance)	survivability, compatibility and independence Area of improvement; none identified		
	Level 2: tracking buoys available from AMOSC and through AMOSC Mutual Aid	In effect	Equipment	Tracker buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership	**In effect**
	Level 3: tracking buoys available from OSRL. Transit times (air) Singapore to Karratha = 3–5 days.	In effect	Equipment	Tracker buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership	**In effect**
	WA purchase additional satellite tracking buoys	Additional	Equipment	There is no expected environmental benefit from having additional tracking buoys, as there are already tracking buoys located on the facility/ vessel ready for deployment 24/7 and any additional needs can be provided by Santos owned stocks. Additional buoys can be accessed from AMSA, AMOSC and OSRL within days with no additional upfront cost.	Increase in availability and reliability	Cost of purchasing additional tracking buoys	**Reject** Does not provide any additional environmental benefit and the cost associated is therefore not warranted
Aerial sur-veillance - aircraft and crew	Maintain contract with service provider for dedicated aerial platform operating out of Karratha. (Helicopter services available through WA's primary contracted supplier. Activation of aerial surveillance using helicopter pilots will occur in 3 hours of notification of the spill. Helicopter on site for surveillance within 6 hrs. Surveillance and recording using helicopter pilots is considered adequate for situational awareness.)	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of aerial observers in initial 24 hours of incident	Cost of contract	**In effect**
	Level 1: Trained Santos observers will be available from Day 2 of the incident, following activation	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with	Provides functionality, availability, reliability, survivability,	Cost of training and maintaining trained staff	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Aerial sur-veillance - observers				the aim of reducing and mitigating environmental impact	compatibility and independence Area for improvement - availability - rapid mobilisation of aerial observers in initial 24 hours of incident		
	Level 2: Access to additional aerial observers through AMOSC Staff and Industry Mutual Aid Core Group Responders	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of AMOSC membership	**In effect**
	Level 3 : Access to additional aerial observers through OSRL (18 people). OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of OSRL membership	**In effect**
	Ensure trained aerial observers based at strategic locations such as Port Hedland, Exmouth and Karratha	Additional	People	Current capability meets need and therefore environmental benefit would be incremental. Having trained observers living locally and on short notice to mobilise would result in trained aerial observers available from Day 1 (current arrangements are that the pilot would provide the initial observations and recording on Day 1 with trained aerial observers from Perth and VI mobilised and operational by Day 2).	Improved availability and reliability	Costs associated with staff employment and training	**Reject** Cost is considered disproportionate to the incremental benefit given surveillance on Day 1 by pilots is considered sufficient
Aerial sur-veillance - unmanned aerial vehicles	Level 2: Unmanned Aerial Vehicles for aerial surveillance available through AMOSC (UAVs and pilots can be accessed through AMOSC with a mobilisation time of 12+ hours)	In effect	System	Use of UAVs may provide an environmental benefit compared to alternative options (such as helicopters and fixed wing aircraft) given shorter deployment time and ability to assess difficult areas.	Provides functionality and availability Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Level 3: Unmanned Aerial Vehicles for aerial surveillance available through OSRL	In effect	System	Use of UAVs may provide an environmental benefit compared to alternative options (such as helicopters and fixed wing aircraft) given shorter	Provides functionality and availability	Cost of membership with OSRL	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				deployment time and ability to assess difficult areas.	Area of improvement; none identified		
Vessel sur-veillance	Vessels and aircraft compliant with Santos's Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	In effect	Procedure	Provides the procedure for interaction and sighting of protected marine fauna from vessel or aircraft, to ensure compliance with EPBC Regulations.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of maintaining and implementing procedure.	**In effect**
	Level 1: vessels in use by WA and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. could be used for surveillance purposes in the event of a spill. (Vessel surveillance will be activated within 90 minutes for available on-site vessels. Santos has access to on-hire vessels supporting WA's VI and NV facilities. WA Vessel Monitoring System has access to automatic identification system live-vessel tracking portal to establish vessel availability.)	In effect	Equipment	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provided limited information.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of existing contracts with vessel providers	**In effect**
	Level 2: vessels sourced through Master Service Agreement, located in region and tracked by WA Vessel Monitoring System.	In effect	Equipment	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provided limited information.	Improves availability and reliability Area of improvement; none identified	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: vessels sourced without existing contracts from any location	In effect	Equipment	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provided limited information.	Improves availability and reliability Area of improvement; none identified	Cost of contracts at the time of requirement.	**In effect**
Water Quality Monitor-ing (operation al and scientific)	Maintain of monitoring service provider contract for water quality monitoring services. Water quality monitoring personnel, equipment and vessel deployed to spill site within 72 hours of monitoring action plan approval.	In effect	System	This monitoring will confirm the distribution and concentration of oil, validating spill trajectory modelling and inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; availability of vessels	Cost of contracts	**In effect**
	Access to additional water quality monitoring services through OSRL	In effect	System	This monitoring will confirm the distribution and concentration of oil, validating spill trajectory	Provides functionality, availability, reliability, survivability,	Cost of OSRL membership	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				modelling and inform the IMT decisions with the aim of reducing and mitigating environmental impact	compatibility and independence Area of improvement; availability of vessels		
	Determine required vessel specifications and improve accuracy of Vessel Tracking System	Improved	Procedure	Improve mobilisation time	Improved availability and reliability	Cost to determine vessel specifications	**Accept**
	Purchase of First Strike Oil Sampling Kits to be positioned at Exmouth and VI. Development of technical procedure for sample collection by untrained personnel	Additional	Equipment, procedure	Will enable Oil fingerprinting, and initial measurements of oil concentrations	Improve function, availability, survivability and compatibility	Cost of purchasing equipment and developing procedure	**Accept**
	Trained monitoring specialists on site	Additional	People	Ensure sampling is conducted correctly	Improves reliability	Costs associated with staff employment	**Reject** This is not necessary as a good procedure for sample collection is in place
Satellite Imagery	Maintain membership with AMOSC provider to enable access and analysis of satellite imagery.	In effect	Systems	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	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Maintain membership with OSRL to enable access to and analysis of satellite imagery	In effect	System	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	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**
Shoreline Assess-ment	Level 1/2: WA-based AMOSC staff and core group operations personnel (WA has arrangements through AMOSC to mobilise WA-based AMOSC staff and Core Group personnel to site 24 hours following initiation)	In effect	People, procedures	To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character, 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	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; availability - reduce time to mobilise personnel to strategic locations	Cost of AMOSC membership	**In effect**
	Level 3: Maintain membership with OSRL to access SCAT trained responders (OSRL, 18 people). OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People, procedures	To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character, degree and distribution of oiling	Provides additional functionality, availability, reliability, survivability, compatibility and independence	Cost of OSRL membership	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				(if present), presence of sensitive receptors (habitats, fauna etc.) and information on shoreline processes and access routes that could aid or hamper response efforts	Area of improvement; none identified		
	Just--In--Time training to train personnel for spill response roles	Additional	People	Greater capacity for shoreline clean-up assessment in the later stages of response	Improved availability and reliability, lower dependence	High cost of training at time of requirement. Extended period prior to minimum shoreline contact provides window of opportunity to train workforce. Trainees require minimal prior skills and will be easily sourced.	**Accept** A contingency plan to create a pool of trained personnel in the early stages of a response in numbers above the expected requirement.
Wildlife Reconn-aissance (aerial/ vessel sur-veillance. Shoreline clean-up assess-ment)	Maintain contract with scientific monitoring service provider for access to fauna aerial observers and personnel experienced in conducting relevant fauna surveys.	In effect	People, procedures	Wildlife reconnaissance aids the IMT to plan and make decisions for executing an oiled wildlife response and for minimising impacts to wildlife associated with the clean-up response	Provides functionality, availability and compatibility Area for improvement; availability - reduce time to mobilise personnel to strategic locations	Cost of contract	**In effect**
	Maintain a list of providers that could assist with fauna aerial observations, e.g. whale shark spotting planes	Additional	People	Wildlife reconnaissance aids the IMT to plan and make decisions for executing an oiled wildlife response and for minimising impacts to wildlife associated with the clean-up response	Improves availability and reliability Area of improvement; none identified	Cost of developing and maintaining list	**Accept**
	Ensure trained marine mammal/fauna observers based at strategic locations such as Port Hedland, Karratha and Broome	Additional	People	Having trained marine mammal/fauna observers living locally and on short notice to mobilise would result in trained aerial observers available from Day 1	Improved availability and reliability	Costs associated with staff employment and training	**Reject** Maintaining trained fauna observers at location is considered grossly disproportionate as they are required only for the initial stages of the response until observers from scientific monitoring provider can be mobilised.
Containment and Recovery - Adopted controls and standards are found in Section 11.6							
Contain-ment and recovery - booms, ancillary equipment	Offshore booms and skimmers to supply capability for 15% oil recovery target (2 containment and recovery units: ~230 m3 per week). Equipment supplied from a combination of AMOSC and AMSA stockpiles.	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Reliability is attained through OSRO contracts.	Cost of OSRO membership contracts for AMOSC. Access to National Plan Resources through AMSA.	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
					Area of improvement; none identified.		
	Offshore Booms and skimmers to supply additional capability for greater than 15% oil recovery target. Equipment supplied from a combination of AMOSC, OSRL, AMSA and Industry Mutual Aid stockpiles.	In effect	Equipment	Potentially reducing the volume of surface hydrocarbons to reduce contact with protection priorities. Greater capacity for containment and recovery operations. Potentially increased volume of oil collected.	Provides functionality, availability, reliability, survivability, compatibility and independence. Reliability is attained through OSRO membership contracts. Area of improvement: none identified.	Cost of OSRO membership contracts for AMOSC and OSRL, MOU in place for Industry Mutual Aid, access to National Plan Resources through AMSA.	**In effect**
	Purchase additional booms and ancillary equipment to be owned by Santos	Additional	Equipment	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of equipment purchase and maintenance	**Reject** The number of containment and recovery units (2) is based on a target recovery rate of 15%, which is already considered to be highly ambitious; past spill events have indicated recovery rates in the range of 4% to 10% at best (IPIECA, 2015c). Santos already has the capability to scale up the oil recovery target through existing arrangements. Furthermore, as an OSRL member, Santos can also gain access to offshore containment and recovery units of OSRL's global capability (made available on a case-by-case basis). Existing capability exceeds the capability required to achieve a 100% oil recovery target.
Contain-ment and recovery - liquid oil waste tanks	Liquid waste storage capacity available to support 33 m3 of temporary waste storage on board deployment vessels for 2 containment and recovery units (66 m3 of storage per day) to achieve 15% recovery target. Supplied through a combination of AMOSC, AMSA and contract with Santos contracted container provider (OEG).	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Reliability is attained through OSRO membership contracts and terms of engagement conditions with OEG. Area of improvement; increasing the functionality of liquid waste storage tanks through decanting operations approved by DoT or AMSA.	Cost of contract with OEG, cost of OSRO membership contracts, MOU in place for AMOSC, access to National Plan Resources through AMSA.	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Contain-ment and recovery-vessels	Vessels in use by Santos and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Suitable towing vessels mobilised to deployment port within 12 hrs. Suitable deployment vessels mobilised to deployment port within 24 hrs.	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified.	Cost of variation to existing contracts with vessel providers	**In effect**
	Vessels sourced through Master Service Agreements, located in region and tracked by Santos Vessel Monitoring System (IHS Maritime Portal)	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides survivability, compatibility and independence. Area of improvement; functionality, availability and reliability of tow vessels.	Cost of vessel monitoring system (IHS Maritime Portal subscription). Cost of contracts at the time of requirement/appointment.	**In effect**
	Vessels sourced without existing contracts from any location and tracked by Santos Vessel Monitoring System (IHS Maritime Portal)	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides survivability, compatibility and independence. Area of improvement; none identified	Cost of vessel monitoring system (IHS Maritime Portal subscription), cost of brokers fees. Cost of contracts at the time of requirement/ appointment.	**In effect**
	Access to additional vessels by contracting vessels to remain on standby for containment and recovery	Additional	Equipment	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of vessel to be on standby when not required for oil spill operations	**Reject** Santos monitors vessel availability through Santos Vessel Monitoring System. Regularly contracted vessels could be supplemented with vessels of opportunity
	Define containment and recovery vessel specifications for deployment and towing vessels and input this information to improve vessel tracking.	Improved	System	More accurate vessel tracking may lead to faster mobilisation times, potential for response operations at more locations	Improved availability and reliability.	Cost and effort to gather and input data	**Accept** Cost of control measure is proportionate to environmental benefit
Contain-ment and recovery-personnel	Level 2: Spill responders from Varanus Is., Devil Creek, Perth (Santos), Fremantle (AMOSC staff), Perth (AMOSC Core Group). Santos resources in place to commence operations within 2–12 hrs. AMOSC Staff and AMOSC Core Group mobilised to deployment port within 24 hrs. For personnel numbers refer to **Appendix S: Resource Capability Assessment**	In effect	People	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Provides functionality, availability, reliability, survivability, compatibility and independence. Functionality attained through training and exercises. Area of improvement; availability - rapid mobilisation of personnel.	Employment and training of Santos staff. Cost of contracts in place for AMOSC staff	**In effect**
	Level 3: Spill responders from Geelong (AMOSC staff), interstate (AMOSC Core Group; AMSA) and international if needed (OSRL).	In effect	People	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Provides functionality, availability, reliability, survivability,	Employment and training of Santos staff.	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances. For personnel numbers refer to **Appendix S: Resource Capability Assessment**				compatibility and independence. Area of improvement; availability - rapid mobilisation of personnel.	Cost of contracts, MOUs in place for AMOSC Core Group and OSRL	
	Train additional Santos personnel for containment and recovery operations	Additional	Personnel	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of training and staff hours	**Reject** AMSA, AMOSC and AMOSC Core Group and OSRL have sufficient numbers of personnel with the appropriate skill set
	Contract for staff from an alternative oil spill personnel provider	Alternative	Personnel	Greater capacity for containment and recovery in the later stages of response	Improved availability and reliability	Time and cost of contractual management	**Reject** AMSA, AMOSC and AMOSC Core Group and OSRL have sufficient numbers of personnel with the appropriate skill set
	Just--In--Time training to train personnel for containment and recovery operations	Additional	People	Greater capacity for containment and recovery in the later stages of response	Improved availability and reliability, lower dependence	Difficult to identify trainees with appropriate prior skill sets such as maritime experience. Concerns around adequacy of training. Supervisors of complex operations require long term experience.	**Reject** Not required to address any gap, and not feasible due to adequacy and safety concerns
Mechanical Dispersion- Adopted controls and standards are found in Section 10.3							
Mechan-ical Dispersion	Use of vessel crews, contract vessels and vessels of opportunity to disperse small areas of amenable hydrocarbon types such as marine diesel.	In effect	People, equipment	Enhanced dispersion and biodegradation of released hydrocarbons	Provides availability, reliability, survivability, compatibility and independence. Limited functionality as mechanical dispersion is secondary response strategy limited by weather conditions, hydrocarbon type and hydrocarbon volume.	Cost of vessel time	**In effect**
Protection and Deflection - Adopted controls and standards are found in Section 12.5							
Protection and deflection- booms and ancillary equipment	Level 2: Shoreline and nearshore booms plus ancillary equipment from Varanus Is. (Santos, 4*Beach Guardian, 8*25m Zoom Boom, 2*skimmer), Exmouth (AMOSC, 20*25m Beach Guardian, 20*25m Zoom Boom, 2 skimmers; Santos, 2*Beach Guardian, 5*25m Zoom Boom, 1*skimmer), Dampier (AMSA, 5* Canadyne Inflatable, 10* Structureflex Inflatable, 5* Versatech Zoom Inflatable, 2 Slickbar Solid Buoyancy, 3*Structureflex Solid Buoyancy, 30* Structureflex Land Sea), Fremantle (AMOSC, 23*35m Beach Guardian, 30*25m Zoom Boom, 18* Curtain Boom, 1*skimmer; AMSA, 15*Structureflex Inflatable, 13*Versatech	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs associated with equipment purchase and maintenance Costs of contracts, MOU with AMOSC, access to National Plan Resources through AMSA	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Zoom Inflatable, 10*Structureflex Solid Buoyancy, 30* Structureflex Land Sea), Broome (AMOSC, various equipment). Vehicles sourced from local hire companies. Transit times (vessel): Varanus Is. to VI operational area = 4 hrs, Karratha to Varanus Is. = 8.4 hrs Varanus Is. to Exmouth = 18 hrs Transit times (road) Fremantle to Exmouth = ~24 hrs Fremantle to Karratha = ~24 hours Fremantle to Port Hedland = ~24 hours Dampier/ Karratha to Exmouth = 7 hrs Exmouth to North West Cape = 0.5 hr. Protection booming equipment mobilised to FOB location within 12 hrs.						
	Level 3: Shoreline and nearshore booms plus ancillary equipment from Geelong (AMOSC), interstate (AMSA) and Singapore (OSRL). Transit times (road/ air) Geelong or Singapore to Exmouth or Karratha = 3–5 days. These resources in place to commence protection and deflection within 3-10 days.	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs associated with equipment purchase and maintenance Costs of contracts, MOUs Costs associated with staff training	**In effect**
	Santos to purchase additional shoreline and nearshore booms and ancillary equipment	Additional	Equipment	Enable more protection and deflection operations to occur simultaneously to protect more key areas	Improved availability and reliability	Costs associated with equipment purchase and maintenance	**Reject** Sufficient quantities of equipment located in the region.
Protection and deflection-vessels	Level 1: Shallow draft vessels in use by Santos and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Boom deployment vessel / remote island transfer vessel mobilised to FOB location/ port within 12 hrs.	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**
	Level 2: Shallow draft vessels sourced through Master Service Agreement, located in region	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Level 3: Shallow draft vessels sourced without existing contracts from any location	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Maintain a list of small vessel providers for nearshore booming	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Access to additional shallow draft boom tow vessels owned by Santos	Additional	Equipment	Faster response times to facilitate protection of key sensitive areas	Improved availability and reliability	Costs of vessel purchase and maintenance	**Reject** High numbers of shallow draft vessels located in the region. One vessel can help to set boom at multiple locations.
	Provision for shallow draft boom tow vessels added to Master Service Agreement	Improved	Equipment	Reduce time required to source vessels and crew in initial phase of response. Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Time involved in providing vessel specifications and liaising with existing suppliers	**Accept**
Protection and deflection-personnel	Level 2: Spill responders from Varanus Is., Devil Creek, Perth (Santos), Fremantle (AMOSC staff), Perth (AMOSC Core Group). Santos Offshore Core Group mobilised to Exmouth within 12 hrs. AMOSC Staff and Industry Core Group mobilised to FOB within 24 hrs. Varanus Island first strike team mobilised within 4 hrs. For personnel numbers refer to **Appendix S: Resource Capability Assessment**	In effect	Personnel	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Availability - Santos access to helo services ensures that regional personnel can be quickly mobilised to the appropriate location. Area for improvement; none identified	Costs of contracts, MOU with AMOSC, access to National Plan Resources through AMSA Costs associated with staff training	**In effect**
	Level 3: Spill responders from Geelong (AMOSC staff), interstate (AMOSC Core Group; AMSA) and international if needed (OSRL). Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances. For personnel numbers refer to **Appendix S: Resource Capability Assessment**	In effect	Personnel	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs of contracts, MOUs with AMOSC and OSRL, access to National Plan Resources through AMSA. Costs associated with staff training	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Just--In--Time training to train personnel for spill response roles	Additional	People	Greater capacity for protection and deflection in the later stages of response	Improved availability and reliability, lower dependence	High cost of training at time of requirement. It may be difficult to identify trainees with appropriate prior skill sets such as maritime experience.	**Accept** IMT has scope to evaluate and implement training if required. Creates a contingency plan to access trained personnel in numbers above the expected requirement.
	Ensure trained personnel based at strategic locations such as Port Hedland, Karratha or Exmouth	Improved	Personnel	Faster response times to facilitate protection of key sensitive areas	Improved availability and reliability	Costs associated with staff employment and training	**Reject** No Santos personnel currently based at Port Hedland, Broome, Karratha or Exmouth so employment costs would be significant and not justified given that helicopters enable rapid transportation of Santos staff within the region.
Protection and deflection-planning	Ningaloo Coast shoreline sensitivity and access data/maps and Tactical Response Plans	In effect	Procedures	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of document preparation and maintenance	**In effect**
	Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations	Improved, additional	Procedures	Improved level of response planning to streamline resourcing and logistics and effect a better response	Improved functionality	Cost involved in revision of sensitivity mapping and tactical response plans and preparation of additional tactical response plans	**Reject** Current maps/plans are adequate to initiate an effective response. Plans will have to be reassessed at the time of the incident, to take into account variables such as weather and tides.
Shoreline Clean-up - Adopted controls and standards are found in Section 13.6							
Shoreline Clean-up - equipment	Level 1: Manual clean-up equipment from local hardware outlets. Decontamination/staging equipment from Exmouth (AMOSC, 1*decon. station). Mobile plant from local hire companies. PPE from Exmouth (Santos, 1*container). Clean-up equipment mobilised to location within 12 hrs.	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of equipment in initial 48 hours of incident	Cost of equipment purchase and hire at the time of incident Cost of membership with AMOSC	**In effect**
	Level 2: Manual clean-up and flushing equipment from Varanus Is. (Santos, 1*container), Fremantle (AMOSC, 1*shoreline support kit and 1*flushing kit) and	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery.	Provides functionality, availability, reliability, survivability,	Cost of equipment purchase and hire at the time of incident	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	state hardware outlets. Decontamination/staging equipment from Karratha (AMSA; 2*decon. stations) and Fremantle (AMOSC, 1*decon. station; AMSA, 2* decon. stations). Mobile plant from state hire companies. PPE from Exmouth and Varanus Is (Santos, 2*containers) and Fremantle (AMOSC, 1*container, 2*gas detectors). Transit times (vessel): Varanus Is. to Exmouth = 18 hrs, Transit times (road) Fremantle to Exmouth = ~24 hrs Dampier/ Karratha to Exmouth = 7 hrs Resources in place to commence shoreline clean-up within 1–3 days			Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	compatibility and independence Area for improvement - availability - procurement and mobilisation of equipment	Cost of equipment purchase and maintenance Cost of contract with AMOSC	
	Level 3: Manual clean-up and flushing equipment from Geelong (AMOSC, 1*shoreline support kit, 1* flushing kit, 1*shoreline impact lance kit), Singapore (OSRL) and national hardware outlets. Decontamination/ staging equipment from Geelong (AMOSC, 1*decon. station). Mobile plant sourced from national hire companies. PPE from Geelong (AMOSC, 1*container, 7*gas detectors). Transit time (road/ air) Geelong or Singapore to Exmouth or Karratha = 3–5 days	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - procurement and mobilisation of equipment	Cost of equipment purchase and hire at the time of incident Cost of equipment purchase and maintenance Cost of memberships with AMOSC and OSRL	**In effect**
	Mechanical mobile plant equipment for clean-up pre purchased and positioned at strategic locations such as Port Hedland, Karratha or Exmouth	Additional	Equipment	Environmental benefits and impacts are dependent on hydrocarbon fate and local ecology. Reduced mobilisation times and improved access would assist, should mobile plant be deemed advantageous	Improved availability and reliability	Costs associated with equipment purchase and maintenance	**Reject** there is a high likelihood that mobile plant equipment is not used due to negative environmental impacts, leaving purchased equipment unutilised and costs disproportionate Locally available hire plant can be used. Additional plant could be purchased and mobilised from Perth if required
	Prepurchase and storage of equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at strategic locations such as Port Hedland, Karratha or Exmouth	Additional	Equipment	Improve mobilisation time, potential for more response locations	Improved availability and reliability	Cost in purchase and maintenance of equipment	**Reject** Equipment for first strike available at Exmouth. Additional equipment can be mobilised to Port Hedland, Broome, Karratha or Exmouth in less than 24 hours.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Shoreline Clean-up - vessels	Level 1: Shallow draft vessels in use by Santos and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Remote island transfer vessel mobilised to FOB location/ port within 12 hrs.	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**
	Level 2: Shallow draft vessels sourced through Master Service Agreement, located in region and tracked by Santos Vessel Monitoring System	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: Shallow draft vessels sourced without existing contracts from any location	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Access to additional shallow draft vessels owned by Santos to transport personnel to key sensitive areas on offshore islands and emergent reefs such as Murion Islands	Additional	Equipment	Faster response times to facilitate protection of key sensitive areas on offshore islands	Improved availability and reliability	Costs of vessel purchase and maintenance	**Reject** High numbers of shallow draft vessels located in the region. One vessel can help to set boom at multiple locations.
	Provision for shallow draft vessels added to Master Service Agreement	Improved	Equipment	Reduce time required to source vessels and crew in initial phase of response. Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability. Improve capacity for Santos to source shallow draft vessels	Time involved in providing vessel specifications and liaising with existing suppliers	**Accept**
Shoreline Clean-up - personnel	Level 2: Clean-up team leaders from Varanus Is., Devil Creek, Perth (Santos), Fremantle (AMOSC staff), Perth (AMOSC Core Group). Santos Offshore Core Group mobilised to Exmouth within 12 hrs. AMOSC Staff and Industry Core Group mobilised to FOB within 24 hrs. For personnel numbers refer to **Appendix S: Resource Capability Assessment**	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Costs associated with staff training Costs of membership, MoU with AMOSC, access to National Plan Resources through AMSA	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Level 3: Clean-up team leaders from Geelong (AMOSC staff), interstate (AMOSC Core Group; AMSA) and international (OSRL). Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances. For personnel numbers refer to **Appendix S: Resource Capability Assessment**	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel	Costs associated with staff training Costs of membership, MoU with AMOSC, access to National Plan Resources through AMSA	**In effect**
	Access to additional team leaders that are locally based at strategic locations (Port Hedland, Karratha and Exmouth) or can be mobilised within short time frames	Additional	People	Improve mobilisation time, potential for more response locations	Improved availability and reliability	Cost of employment and training of staff Cost of being locally based or on a rapid mobilisation plan	**Reject** Santos already employs trained oil spill responders in the region that can be mobilised to key areas by helicopter within short time frames.
	Clean-up labour personnel predominantly based in Perth.	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Costs of labour hire through existing service provider	**In Effect**
	Just--In--Time training to train personnel for spill response roles	Additional	People	Greater capacity for shoreline clean-up in the later stages of response	Improved availability and reliability, lower dependence	High cost of training at time of requirement. Extended period prior to minimum shoreline contact provide window of opportunity to train workforce Trainees require minimal prior skills and will be easily sourced.	**Accept** A contingency plan to create a pool of trained personnel in the early stages of a response in numbers above the expected requirement.
	Faster access to clean-up personnel via Perth based labour hire contractor	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Not feasible to mobilise labour hire personnel in less than 72 hours	**Reject** Not feasible to mobilise labour hire personnel in less than 72 hours
	Faster access to clean-up personnel via locally based labour hire companies or emergency response organisations	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	No identified regional labour hire companies	**Reject** No identified regional labour hire companies
	Faster access to clean-up personnel via Santos employment of local personnel - Port Hedland, Broome, Karratha or Exmouth	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Costs associated with personnel employment and training	**Reject** Cost of permanently employing local personnel is grossly disproportionate to benefits of

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
							availability in initial phase of response.
Shoreline Clean-up - planning	Shoreline sensitivity mapping and Tactical Response Plans	In effect	Procedures	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation in initial 48 hours of incident	Cost associated with development and maintenance of mapping and Tactical Response Plans	**In effect**
	Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for all PPAs	Improved, additional	Procedures	Improved level of response planning to streamline resourcing and logistics and effect a better response	Improved functionality	Cost involved in revision of sensitivity mapping and tactical response plans and preparation of additional tactical response plans	**Reject** Current maps/plans are adequate to initiate an effective response. Plans will have to be reassessed at the time of the incident, to take into account variables such as weather and tides.
Shoreline Clean-up response	Prioritise use of existing roads and tracks	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities, improve response time and efficiency			**In effect**
	Soil profile assessment prior to earthworks	In effect	Procedures	Improved baseline information for shoreline condition	Improved functionality		**In effect**
	Pre-cleaning and inspection of equipment (quarantine)	In effect	Procedures	Reduced potential for contaminating environment during response activities	Improved functionality		**In effect**
	Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance	In effect	Procedures	Improved capacity to respond appropriately to areas of potential cultural significance	Improved functionality		**In effect**
	Select temporary base camps in consultation with DoT and DBCA	In effect	Procedures	Optimise response based on camp location, reduce environmental impact of camps	Improved functionality		**In effect**
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions	In effect	Procedures	Improved response efficiency	Improved functionality		**In effect**
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat.	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities	Improved functionality		**In effect**
	Operational restriction of vehicle and personnel movement to limit erosion and compaction	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities	Improved functionality		**In effect**
	Stakeholder consultation	In effect	Procedures	Improved response efficiency	Improved functionality		**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
Oiled Wildlife Response - Adopted controls and standards are found in Section 14							
Oiled wildlife response - planning	Implementation of the Western Australian Oiled Wildlife Response Plan (WAOWRP) and Pilbara Region Oiled Wildlife Response Plan	In effect	Procedure	Working within the guidelines of the WAOWRP and Pilbara regional plan will ensure a coordinated response and that the expectations of the Control Agency are met with the overall aim to increase the likelihood of success of the OWR (success in terms of wildlife survivorship and rates for release back into the wild).	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement- framework for how Santos will integrate with Control Agencies for OWR	Effort and time involved in developing OWR implementation plan within OPEP based on guidance from WAOWRP and Pilbara Regional Plan	**In effect**
	Santos Oiled Wildlife Response Framework (7700-650-PLA-0017); sets the corporate guidance for OWR preparedness and response and defines how Santos will integrate with Control Agencies to provide a coordinated response	In effect	Procedure	The framework is complementary to the WAOWRP and Pilbara Regional Plan and is facilitates a rapid coordinated response, and the provision of resources by Santos in order to increase the likelihood of success of the OWR.	Improved functionality and reliability.	Cost of document development and maintenance	**In effect**
Oiled wildlife response - equipment	Level 2 OWR kits and containers available from AMOSC, AMSA, DBCA or DoT in Exmouth, Darwin, Broome, Karratha, Fremantle, or Kensington. WA equipment (OWR containers) mobilised to Exmouth region within 24 hrs.	In effect	Equipment	Timely access to appropriate equipment is needed for the effective treatment of wildlife in order to increase the likelihood of success of the OWR	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Level 3 OWR equipment available from OSRL. Transit times (road/ air) Singapore to Karratha = 3–5 days.	In effect	Equipment	Appropriate equipment is needed for the effective treatment of wildlife in order to increase the likelihood of success of the OWR	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**
Oiled wildlife response - personnel	Level 1/2 Santos personnel trained in OWR. OWR trained personnel mobilised to Exmouth region within 24 hrs.	In effect	People	Timely access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; ensure personnel are based not just in the Perth Office but also at VI and DC facilities	Cost of training and maintaining training	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	Level 2 OWR personnel from AMOSC, AMOSC-activated Wildlife Response contractors, and Industry Mutual Aid. Mobilisation of OWR personnel to site will start to occur in 24-48 hours following notification of actual or imminent impact to wildlife.	In effect	People	Timely access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Cost of membership with AMOSC	**In effect**
	Level 3 OWR personnel available through OSRL. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**
	Maintain labour hire arrangements for access to untrained personnel. Untrained personnel accessed through labour-hire arrangements would receive an induction, on-the-job training and work under the supervision of an experienced supervisor.	In effect	People	During a large scale OWR the ability to access large numbers of personnel through labour hire arrangements is imperative in terms of capability for conducting an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of labour hire at time of incident	**In effect**
	Additional Santos OWR trained personnel positioned at VI and Perth	Additional	People	Additional personnel trained in OWR and who are located at facilities will enhance the first strike capability of Santos and therefore enhance the likelihood of success of the OWR, particularly for those instances where oil is ashore within 48 hours	Improved functionality, availability, reliability and independence.	Cost of training staff	**In effect**
	Pre-hire and/or prepositioning of staging areas and responders	Additional	System	This may enhance response times and first strike capability and hence improve the likelihood of success of the OWR. Conversely, prepositioned personnel and staging areas may result in negative impacts to the environment and wildlife.	Improved functionality, availability, reliability and independence.	Additional wildlife resources could total $1,500 per operational site per day. This is a guaranteed cost regardless of whether a spill occurs or not.	**Reject** The cost of setting up staging areas and having responders on standby is considered disproportionate to the environmental benefit gained. Further, prepositioned personnel and staging sites may have negative impacts on the environment and wildlife. The overall OWR capability Santos can access through Santos staff, AMOSC, AMOSC mutual aid, Santos labour force hire arrangements, DBCA and wildlife carer network are considered adequate, with further advice

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
							and international resources available through OSRL.
	Direct contracts with service providers	Alternative	System	This option duplicates the capability accessed through AMOSC and OSRL and would complete for the same resources without providing a significant environmental benefit	Does not improve effectiveness	Cost of contract	**Reject** This option is not adopted as the existing capability meets the need.
Waste Management - Adopted controls and standards are found in Section 16.6							
Waste Manage-ment	Waste management sourced through contract with waste service provider. Contract with waste service provider to be maintained and periodically reviewed. Waste service provider waste receptacles mobilised from Karratha within 12 hrs for containment and recovery, protection and deflection and shoreline clean-up response strategies.	In effect	System	Timely and efficient handling of waste will reduce environmental impacts of waste and waste management. Consideration given to risks of secondary contamination.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Cost of contract	**In effect**
	Maintain contracts with multiple service providers	Additional	System	Contract with additional waste service provider will not provide an additional environmental benefit as there are two major service providers in the region and reciprocal arrangements facilitate access to equipment of both.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Significant additional cost in maintaining two contracts for the same service	**Reject** No environmental benefit
	Temporary waste storage capacity available through waste service provider, AMOSC, AMSA, OSRL stockpiles	In effect	Equipment	Timely and efficient handling of waste will reduce environmental impacts of waste and waste management. Consideration given to risks of secondary contamination.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Costs of contracts, MOU with waste service provider, AMOSC and OSRL, access to National Plan Resources through AMSA	**In effect**
	Procure temporary waste storage for Santos stockpile	Additional	Equipment	Additional storage available if required. Tanks may be stored in geographic locations that may reduce mobilisation times and allow faster collection and storage of waste. Additional storage may facilitate continuous collection operations to occur.	Provides functionality, availability, reliability, survivability, compatibility and independence	Additional cost in purchase and maintenance of tanks	**Reject** Purchasing this equipment for Santos stockpile is surplus to Santos requirements as AMOSC, AMSA, OSRL provides this equipment in strategic locations. Reduced mobilisation time is not an advantage, as waste storage can be mobilised at the same time as collection response strategies, and no waste needs to be stored prior to collection commenced.
	Vessels for waste transport through Santos contracted providers. To minimise vessel decontamination	In effect	Equipment	Timely and efficient handling of waste will reduce environmental	Provides functionality, availability, reliability,	Contract with vessel contractors to be	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
	requirements, larger vessel will remain on station whilst smaller vessel will transport waste to Dampier.			impacts of waste and waste management. Consideration given to risks of secondary contamination.	survivability and compatibility. Area of improvement; dependence and availability of vessels	maintained and periodically reviewed	
	Contract additional vessels on standby for waste transport	Additional	Equipment	Reduce delays in transportation of waste, particularly greater capacity for containment and recovery in the initial 2-5 days of response	Provides functionality, availability, reliability, survivability, compatibility and dependence	Cost in contracting vessels to remain on standby for incident waste requirements	**Reject** Expense of maintaining vessels on standby that are surplus to day-to-day requirements is disproportionate to environmental benefit. Santos is accustomed to coordinating logistics for tasks around finite resources. Santos monitors vessel availability through Santos Vessel Tracking System. Regularly contracted vessels could be supplemented with vessels of opportunity
	Vessel to vessel waste transfer plan to be developed in line with the waste transfer concept of operations (defined in 7710-650-ERP-0001). Plan to give details of waste storage requirements and procedures. Plan to give details of waste storage requirements and procedures.	In effect	Procedure	Allows effective use of available vessels and minimises vessel decontamination requirements	Provides functionality, availability, reliability, survivability, compatibility and independence.	Cost of documentation development, implementation, maintenance and exercising	**In effect**
	Decanting oily water, by returning into boomed area, to be undertaken subject to necessary approvals from AMSA or DoT	In effect	System, Procedure	Allows more effective handling, transportation and disposal of concentrated wastes	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort to obtain and adhere to approvals	**In effect**
Scientific Monitoring - Adopted controls and standards are found in Section 17.8							
Scientific Monitor-ing - monitoring service provider and equipment	Maintenance of Monitoring Service Provider contract for scientific monitoring services and annual review of standby manual. SMP provider and monitoring equipment mobilised to site within 72 hrs of monitoring action plan approval.	In effect	System	This is the main tool for determining the extent, severity and persistence of environmental impacts from an oil spill and allows operators to determine whether their environmental protection outcomes have been met (via scientific monitoring activities). It is used to inform areas requiring rehabilitation. This strategy also evaluates the recovery from the spill.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of contract with Scientific Monitoring Service Provider	**In effect**
	Regular capability reports from Monitoring Service Provider shows personnel availability and annual reviews of standby manual	In effect	System	This ensures the Monitoring Service Provider has the capability to undertake Scientific Monitoring, including, post-spill preimpact surveys within the	Improves functionality, availability and reliability	Cost of contract with Scientific Monitoring Service Provider	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/Reject
				EMBA of receptors with deficient baseline data			
	Conduct periodical review of existing baseline data sources across the Santos combined EMBA	In effect	System	This ensures that receptors within the EMBA with deficient baseline data are identified	Improves functionality and provides compatibility	Cost of contract with Scientific Monitoring Service Provider	**In effect**
	Scientific monitoring personnel, plant and equipment on standby at the operational location	Additional	People, equipment	Improve mobilisation time	Improved availability and reliability	Cost would be in excess of $1 mil annually	**Reject** Cost of control measure is disproportionate to the environmental benefit
	Maintain equipment list and list of suppliers for implementation of Scientific Monitoring Plans	Improved	Procedure	Improve response time	Improved functionality, availability and reliability	Cost of contract with Scientific Monitoring Service Provider	**Accept**
	Oil sampling kits for scientific monitoring personnel to positioned at Varanus Is. and Exmouth	Improved	Equipment	Improve response time	Improved availability and reliability	Cost associated with purchase of equipment and maintenance	**Accept**
Scientific Monitor-ing - vessels	Level 2: vessels sourced through Master Service Agreement, located in region and tracked by Santos Vessel Monitoring System. Santos to mobilise monitoring vessels to deployment location within 72 hrs.	In effect	Equipment	Improve response time	Provides availability and reliability	Effort associated with maintaining MSA	**In effect**
	Level 3: vessels sourced without existing contracts from any location	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides survivability, compatibility and independence. Area of improvement; functionality, availability and reliability of tow vessels.	Cost of contracts at the time of requirement.	**In effect**
	Determine required vessel specifications required for Scientific Monitoring implementation and improve accuracy of Vessel Tracking System	Improved	Procedure	Improve mobilisation time	Increase in availability and reliability	Effort to determine vessel specifications and improve tracking	**Accept**

Appendix C: POLREP

Government of **Western Australia**
Department of **Transport**

Marine Pollution Report (POLREP)
MEER

When blank, this form is classed as **OFFICIAL**, when filled out, this form is classed as **OFFICIAL-SENSITIVE.**

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

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

INCIDENT DESCRIPTION

Incident Name: ____________________ Date and Time of Incident (24 hr format): ____________________

Location name/description: ____________________

Incident Coordinates: Latitude of spill ____________________ Longitude of spill ____________________

Description of Incident: ____________________

Weather conditions at site: ____________________

OIL DETAILS

Pollutant source

Amount of fuel/pollutant on board: ____________________

☐ 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 spilt, if known (litres): ____________________

Has the discharge stopped? ☐ Yes ☐ No ☐ Unknown

☐ Photos taken Details: ____________________ held by:____________________

☐ Video taken Details: ____________________ held by:____________________

☐ Samples taken Description: ____________________ held by:____________________

☐ Items retrieved Description: ____________________ held by:____________________

To attach photos, this form must be opened in acrobat, or alternatively, photos can be attached to the submission email before sending.

ADDITIONAL INFORMATION

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

Equipment used? ☐ AMSA ☐ State ☐ Industry

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

KEY CONTACT DETAILS

Name:____________________ Position: ____________________ Phone: ________________

Control Agency: Select the Control Agency Jurisdictional Authority: Select the Jurisdictional Authority

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 State Hazard Plan - Maritime Environmental Emergency.
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.

Pollution Report (POLREP)		
Reporter's Signature:		
Name:	Agency:	Role:

Once you have completed the form please check that all relevant fields have been filled with accurate data.
Please email completed form to marine.pollution@transport.wa.gov.au

Appendix D: SITREP

Maritime Environmental Emergency Situation Report (SITREP)

MEER

Government of **Western Australia**
Department of **Transport**

When blank, this form is classed as **OFFICIAL**, when filled out, this form is classed as **OFFICIAL-SENSITIVE.**

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

MARITIME ENVIRONMENTAL EMERGENCY 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 DESCRIPTION

Incident Name: ______________________ Ref. No. ______________________

Incident Controller: ______________________

Incident Declaration Level: Please select ______________ Controlling Agency: Please select ______________

Priority ☐ Urgent ☐ Immediate ☐ Standard

Final SITREP? ☐ Yes ☐ No

Next SITREP on: ______________________

Date and Time of Incident (24 hr format): ______________________

POLREP or AMSA Form 18 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: ____

Maritime Environmental Emergency Situation Report (SITREP)		
Reporter's Signature:		
Name:	**Agency:**	**Role:**

Once you have completed the form please check that all relevant fields have been filled with accurate data.
Please email completed form to marine.pollution@transport.wa.gov.au

Appendix E: Vessel Surveillance Observer Log

Santos

Vessel Surveillance Observer Log – Oil Spill

Survey Details					
Date	Start time:	End Time:	Observers:		
Incident:			Area of Survey:		
Vessel:			Master:		
Weather Conditions					
Wind speed (knots):			Wind direction:		
Time high water and height (LAT):			Current direction:		
Time low water and height (LAT):			Current speed (nM):		
Tide during observations:			Sea state:		
Stage of tide during observations (incoming/falling):			Other weather observations:		

Slick Details										
Slick grid parameters by lat/long:				Slick grid parameters (vessel speed)			Slick grid dimensions: N/A			
Length Axis:		Width Axis:		Length Axis: N/A			Width Axis	Length	nm	
Start Latitude		Start Latitude		Time (seconds)			Time (seconds)	Width	nm	
Start Longitude		Start Longitude						Length	nm	
End Latitude		End Latitude		Speed (knots)			Speed (knots)	Width	nm	
End Longitude		End Longitude						Grid area	km^2	
Code	Colour	%age cover observed	Total grid area		Area per oil code		Factor	Oil volume		
1	Silver			km^2		km^2	40-300 L/ km^2		L	
2	Iridescent (rainbow)			km^2		km^2	300-5,000 L/ km^2		L	
3	Discontinuous true oil colour (Brown to black)			km^2		km^2	5,000-50,000L/ km^2		L	
4	Continuous true oil colour (Brown to black)			km^2		km^2	50,000 – 200,000 L/ km^2		L	
5	Brown / orange			km^2		km^2	>200,000 L/ km^2		L	

Santos

Timeline of observations:

Time	Description

Appendix F: Aerial Surveillance Observer Log

Santos

Aerial Surveillance Observer Log – Oil Spill

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

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

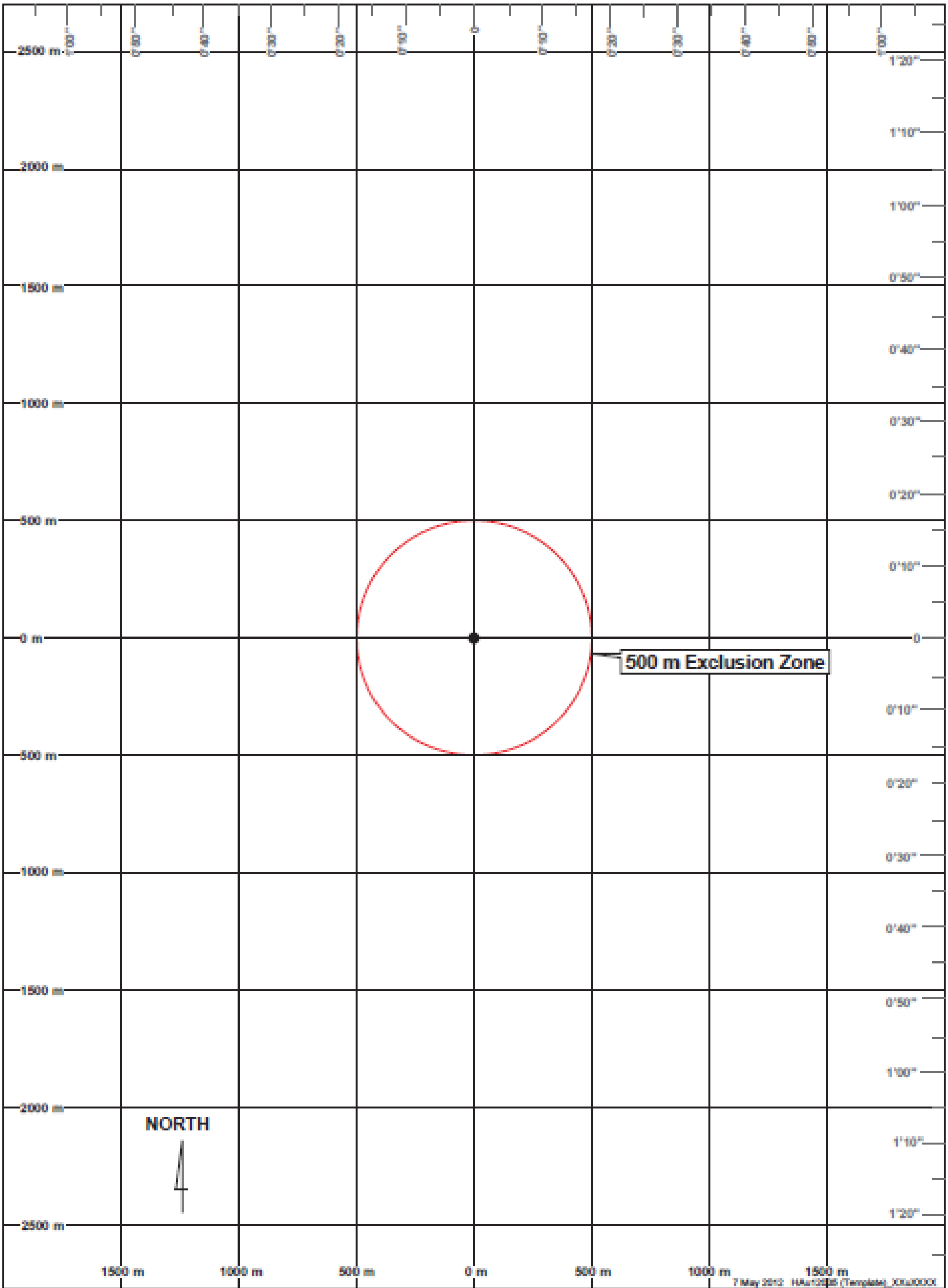
Santos

Slick Details						
Slick grid parameters (lat/long)		Slick grid parameters (air speed)		Slick grid dimensions		
Length Axis	Width Axis	Length Axis		Width Axis	Length	nm
Start Latitude	Start Latitude	Time (seconds)		Time (seconds)	Width	nm
Start Longitude	Start Longitude				Length	nm
End Latitude	End Latitude	Air Speed (knots)		Air Speed (knots)	Width	nm
End Longitude	End Longitude				Grid area	km^2

Code	Colour	% cover observed	Total grid area		Area per oil code		Factor	Oil volume	
1	Silver			km^2		km^2	40-300 L/ km^2		L
2	Iridescent (rainbow)			km^2		km^2	300-5,000 L/ km^2		L
3	Discontinuous true oil colour (Brown to black)			km^2		km^2	5,000-50,000L/ km^2		L
4	Continuous true oil colour (Brown to black)			km^2		km^2	50,000 – 200,000 L/ km^2		L
5	Brown / orange			km^2		km^2	>200,000 L/ km^2		L

Appendix G: Aerial Surveillance Surface Slick Monitoring Template

AERIAL SURVEILLANCE SURFACE SLICK MONITORING TEMPLATE



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

Appendix H: Aerial Surveillance Marine Fauna Sighting Record

Santos

OIL SPILL SURVIELLANCE - MARINE FAUNA SIGHTING RECORD SHEET

Date:		**Time:**	
Latitude:		**Longitude:**	

MARINE FAUNA ID GUIDE

○ Humpback whale

○ Blue whale

○ Minke whale

○ Sperm whale

○ Killer whale

○ Bryde's whale

○ Whale species unknown

○ Bottlenose dolphin

○ Spinner dolphin

○ Dolphin species unknown

○ Whale shark

○ Dugong

○ Hawksbill turtle

○ Loggerhead turtle

○ Green turtle

○ Flatback turtle

○ Leatherback turtle

○ Turtle species unknown

FAUNA DETAILS					
Category	**Type/species?** **Adult/juvenile?** **ID confidence?**	**Number**	**Date/Time**	**Photo/ video taken?** **Reference No.**	**Behaviour / Comments.** **Proximity to oil? Oiled?** **Milling? Feeding? Transiting?**
Cetaceans (Whales/ Dolphins)					
Turtles					
Birds					
Dugongs					
Sharks					
Other					

Santos

Other details for each observation location

WEATHER DETAILS
Sea State ◯ Mirror calm ◯ Small waves ◯ Slight ripples ◯ Large waves some whitecaps ◯ Large waves, many whitecaps
Visibility ◯ Excellent ◯ Good ◯ Moderate ◯ Poor ◯ Very Poor

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

Appendix I: Aerial Surveillance Shoreline Observation Log

Santos

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 J: IMT Resourcing

IMT Resourcing

Santos manages its IMT capability through a range of arrangements including internal Santos personnel and external support. Santos internal capability includes competent personnel available for incident management from various Santos business units in Australia. Santos also has access to IMT support personnel through a range of external arrangements consisting of:

+ AMOSC Member Agreement
+ Industry Mutual Aid /Core Group Personnel
+ OSRL Member Agreement
+ Specialist Service providers including:
  - WWC: for Source Control support
  - RPS: For oil spill modelling/visualization support
  - Monitoring Service provider
  - NWA: Waste Management Contractor
  - TOLL: Logistics Services Contractor
  - Aspen: Medical Services Provider
  - Recruitment Servicer provider/ Labour Hire Companies

Santos's Master Services Contract with AMOSC gives access to 80–120 oil spill trained personnel through industry Core Group. The Expanded IMT Resourcing Plan below (**Table J-1**) assumes about 25% of this capability available for IMT support and the remaining 50–90 personnel available for field response team roles. Santos has guaranteed access to 18 Response Specialists from OSRL for any incident under the Associate Membership Agreement. OSRL has about 150 oil spill technical personnel available across their global bases. Santos may request for additional resources from OSRL for major oil spill events and the resources will be available on a best endeavour basis. The Expanded IMT Resourcing Plan below (Table J-1) assumes about 30% of this capability available for IMT support. Santos also has in place arrangements with specialist service providers for roles which apply non-oil-spill expertise in a response context, such as Logistics, Finance, Waste Management, Source Control etc. The IMT capability for these roles is established through the specialist service providers as listed above.

Santos will work closely with relevant government authorities (e.g. DoT, DBCA) for incident management aspects related to shoreline response and oiled wildlife response. The capability available under the SRT/NRT (~150 IMT personnel / 40 SRT personnel) is not included in the expanded IMT resourcing plan.

The WCD Response timeline is estimated to be 14–16 weeks. This is estimated based on the timeline for shoreline clean-up activities (with Montebello Islands estimated to have the longest shoreline clean-up time of 12 weeks). Response termination and demobilization will follow a phased approach and additional 2–4 weeks is added to account for the final response termination and demobilisation phase once the shoreline clean-up activities are completed. Peak resourcing requirements for IMT is anticipated between week 1 to week 12 and thereafter to decline until the response is terminated.

Assuming a protracted response requiring two rotational IMT teams with a day and night shift for each team, the total resourcing requirement for the expanded IMT is estimated to be 124 persons. Santos internal resourcing (including support from other business units in Australia) provides access to 104 personnel for IMT support and an additional 193 personnel is estimated to be available through external arrangements. The predicted allocation of resources to the expanded IMT roles is shown in

Table J-1. If there is a shortfall in the number of available Santos personnel, Santos has external resourcing arrangements in place (refer to **Section 4.2.9**).

Table J-1: Expanded IMT Resourcing Plan

#	IMT POSITION		Required	Available Resources Santos	Total Allocated personnel available via Contracting Arrangements	Total Personnel Available through internal/external Arrangements
1	INCIDENT COMMANDER		2	3	11	14
	DEPUTY IC		2			
2	Safety Officer		2	4	6	10
3	Public Information Officer		2	6	0	6
4	DoT LO*		*0*	*0*	*0*	*0*
	Media LO*		*0*	*0*	*0*	*0*
5	HR		3	10	0	10
6	PLANNING SECTION CHIEF		2	4	4	8
	Deputy Planning Section Chief		2			
	Situation Unit Lead		2	8	9	17
		COP Display Processor/GIS Specialist	2			
	Resources Unit Lead		2			
	Documentation Unit Lead		2	4	0	4
	Environment Unit Lead		2	7	31	38
	Shoreline Response Programme Manager		2			
		STR Manager	2			
		SCAT Programme Coordinator	2			
		SCAT Data Manager	2			
		SCAT Field Coordinator	2			
	Technical Specialists	Modelling Specialist	2	0	5	5
		Sampling/Monitoring Specialist	2	0	3	3
		Waste Management Specialist	2	0	2	2
		Wildlife Specialist	2	0	8	8
		Response Specialists (as required for branches)	10	0	10	10
7	OPERATION SECTION CHIEF		3	4	9	13
	Deputy Operations Section Chief		3			
	Source Control Branch Director		2	14	0	14
		Relief Well Group Lead	2			
		Subsea Intervention Group Lead	0			
	Staging Branch Director		2	3	0	3
	Monitoring Branch Director		2	2	1	3
	Wildlife Response Branch Director		2	2	0	2
	Air Operations Branch Director		2	2	3	5
	Waste Branch Director		2	1	1	2
	Offshore Response Branch Director		2	3	12	15
		Dispersant Operations Group Lead	0			
		Recovery & Protection Group Lead	2			
	Shoreline Clean-Up Branch Director		2	4	22	26
		Geographical Division Supervisors	6			
8	LOGISTICS SECTION CHIEF		3	4	8	12
	Logistics Specialists (as required for branches)		7	0	8	8
	Support Branch Director		3	7	9	16
		Supply Unit Lead Lead	2			
		Facilities Unit Lead	2			
		Ground Support Unit Lead	2			
		Vessel Support Unit Lead	2			
	Service Branch Director		3	5	13	18
		Communications Unit Lead	2			
		Medical Unit Lead	2			
		Food Unit Lead	2			
9	FINANCE SECTION CHIEF		3	7	18	25
		Procurement Unit Lead	2			
		Claims Unit Lead	2			
		Cost Unit Lead	2			
		Sub-total	*124*	*104*	*193*	297

NA = Not Applicable

*These roles are provided by DoT

	Department of Transport Office	Required	Available Resources		Total Personnel Available through internal/external Arrangements
			Santos	Total Allocated personnel available via Contracting Arrangements	
1	CMT Liaison Officer	1	5	0	5
2	Deputy Incident Controller	1	2	0	2
3	Deputy PIO	1	2	0	2
4	Deputy Planning Officer	1	2	0	2
5	Deputy Intelligence Officer	1	1	1	2
6	Environmental Support Officer	1	1	1	2
7	Deputy Logistics Officer	1	1	1	2
8	Deputy Operations Officer	1	1	1	2
9	Deputy Finance Officer	1	2	0	2
10	Deputy Division Commander (FOB)	1	1	1	2
11	Deputy Waste Management Coordinator	1	1	1	2
		11	*19*	*6*	25

Santos

Appendix K: Testing Arrangements Plan

Testing Arrangements Plan

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
1	**Source Control Options**				
	Relief Well Drilling - Access to MODU	MODU Register review	Once per month for the duration of drilling campaign	Identify suitable MODU that can be utilized in the event of a Source control incident requiring a relief well	Document the identified suitable MODU by: Name MODU Type Location Contract Status
	Access to Source Control Emergency Response Personnel	Desktop Exercise	Annually (when drilling activity is occurring)	To check arrangements for access to Well Control Specialists from WWC as per Source Control Planning and Response Guideline DR-00-OZ-20001	Confirmation (email) from WWC that listed Well Control specialists can be made available and will be mobilised within 72 hours of a notification
	Testing of Santos Source Control Planning and Response Guideline DR-00-OZ-20001	Desktop Exercise	Annually	Testing of key arrangements in the Santos Source Control Planning and Response Guideline DR-00-OZ-20001	Validate key arrangements in Santos Source Control Planning and Response Guideline DR-00-OZ-20001
	Vessel Fuel Tank Rupture - SOPEP	Contract/Plan Review	Prior to vessel arrival in field	To confirm that each vessel within the field has an approved SOPEP in place	Review to confirm approved SOPEP in place for vessels
2	**Monitor & Evaluate Options**				
	Vessel Surveillance a) Access to vessels	Contract/Plan Review	Annually	To confirm access to vessels for surveillance	Review to confirm Master Service Agreements (MSAs) with vessel providers to gain access to vessels
	Aerial Surveillance a) Access to aircraft	Contract/Plan Review	Annually	To confirm access to aircrafts for surveillance	Review to confirm Master Service Agreements (MSAs) with aircraft providers to gain access to aircrafts for surveillance
	Aerial Surveillance	Contract/Plan Review	Annually	To confirm access to trained aerial observers	Review to confirm access to trained aerial observers through;

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
	b) Access to trained aerial observers				Trained Santos personnel or AMOSC Member Contract or OSRL Associate Member Contract
	Unmanned Aerial Vehicles (UAV) a) Access to UAV providers	Contract/Plan Review	Annually	To confirm access to UAV providers	Review to confirm access to UAV providers through; AMOSC Member Contract or OSRL Associate Member Contract
	Fauna observations – Maintain a list of air charter companies that could provide fauna observation services	Review List	Annually	To confirm that a list of air charter companies that could provide fauna observation services is maintained	Review to confirm that a list of air charter companies that could provide fauna observation services is maintained
	Tracking Buoys a) Access to Tracking Buoys	Contract/Plan Review	Prior to activity commencement	To confirm access to tracking buoys	Review to confirm access to 12 Tracking Buoys
	Tracking Buoys b) Response readiness	Communication/Tracking software Test	6-monthly	To confirm response readiness for Tracking buoys	Tracking Buoys pass functional test as per operational instructions
	Oil Spill Modelling a) Access to oil spill modelling service provider	Contract/Plan Review	Prior to activity commencement	To confirm access to emergency response oil spill modelling services	Review to confirm access to emergency oil spill modelling services through maintenance of service provision contract
	Satellite Imagery a) Access to Satellite Imagery service provider	Contract/Plan Review	Prior to activity commencement	To confirm access to satellite imagery services	Review to confirm access to satellite imagery services through; AMOSC Member Contract or OSRL Associate Member Contract
	Operational Water Quality Monitoring a) Access to monitoring service provider	Contract/Plan Review	Prior to activity commencement	To confirm access to operational water quality monitoring services	Review to confirm access to operational water quality monitoring services through maintenance of service provision contract

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
	Operational Water Quality Monitoring b) Access to fluorometry equipment	Contract/Plan Review	Prior to activity commencement	To confirm access to fluorometry equipment for water quality monitoring	Review to confirm access to fluorometry equipment through; Maintenance of service provision contract with monitoring service provider OSRL Associate Member contract
	Operational Water Quality Monitoring d) Access to Dispersant Efficacy Field Test Kit	Equipment Check	Annually	To confirm access to Dispersant Efficacy Field Test Kit	Review to confirm access to Dispersant Efficacy Field Test Kit
	Operational Water Quality Monitoring e) Access to Oil Sampling Kit	Equipment Check	Annually	To confirm access to Oil Sampling Kit	Review to confirm access to Oil Sampling Kit
	Shoreline Clean-up Assessment a) Access to trained Shoreline Clean-up and Assessment Technique (SCAT) personnel	Contract/Plan Review	Prior to activity commencement	To confirm access to trained SCAT personnel	Review to confirm access to trained SCAT personnel through; AMOSC Member Contract OSRL Associate Member Contract TRG arrangements
		Desktop Exercise	Annually	To confirm access to a range of Monitor & Evaluate options to ensure situational awareness for IMT	Access to vessel and aerial platforms for surveillance confirmed. Availability of trained aerial observers from day 2 confirmed through internal or external resources Spill modelling delivered to IMT within 2 hrs of request to service provider Availability of Tracking Buoy for deployment confirmed by onsite team Satellite imagery acquisition and timelines confirmed by the service provider upon

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
					notification Access to water quality monitoring services confirmed by service provider upon notification Availability of Dispersant Efficacy Field Test Kit confirmed by on-site team Access to SCAT trained personnel confirmed through AMOSC or OSRL contract
3	**Containment & Recovery**				
	a) Access to offshore containment Booms	Contract/Plan Review	Annually	To confirm access to offshore containment booms	Review to confirm access to offshore containment booms through the following; AMOSC Member Contract OSRL Associate Member Contract
	b) Access to offshore recovery devices	Contract/Plan Review	Annually	To confirm access to offshore recovery devices	Review to confirm access to offshore recovery devices through the following; AMOSC Member Contract OSRL Associate Member Contract
	c) Access to vessels	Contract/Plan Review	Annually	To confirm access to vessels for containment and recovery operations	Review to confirm Master Service Agreements (MSAs) with vessel providers to gain access to vessels for containment and recovery operations
	d) Access to trained responders	Contract/Plan Review	Annually	To confirm access to trained responders	Review to confirm access to trained responders through the following; AMOSC Member Contract OSRL Associate Member Contract Access to National Plan resources through AMSA
		Desktop Exercise	Annually	To test activation procedure to access containment and recovery equipment and trained responders	Emails confirming access to containment and recovery equipment and trained responders

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
				from external arrangements and service providers To confirm access to containment recovery equipment and trained responders from external arrangements and service providers	through external arrangements and service providers
4	**Mechanical Dispersion**				
	a) Access to vessels	Contract/Plan Review	Annually	To confirm access to vessels for mechanical dispersion	Review to confirm Master Service Agreements (MSAs) with vessel providers to gain access to vessels
5	**Dispersant Application**				
	Dispersant Application a) Access to Dispersants	Review – Contract / Agreement	Annually	To confirm access to dispersants	Review to confirm access to dispersants through the following; AMOSC Member Contract OSRL Associate Member Contract OSRL Global Dispersant Stockpile Supplementary Agreement AMSA National Plan
	Dispersant Application d) Access to subsea dispersant injection equipment	Review – Contract / Agreement	Annually	To confirm access to Subsea Dispersant Injection equipment	Review to confirm access to subsea Dispersant Injection equipment through AMOSC SFRT participant contract
	Dispersant Application f) Logistics arrangement for GDS dispersant stockpile mobilization for a Level 3 oil spill incident	Desktop Exercise	Annually	To confirm GDS dispersant stockpiles can be mobilized in the event of a Level 3 incident	Confirm mobilization time frames as per Dispersant Logistics Plan
		Desktop Exercise	Annually	To test activation procedure to access dispersants and application systems from external arrangements and service providers	Emails confirming access to dispersants and application systems from service providers/external arrangements

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
				To confirm access to dispersants and application systems from external arrangements and service providers	
6	**Shoreline Deflection & Protection**				
	a) Access to shoreline deflection & protection equipment	Contract/Plan Review	Annually	To confirm access to shoreline deflection and protection equipment	Review to confirm access to shoreline deflection and protection equipment through the following; Santos' equipment AMOSC Member Contract OSRL Associate Member Contract Access to National Plan resources through AMSA
	b) Access to trained responders	Contract/Plan Review	Annually	To confirm access to trained responders	Review to confirm access to trained responders through the following; AMOSC Member Contract OSRL Associate Member Contract TRG arrangements Access to National Plan resources through AMSA
	c) Access to shallow draft vessels	Review of list of shallow draft vessel providers	Annually	To confirm access to shallow draft vessels to support shoreline deflection & protection	Review to confirm access to shallow draft vessel providers
	d) Santos' shoreline deflection and protection equipment	Deployment Exercise	Annually	To confirm response readiness for Santos' shoreline deflection and protection equipment	Shoreline deflection and protection booms and recovery devices (disc/brush skimmers) deployed successfully as per operational instructions

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
		Desktop Exercise	Annually	IMT to confirm shoreline protection priorities and develop IAP shoreline deflection and protection sub-plan To test activation procedure to access shoreline deflection and protection equipment and trained responders from external arrangements and service providers To confirm access to shoreline deflection and protection equipment and personnel from external arrangements and service providers	Shoreline protection priorities established by IMT IAP shoreline deflection and protection sub-plan developed by IMT Emails confirming access to shoreline deflection and protection equipment and trained responders through external arrangements and service providers
7	**Shoreline Clean-up**				
	a) Access to shoreline clean-up equipment	Contract/Plan Review	Annually	To confirm access to shoreline clean-up equipment	Review to confirm access to shoreline clean-up equipment through the following; AMOSC Member Contract OSRL Associate Member Contract Access to National Plan resources through AMSA
	b) Access to trained responders	Contract/Plan Review	Annually	To confirm access to trained responders	Review to confirm access to trained responders through the following; AMOSC Member Contract OSRL Associate Member Contract TRG arrangements Access to National Plan resources through AMSA

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
	c) Access to labour hire	Contract/Plan Review	Annually	To confirm access to labour hire	Review to confirm access to labour hire through maintenance of contract with labour hire provider
		Desktop Exercise	Annually, subject to DoT availability	To test coordination with DoT to implement shoreline clean-up plan as detailed in Section 15 of the OPEP To test activation procedure to access shoreline clean-up equipment and personnel from external arrangements and service providers To confirm access to shoreline clean-up equipment and personnel from external arrangements and service providers	IMT interfaces established between Santos and DoT to jointly manage shoreline clean-up activities for impacted shorelines as identified in the OPEP Section 13 Shorelines clean up priorities established, and IAP shoreline clean-up sub-plan developed by IMT in consultation with DoT Shoreline clean-up resourcing plan established and access to equipment and personnel confirmed through internal and external arrangements/service providers to meet these requirements.
		DoT Joint Exercise	Every 2 years; The exercise will be coordinated by DoT and will be dependent on DoT's interest and availability. Santos will express interest for a joint exercise with DoT	To test collective response arrangements between Santos and DoT for a Level 2/3 oil spill incident impacting State waters	IMT interface between Santos and DoT IMT established to jointly manage the shoreline clean-up activities as identified for the exercise scenario Shoreline response plan jointly developed by Santos and DoT Equipment and personnel required identified and implemented through collective response arrangements between Santos and DoT.

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
8	**Oiled Wildlife Response**				
	a) Access to OWR equipment	Contract/Plan Review	Annually	To confirm access to OWR equipment	Contract review to confirm access to OWR equipment through the following; AMOSC Member Contract OSRL Associate Member Contract Access to National Plan resources through AMSA
	b) Access to OWR personnel	Contract/Plan Review	Annually	To confirm access to OWR personnel	Contract review to confirm access to OWR personnel through the following; AMOSC Member Contract OSRL Associate Member Contract Santos personnel
		Desktop Exercise	Annually	To confirm activation procedure for OWR services with external service providers To confirm access to OWR equipment from external arrangements To confirm access to OWR personnel through a combination of internal and external resources	Emails from service providers confirming OWR equipment availability. Access to OWR personnel confirmed through a combination of internal and external resources
9	**Waste Management**				
	a) Access to personnel, equipment, and vehicles through Waste Service Provider	Contract/Plan Review	Annually	To confirm access to personnel, equipment, and vehicles for oil spill waste management	Contract review to confirm access to personnel, equipment, and vehicles for oil spill waste management
		Desktop Exercise	Annually	To confirm activation procedure for oil spill waste management services	Confirmation email from service provider on personnel, equipment, and vehicles for oil spill waste management within 24hrs of notification

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
10	**Scientific Monitoring**				
	a) Access to specialist monitoring equipment	Contract/Plan Review	Annually	To confirm access to specialist monitoring equipment	Contract review to confirm access to specialist monitoring equipment
	b) Access to specialist monitoring personnel	Contract/Plan Review	Annually	To confirm access to specialist monitoring personnel	Contract review to confirm access to specialist monitoring personnel
		Desktop Exercise	Annually	To confirm activation procedure for scientific monitoring services To confirm access to personnel and equipment	Confirmation email from monitoring service provider on monitoring personnel and equipment available
11	**IMT**				
	a) Access to trained IMT personnel	Contract/Plan Review	Annually	To confirm access to trained IMT personnel	Review to confirm access to IMT personnel through the following; AMOSC Member Contract OSRL Associate Member Contract Access to National Plan resources through AMSA
		Availability Test for IMT	Annually	To confirm appropriate Santos's personnel to fill the IMT roles outlined in this OPEP	Each role listed can be filled by appropriately qualified staff and reporting hierarchy understood
		Level 2/3 IMT exercise	Annually	To confirm the response capability and capacity for Santos IMT To confirm external capability and capacity arrangements for IMT	IAP is completed for the operational period and approved by the Incident Commander An operational NEBA is undertaken for the operational period of the incident by the IMT External arrangements tested and successfully integrated with IMT

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
12	**Others**				
	Communications Testing a) Communications channels in place and functioning	Desktop	Required for every approved OPEP. When response arrangements have changed. Annually	To test all communication and notification processes to service providers and regulatory agencies defined within the OPEP	Notification and communication processes tested successfully for: ○ Service providers ○ Regulatory agencies Communications Test Report completed Corrections updated within the Santos Incident Response Telephone Directory (SO-00-ZF-00025.020)
	Others - AMOSC	Audit	Every 2 years	To confirm SLA including equipment readiness and personnel competency	Audit confirms the OSRO’s ability to meet the SLA/contract commitments Records indicate appropriate maintenance program confirming equipment readiness Personnel competency is assessed to be up to date
	Others - OSRL	Audit	Every 2 years	To confirm SLA including equipment readiness and personnel competency	Audit confirms the OSRO’s ability to meet the SLA/contract commitments Records indicate appropriate maintenance program confirming equipment readiness Personnel competency is assessed to be up to date
	Others - Santos Oil Spill Response Equipment Inventory Register	Equipment Check	Minimum every 6 months, or when change is communicated from equipment custodians.	To confirm the status of available oil spill response equipment	Review to confirm access to oil spill response equipment on the register

Appendix L: 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 M: Shoreline Response Strategy Guidance

Shoreline Response Strategy Guidelines

Guidance on response methods for sensitive coastal habitats is provided in **Table M-1**.

Guidance on applicable shoreline clean-up techniques based on shoreline substrate and degree of oiling are presented in **Figure M-1** to **Figure M-4**.

Table M-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.
Mudflats	- 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 channels filling/ draining mudflats. - Efforts to manually clean mudflats may result in further damage due to trampling of the oil into sediments which typically rich in biota and provide a food source for fish and birds. - Therefore, natural remediation may be the preferred approach and if removal is required, the flushing of oil into open water, if feasible, may be preferred to manual collection - The presence of wildlife (e.g. shorebirds) and sensitive flora (e.g. mangroves) which are often associated with mudflats needs to be considered in determining the best approach.

Sensitive Receptors	Strategy Guidance
Sandy beaches	- Clean-up techniques will depend upon the degree of infiltration into sand or and degree of burial which will require surveying/mapping - Clean-up will also depend upon sensitivity of environment (existing ecological features), access to the beach and potential for additional erosion. - Oil and oiled sediments can be physically removed offsite, moved to surf zone for surf washing of sediment or assisted to move to water edge by ploughing of channels or flushing. - Recovery of oil can be by manual means (hand tools) or mechanical means (earth moving, pumping equipment). - The sensitivity of the environment is a key factor, with manual removal creating less waste and disturbance but more consuming in time and resources.
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.
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.
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.

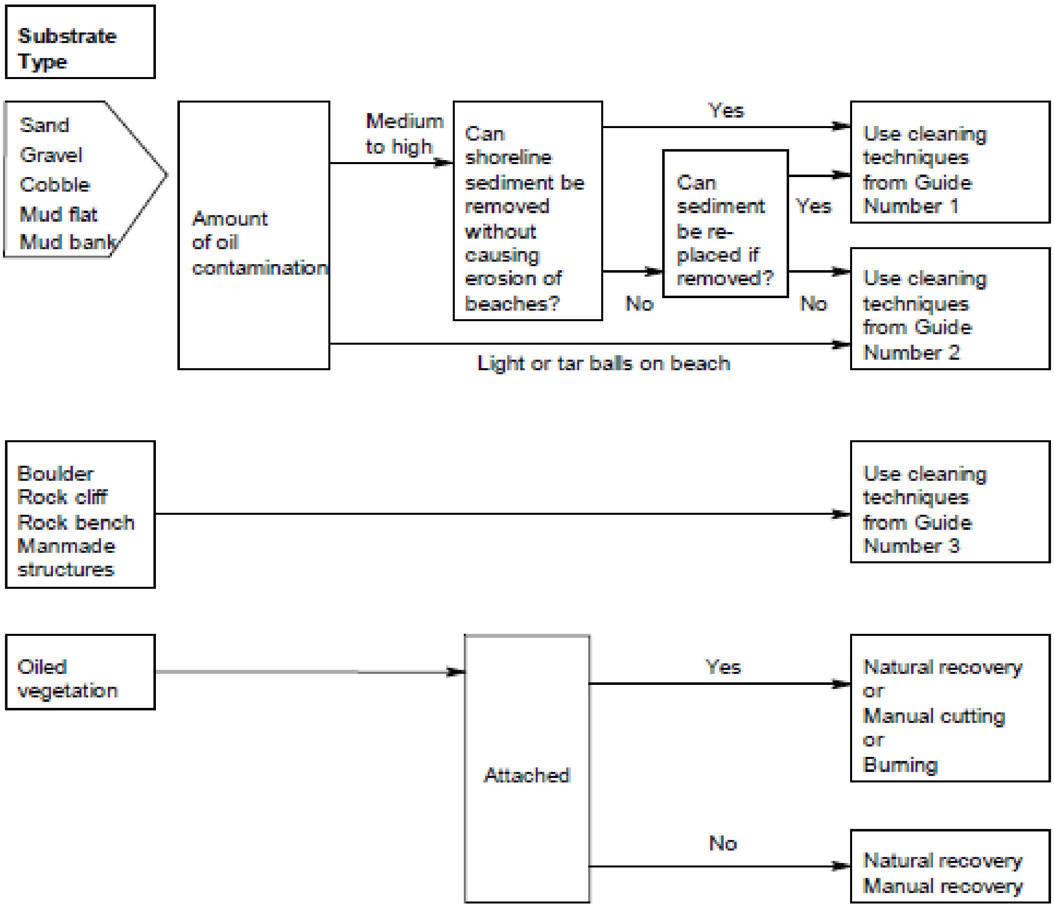


Figure M-1: Shoreline Clean-up Master Decision Guide

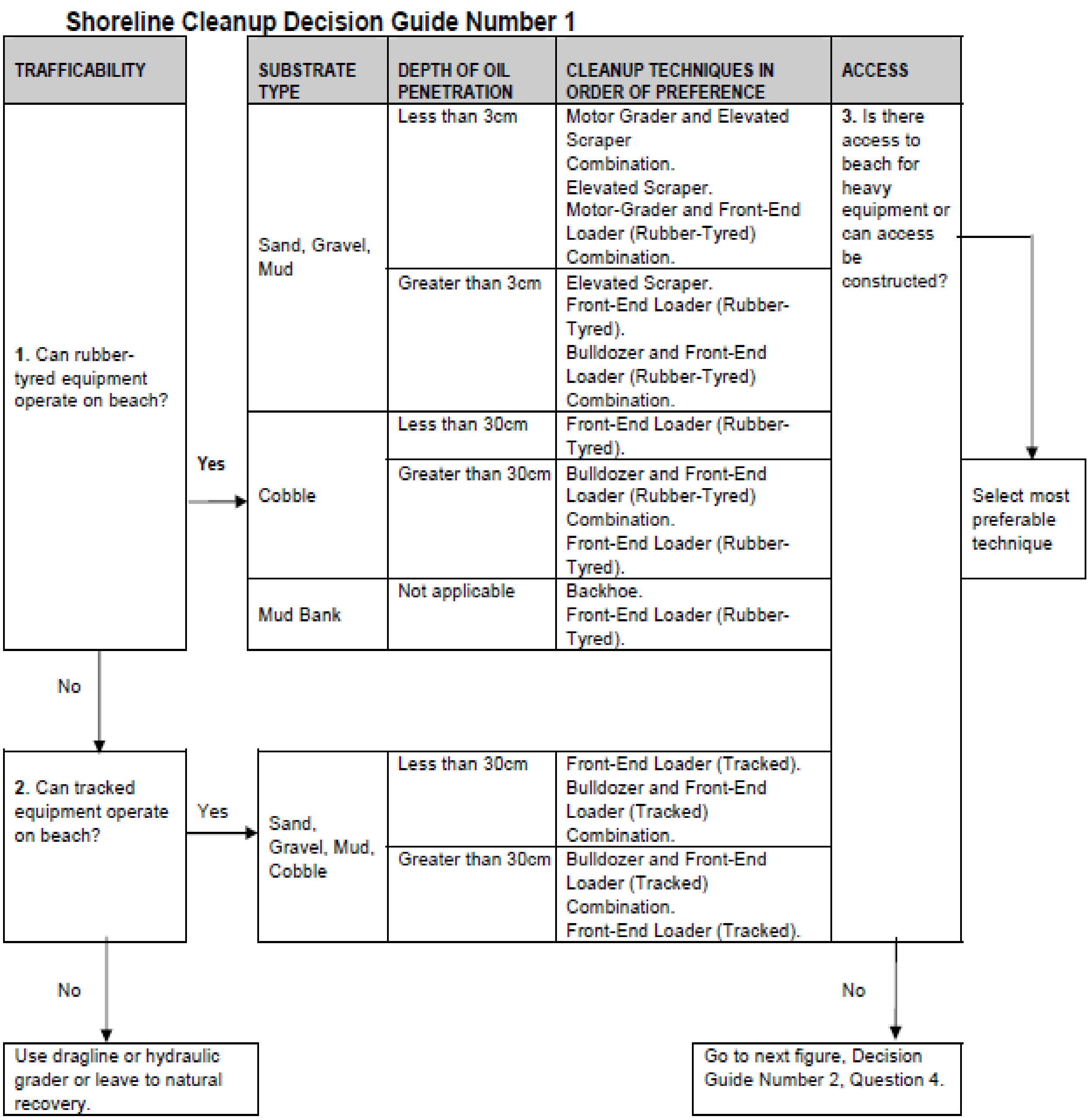


Figure M-2: Shoreline Clean-Up Decision Guide 1

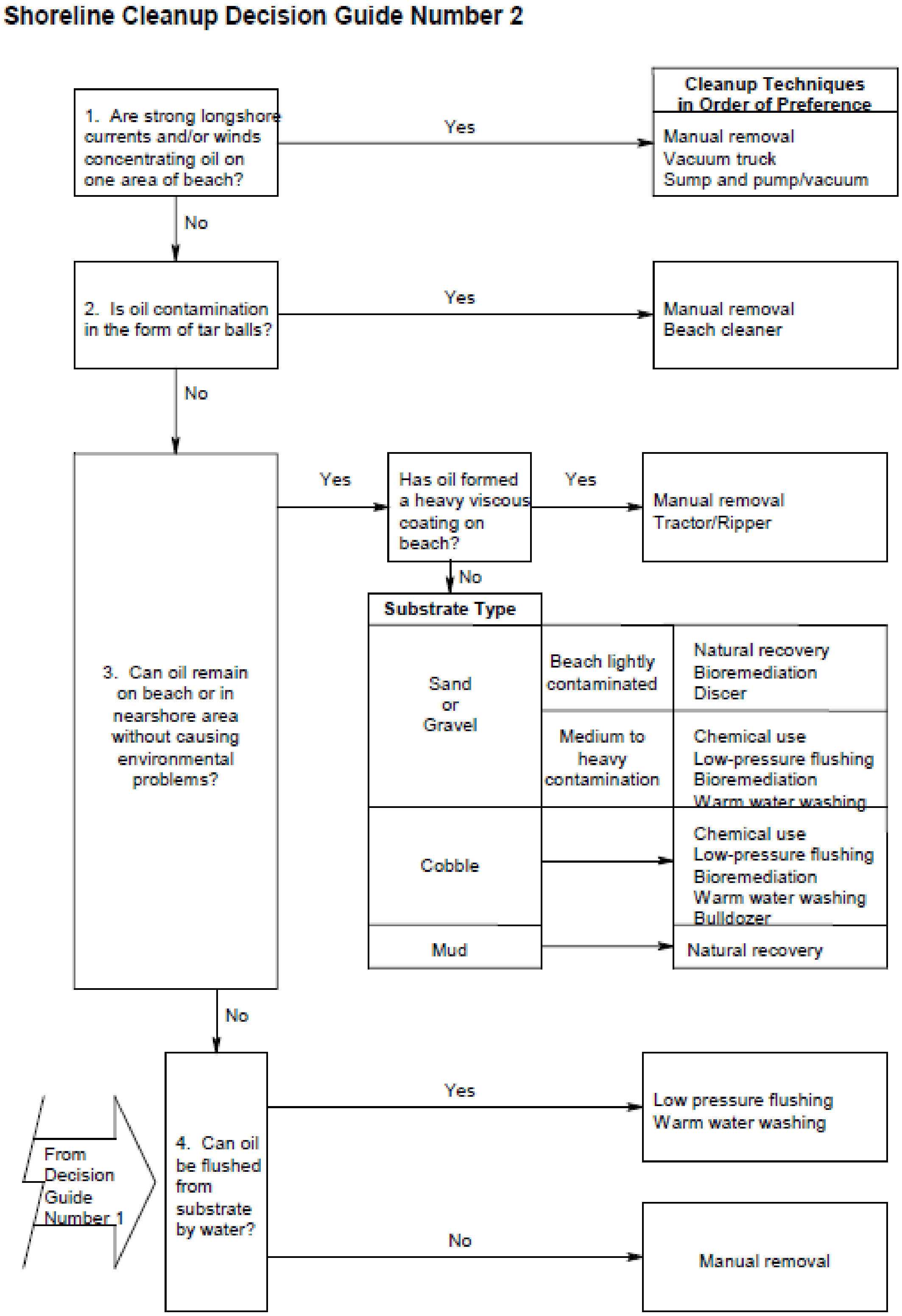


Figure M-3: Shoreline Clean-Up Decision Guide 2

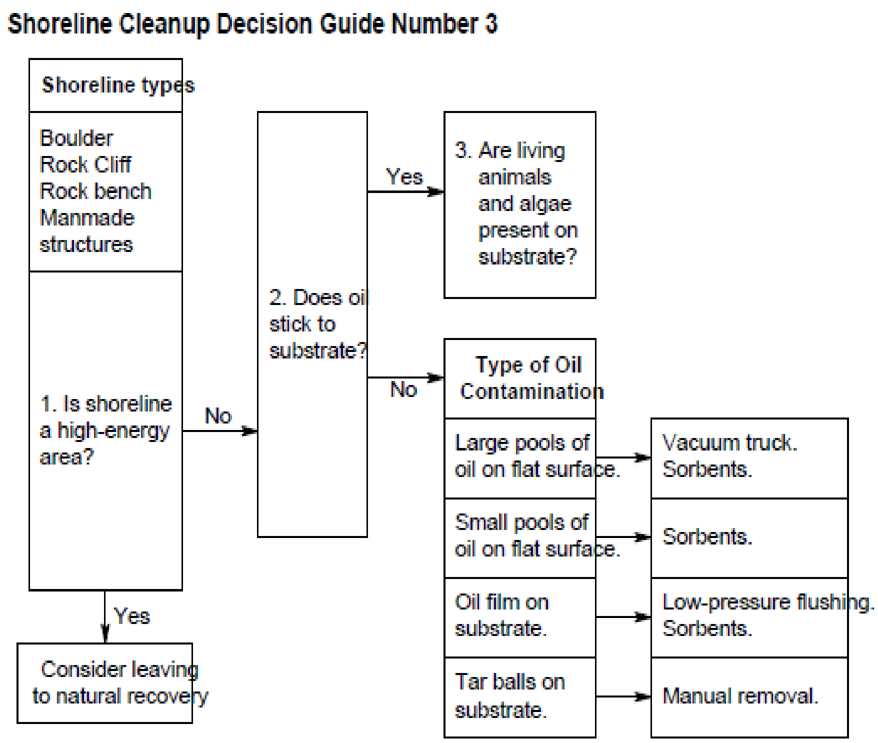


Figure M-4: Shoreline Clean-Up decision Guide 3

Appendix N: Operational Guidelines for Shoreline Response

Operational Guidelines for Shoreline Clean-up activities

1.1.1 Worksite preparation guidelines

The following provides guidelines for the preparation of staging areas supporting shoreline clean-up operations.

Organisation and worksite set-up

The worksite does not only include the polluted areas that require cleaning. Several other specific areas must be identified and cordoned off and routes for pedestrians and vehicles should be signposted.

These specific areas are:

- The polluted area;
- The waste storage area, with different types of containers suitable for the different kinds of waste;
- The decontamination area: whatever the size of the spill, a decontamination phase for operational personnel, equipment and tools must be carried out in order to provide some comfort to personnel after each work session, avoiding oiling clean areas, and group together personal clean-up equipment and protective gear, to facilitate the management of the site (cleaning, storage, re-use);
- A rest area, with at least changing rooms, toilets, a first aid kit and cold and hot beverages. Cold or even hot meals can also be organised on the spot provided that a canteen tent or temporary building is available; and
- A storage area for tools and machinery (or equipment warehouse).

Access to the worksite should be restricted and traffic of vehicles should be strictly regulated to avoid accidents.

Preparation

- Prevent the general public from accessing the worksite;
- Delineate accesses for vehicles and machinery (check load-bearing capacity) and routes;
- Channel vehicle and pedestrian traffic;
- Protect the ground (geotextile, roll out mat system…) during operations in sensitive areas (dunes...);
- Prepare and signpost the different areas of activity (on the beach), living areas (locker room, meals, showers, toilets...) and stockpiling areas presenting a risk (fuel, equipment, waste pit....);
- Define a site for fluid storage away from the locker room:
    - Provide an extinguisher for each cabin
    - Set up a recovery system for fuel leaks
- Provide at least minimum lighting for installations and the surrounding area during the winter.

Basic Equipment	Extra Equipment
✓ Plastic liners, geotextiles ✓ Barrier tape and stakes ✓ Signposting equipment	✓ Bins, barrels, skips, tanks ✓ Hot and cold beverages (Welfare) ✓ Cooking oil, soap (Welfare) ✓ Earthmoving equipment

PRIMARY STORAGE OF WASTE

A primary storage site is:

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

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

The return of the site to its original condition implies:

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

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

Primary waste storage sites should meet certain criteria:

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

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

BASE CAMP/REST AREA

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

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

At base camp, operators must be provided with:

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

Selection of the rest area must meet certain criteria:

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

Equipment

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

STORAGE AREA FOR EQUIPMENT AND MACHINERY

This area consists of and equipped repair and maintenance site.

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

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

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

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

Equipment

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

1.1.2 Manual clean-up guidelines

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

Conditions of use

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

Equipment

Basic Equipment:

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

Extra Equipment:

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

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

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

Impact

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

Performance

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

1.1.3 Mechanical clean-up guidelines

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

Conditions of use

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

Equipment

Basic equipment:

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

PPE: At least suitable for heavy machinery operation

Impact

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

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

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

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

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

1.1.4 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 O: Scientific Monitoring Plans

2 Scientific Monitoring Plans by Receptor

The following components of the SMP are outlined in this section:

+ SMP1: Water Quality
+ SMP2: Sediment Quality
+ SMP3: Sandy Beaches and Rocky Shores
+ SMP4: Mangroves
+ SMP5: Intertidal Mudflats
+ SMP6: Benthic Habitats
+ SMP7: Seabirds and Shorebirds
+ SMP8: Marine Mammals
+ SMP9: Marine Reptiles
+ SMP10: Seafood Quality
+ SMP11: Fish, Fisheries and Aquaculture
+ SMP12: Whale Sharks.

Given the low likelihood and unpredictable nature of a Level 3 incident, it is very unlikely that one pre-established monitoring design will be appropriate for all scenarios. Instead, monitoring will require an adaptive approach which may employ previous baseline monitoring, new post-spill data, spatial control sites, or post-spill pre-impact data that follows a consistent decision framework (Department of Environment and Conservation 2009). The scientific monitoring implemented will be in accordance with the scale, location, and duration of the oil spill. Only the relevant plans as determined by the initiation criteria will be implemented.

Table 1 provides a glossary of an SMP as prepared in this report.

Table 1: Glossary of Scientific Monitoring Plans.

SMP Receptor	
Rationale	Importance of receptor, possible impact and importance of monitoring program.
Aim	Description of program aim(s)
Baseline	Refer to Baseline Data Review (SO-91-RF-20022).
Contact	Contact is defined as occurring where any aerial, visual or florescence observation reports submitted to the Incident Command Team (ICT) show presence or likely presence of oil; or spill fate modelling predicts oil at sensitive receptors of > 1g/m^2 for surface oil, and >10 ppb for entrained and dissolved oil. This then activates the relevant SMP, which determines if any impact has occurred based upon applicable thresholds.
Initiation criteria	Initiation criteria, based on data from OMPs.

Termination criteria	Termination criteria based on analysis of Scientific Monitoring data translated to the Incident Management Team (IMT) through the planning function.
Receptor impact	Measured states and pressures according to the State-Pressure-Response model.
Methodological approach	Descriptions of sampling methods in order to carry out scientific monitoring, including reference to methods described in an appendix.
Scope of works	Timeline for scope of works (SoW) development.
Statistically significant	The basis of the significance is determined by the methodological approach as outlined in the relevant SMP.
Resources	List of required resources which may not necessarily be listed within a description of a particular method.
Implementation	Mobilisation requirements for service provider(s).
Analysis and reporting	Summary of analysis, data management and reporting.

SMP1 Marine Water Quality

SMP1 – Marine Water Quality	
Rationale	The release of hydrocarbons at sea will pollute marine waters via floating, entrained or dissolved aromatic hydrocarbons. The water quality SMP may also be used in conjunction with OMP1 (Surveillance and Monitoring), to inform the sampling design of other SMPs where objectives are to evaluate impact to 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 to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available metadata 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.

SMP1 – Marine Water Quality	
	In the absence of baseline or similar non-impact sites data, concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are below the relevant hydrocarbon contaminant trigger level within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower and values are not significantly different to reference sites. Forensic fingerprinting of the released hydrocarbon and water quality sample analysis by way of gas chromatography/mass spectrometry (GC/MS) may be used to determine the source of contaminants where this is not otherwise clear from operational monitoring.
Receptor impact	Impacts to specific receptors from hydrocarbons within marine waters are described in individual SMPs.
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied; 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. See **Appendix A** and **Figure 1** for detailed description of these approaches. The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling. Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design. <u>Water profiles</u> SMP1 – Marine Water Quality A water quality probe will be used to measure conductivity (to derive salinity in PSU), temperature and depth (CTD), dissolved oxygen (% and mg/L), turbidity (FNU or NTU), 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.

SMP1 – Marine Water Quality	
	The laboratory(ies) will inform and supply the appropriate sample containers, storage requirements, holding times, detection limits/limit of reporting for required analytes and the analysis required for each 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 Appendices: + 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 work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ Marine scientist with experience in water quality sampling + Geographic Information Systems (GIS) personnel + National Association of Testing Authorities (NATA) accredited laboratories for water sample analysis + Vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Sampling equipment + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the SoW following approval by Santos (this time allows for costing, preparation of equipment and disposables and travel time to site).
Analysis and reporting	Chemical analysis will be carried out by NATA-accredited laboratories. A government endorsed laboratory for forensic fingerprinting (GS/MS) will be used.

SMP1 – Marine Water Quality	
	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.

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 to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available databases will be reviewed for applicable marine baseline sediment quality and infauna data. In the absence of baseline sediment quality data, hydrocarbon contaminant trigger values for marine sediments as listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) will be used as a proxy for baseline levels. Where other regulatory site-specific trigger levels exist, the lower of these levels and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) levels will be used as proxy baseline levels.
Initiation criteria	Operational Monitoring or SMP1 indicates that contacted sediment or sediment predicted to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Concentrations of hydrocarbons in marine benthic and shoreline sediments, attributable to the released hydrocarbon, are not significantly higher than baseline or similar non-impact sites. In the absence of baseline or similar non-impact sites data, concentrations are below marine sediment quality interim guideline levels within the ANZG (2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower. For infauna assemblages, abundance and species diversity/richness/composition are not significantly different from baseline (where baseline data exists) or are not

SMP2 – Sediment Quality	
	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 is 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
Methodological approach	Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012): 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied; 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. See **Appendix A** and **Figure 1** for detailed description of these approaches. The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling. Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design Sediment quality Operational Monitoring (including spill trajectory modelling) and the results of SMP1 Marine Water Quality monitoring will be used to inform the location of potentially impacted sediment sites.

SMP2 – Sediment Quality	
	Sediment monitoring sites in nearshore and shoreline locations will also consider and align where practicable, with sites selected for habitat monitoring (i.e. SMP3, 4, 5 and 6). Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design. At each site, replicate sediment samples will be taken including those for QA/QC purposes. Sediment grab (i.e. Van Veen or Box corer) or coring equipment will be selected based on water depth (offshore, inshore or shoreline) and sample size requirements. Sediment sample collection and handling will align with Standard operating procedures found in the Oil Spill Monitoring Handbook (Hook et al. 2016), specifically the following sections according to sampling equipment utilised: + Appendix G hydrocarbon analysis (Grab samplers) + Appendix H hydrocarbon analysis (Ship borne corer) + Appendix H Manual push corer, and + Appendix O Sediment infauna. 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 (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of infauna to lowest taxonomic resolution possible. eDNA will also be collected to detect for the presence of marine infauna species in sediments. Sediment will be removed from the surface of a subset of the sediment sample and sent to an appropriate laboratory for analysis.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ Marine scientist with field experience in deep sea sediment sampling + Scientist with skills in infauna identification + GIS personnel + NATA accredited laboratory for sample contaminant analysis + Laboratory for infauna sorting and taxonomic identification + Vessel with appropriate davit/winch to deploy grab/corer equipment and tender in operation + Refuelling facilities

SMP2 – Sediment Quality	
	+ Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be capable of mobilising within 72 hours of the SoW having been approved by Santos. Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Sediment samples analysed by NATA-accredited laboratories for presence and concentrations of hydrocarbons associated with the spill including full suite PAHs and total organic carbon. A government endorsed laboratory for forensic fingerprinting (GC/MS) will be used. Infauna samples sorted and identified by qualified marine invertebrate specialist to acceptable taxonomic groups. Data will be entered to spatially explicit database and analysed statistically in order to detect significant differences among sites. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

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 to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available databases shall be reviewed for applicable rocky shoreline and sandy beach biota baseline data.
Initiation criteria	Operational monitoring, SMP1 or SMP2 indicates that rocky and/or sandy shorelines are contacted or predicted to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Shoreline assemblage structure, and hydrocarbon concentration levels in representative invertebrate species, are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND

SMP3 – Sandy Beaches and Rocky Shores	
	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.
Methodological approach	Monitoring will be designed as follows: 4. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 5. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 6. Where no baseline data sites are involved, a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied. Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority where no baseline data exists. If this opportunity is not available, a gradient approach to monitoring will be applied. Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. Rocky shoreline intertidal assemblages (fauna and flora) will be monitored using a quadrat/transect approach, with the positioning of quadrats/transects accounting for any natural variation in assemblage structure along a seaward-landward gradient. Assemblage structure to be recorded through in-situ counts of fauna and flora or still images taken for further analysis. Sandy shoreline infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists, the methodology will be adapted to available data so that results are comparable. Samples to be sieved with collected infauna preserved (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists.

SMP3 – Sandy Beaches and Rocky Shores	
	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 work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in shoreline macroinvertebrates sampling + Supporting Scientist + GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Laboratory facilities for sorting and taxonomic identification of specimens
Implementation	With the aim of collecting post-spill pre-impact data, service provider able to mobilise within 72 hours of the SoW having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Specimens not identified in situ (in the field) will be processed and identified in the laboratory by appropriately qualified scientists. Biota tissue samples (if collected) analysed for hydrocarbon contaminants by NATA-accredited laboratories. Data will be entered to spatially explicit database and analysed in order to test for significant difference between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

SMP4 Mangrove Communities

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
Rationale	In the event of Tier 2 or 3 spill, mangroves may be contacted by floating or entrained oil. Mangrove health may be adversely affected due to increased concentration of hydrocarbons in sediments and coating due to surface oil, which in turn can lead to leaf-loss, mortality and a reduction in areal extent of mangrove habitat. This plan's focus is mangrove vegetation. Associated monitoring of sediment quality and mudflat fauna is described in SMP2 and SMP5, respectively.
Aim	To monitor changes to mangrove extent and health in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). 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 as defined in **Table 1**.
Termination criteria	Mangrove extent and health are not significantly different from their baseline state (where baseline data exists) or are not statistically 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.
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).

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
	Where long term on-ground baseline monitoring has occurred, further post impact on-ground monitoring should be carried out to complement any analysis of remote sensing. Analysis of long-term on-ground monitoring data will be as follows: 1. Where long-term baseline data sites (only) are contacted a control chart (time-series) design will be applied. 1. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 2. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1,** detailed in Baseline Data Review (SO-91-RF-20022 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 operations (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 work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in mangrove condition assessment + Supporting Scientist + GIS and remote-sensing personnel + Available vessel in operation + Satellite and/or aerial imagery
Implementation	On-ground monitoring will only occur where long-term baseline data has been collected, and hence no post-spill pre-impact data collection will be required. On-ground post-spill data will be collected at an appropriate time as guided by the analysis of remote sensing imagery, and potential on-ground assessment.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to test statistically significant change to parameters associated with hydrocarbon spill. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

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) occurs 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. 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 to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available baseline databases shall be reviewed for applicable intertidal mudflat infauna baseline data.
Initiation criteria	Operational Monitoring, SMP1 or SMP2 indicates that mudflat habitats are contacted or predicted to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Mudflat infaunal assemblages are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated; AND Clean-up of the shoreline site has been completed.
Receptor impact	Impact to mudflat epifauna and infauna from pressures, including hydrocarbons, is measured through change in: + Species diversity + Assemblage composition + Abundance of indicator taxa. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Overfishing (bait collecting) + Introduction of marine pests + Climate change.
Methodological approach	Monitoring will be designed as follows: 7. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 8. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	9. Where no baseline data sites are involved a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority if baseline data are not available. If this opportunity is not available, a gradient approach to monitoring will be applied. Mudflat infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists methodology to adapt to available data such that results are comparable. Sites selected for mudflat infauna sampling to be concurrently sampled for sediment quality as per SMP2. Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. Samples to be sieved with collected infauna preserved (buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Scientist with experience in epifauna and infauna assessment and sampling + Supporting Scientist + GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	With the purpose of collecting post spill pre-impact data, service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilization time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database and analysed 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.

SMP6 Benthic Habitats

SMP6 – Benthic Habitats	
Rationale	Benthic habitats are those habitats associated with the seafloor. Major benthic habitats at risk are: + Coral reefs (likely high susceptibility to spill) + Macroalgae and seagrass (likely moderate susceptibility to spill) + Non-coral benthic filter feeders (likely moderate susceptibility to spill) + Sub-tidal pavement (likely moderate susceptibility to spill) + Soft-substrate (likely lower susceptibility to spill). Macroalgal and seagrass communities are important primary producers that 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 life cycles. Corals are important primary producers that provide food, substrate, and shelter for a diversity of marine life, including invertebrates and fish. They also protect coastlines from wave erosion and provide important substrate for algae. Undisturbed intertidal and subtidal coral reefs occur in several locations throughout the region.
Aim	To monitor changes in the cover and composition of benthic habitats in relation to an oil spill and associated activities. To monitor change in hard coral health and reproduction in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available baseline metadata databases will be reviewed for applicable benthic habitat and coral health and reproduction baseline data. Remote sensing data, satellite and aerial imagery previously acquired may also be applicable for shallow clear-water benthic habitats to detect changes in benthic habitat cover and composition. Pollution-induced change to benthic habitat cover and composition may take some time to be detected. Therefore, post-spill, pre-impact benthic survey data will be collected when required to have a baseline state following initial oil contact.
Initiation criteria	<u>Benthic habitat cover and composition</u> Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill. <u>Coral health and reproduction</u> + Operational Monitoring, SMP1 or SMP2 indicates that coral habitat is contacted or is predicted to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	<u>Benthic habitat cover and composition</u>

SMP6 – Benthic Habitats	
	Cover and composition of benthic habitats are not statistically significantly different from that of their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages. <u>Coral health and reproduction</u> Hydrocarbon concentration in corals, reproductive state and settlement indices are not statistically different from the baseline state (where baseline data exists) or from comparable non-impacted assemblages.
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.
Methodological approach	Monitoring design will be as follows: 10. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 11. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 12. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). <u>Benthic Habitat Cover and Composition</u> Field survey methodology will be based upon acquiring repeat digital imagery (video or still images) of benthic habitats along random transects (preferable), using a stratified sampling approach at each site to target different habitat types and depths where clear gradients in these conditions exist. Site selection and image acquisition methodology will aim to align applicable baseline studies where these exist, such that imagery is comparable. The number of sites and frequency of sampling will depend upon the sampling design philosophy. Divers, towed video or remotely operated vehicles (ROVs) will be employed to collect imagery considering safety aspects and the depth of water at survey locations. Where divers are employed, fish species may also be recorded where practicable (for example following methodologies employed by Babcock et al. (2008) to contribute to SMP11.

SMP6 – Benthic Habitats	
	Coral Health and Reproduction 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, ecotoxicology testing of the released hydrocarbon on the larval competency of representative coral species will be conducted. Settlement plates will be deployed to monitor settlement of coral recruits following spawning periods to ascertain the level of coral recruitment at impacted and non-impacted sites.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Senior Marine Scientist with experience in benthic habitat assessment + Supporting Scientist + Divers or ROV operators + GIS personnel + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Diving equipment or ROVs + Video recording facilities + Satellite imagery
Implementation	Service provider is to be able to mobilise within 72 hours of the SoW being approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Digital imagery will be analysed using a point-count technique (using software such as AVTAS, Coral Point Count with Excel extensions (CPCe) or TransectMeasure (SeaGIS)) to estimate the percentage cover of biotic and abiotic categories (in line with the CATAMI classification scheme) comprising the benthic habitat. Biotic categories to include the following as applicable: corals; macroalgae and seagrass; and non-coral benthic filter feeders. Live, dead and bleached coral cover shall be recorded. The imagery collected will allow for the determination of percent cover, abundance, measurement of size (if scaling lasers are included in the image) and a visual assessment of health (Kohler and Gill 2006).

SMP6 – Benthic Habitats	
	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 ecotoxicological laboratory in addition to standard suite of ecotoxicological tests using released hydrocarbon. Data will be entered to spatially explicit database and analysed 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.

SMP7 Seabirds and Shorebirds

SMP7 – Seabirds and Shorebirds	
Rationale	Marine waters and coastal habitats in the EMBA contain key habitats that are important to birds, including offshore islands, sandy beaches, tidal flats, mangroves and coastal and pelagic waters. These habitats support a variety of birds which utilise the area in different ways and at different times of the year. Birds can be broadly grouped according to their preferred foraging habitat as coastal/ terrestrial birds, seabirds and shorebirds, both migratory and resident. For the purposes of this document, seabirds and shorebirds are defined as: + shorebirds – those birds that inhabit and feed in the intertidal zone and adjacent areas and are resident or migratory, using the area principally during the austral summer. + seabirds – those birds associated with the sea and deriving most of their food from it, and typically breeding colonially, including the marine raptors osprey and white-bellied sea eagle.
Aim	Quantify seabirds and shorebirds, in the spill and response areas. Quantify lethal and/or sub-lethal impacts of hydrocarbon spill exposure on seabirds and shorebirds. Monitor changes in seabird populations (reproductive success) in relation to the hydrocarbon spill and clean-up activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (Department of Agriculture, Water and the Environment (DAWE) (http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and any local oiled wildlife response plans should also be consulted.

SMP7 – Seabirds and Shorebirds	
Initiation criteria	Operational monitoring indicates that known foraging, roosting or nesting areas for seabirds and/or shorebirds has been contacted, or are predicted to be contacted, by a hydrocarbon spill; OR Operational monitoring indicates that seabirds and shorebirds have been contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are not present in seabird and shorebird tissues; AND Measured variables are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured variables at non-impacted sites; AND Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to seabirds and shorebirds from pressures including hydrocarbons is measured through change in: + Species diversity + Bird abundance + Health/condition + Breeding success (resident species only). Other pressures to these states are: + Physical disturbance of foraging and nesting habitat + Accidental chemical spillage + Entanglement in litter + Displacement by less favourable species (e.g. Silver Gull) + Predation + Climate change.
Methodological approach	Monitoring design will be as follows: 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. Given the ease of survey establishment, post-spill pre-impact monitoring will be attempted wherever practicable in order to established pre-impact state. 3. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1,** detailed in Baseline Data Review (SO-91-RF-20022).

SMP7 – Seabirds and Shorebirds	
	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, such as Birdlife Australia's Australian Shorebird Monitoring Program and survey guidelines standardised by the DAWE (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 work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ Experienced seabird biologist + Experienced shorebird biologist + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database and analysed in order to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Draft annual report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

SMP8 Marine Mammals

SMP8 – Marine Mammals	
Rationale	At least 11 species of listed marine mammals are known to, or are thought to occur, in Australian waters within the environment that may be affected. These include cetaceans (whales and dolphins) and sirenians (dugong). Effects to marine megafauna due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates, and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.
Aim	To monitor short and long-term environmental effects on marine mammals that may have resulted from the hydrocarbon spill and associated response.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and local oiled wildlife response plans should also be consulted.
Initiation criteria	Operational monitoring indicates that marine mammals are contacted or predicted to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Restoration or resumption of key biological processes (e.g. abundance, distribution, breeding) necessary to ensure post-impact recovery is demonstrated. Specific criteria to be developed by Marine Scientist(s) with expertise in marine mammals of the region; AND No further instances of dead marine mammals with detectable levels of hydrocarbons attributable to the hydrocarbon spill; AND Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to marine mammals from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Physical disturbance + Entanglement in fishing gear and litter + Accidental chemical spillage + Climate change + Over-exploitation.
Methodological approach	Aerial and marine surveys will be implemented to identify individuals in proximity of the spill and to quantify damage: + Aerial surveys will follow the protocols of Hedley et al. (2011)

SMP8 – Marine Mammals	
	+ 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 work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	**Aerial survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities **Vessel-based survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Sample container and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database. Data and conclusions will be summarised in an environmental report card. Statistical power related to these receptors is likely to be low, due to observational data and small sample sizes. Therefore, the assessment of quantified impacts will be corroborated with marine scientist(s) with expertise in relevant fauna. 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.

SMP9 Marine Reptiles

SMP9 – Marine Reptiles	
Rationale	At least 10 species of listed marine reptiles are known to, or are thought to occur, in Australian waters within the environment that may be affected. This includes six species of marine turtle that occur in, use the waters, and nest on sandy beaches, two species of sea snake and one species of estuarine crocodile found in most major rivers systems of the Kimberley region and in the Northern Territory. 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.
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 marine reptile populations in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and local oiled wildlife response plans should also be consulted.
Initiation criteria	Operational monitoring indicates that marine reptiles or nesting sites are contacted or likely to be contacted by a hydrocarbon spill; OR Operational monitoring indicates that marine reptiles are contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are no longer present in marine reptile tissues collected from live or dead individuals; AND In the event that an impact attributable to the hydrocarbon spill is detected on marine reptiles, the measured parameters are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured parameters at non impacted sites; AND Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to marine reptiles from pressures including hydrocarbons is measured through change in: + Abundance + Health/condition + Nesting success (turtles and crocodiles). Impact to other marine reptiles from pressures including hydrocarbons is measured through change in observed injury and condition. Other pressures to these states are:

SMP9 – Marine Reptiles	
	+ 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.
Methodological approach	**Abundance** In-water impacts – aerial surveys. Shoreline impacts – ground surveys (either rapid 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 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 work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	**Aerial survey** + Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s)

SMP9 – Marine Reptiles	
	+ Refuelling facilities **Vessel-based Survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database. Turtle data will be analysed in order to test for significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card. Owing to their observational nature and potentially low sample size, observed impacts to other reptile fauna will be corroborated with marine scientist(s) with expertise in relevant fauna for the region. 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.

SMP10 Seafood Quality

SMP10 – Seafood Quality	
Rationale	Exposure of commercial and recreationally targeted demersal and pelagic fish species to entrained and dissolved aromatic hydrocarbons can cause flesh tainting and increase the levels of toxicants above human consumption guidelines. Aromatic hydrocarbons are carcinogenic to humans. This scope includes finfish, sharks and invertebrates (principally crustacea).
Aim	To identify potential human health risks due to the presence of hydrocarbon concentrations in the flesh of targeted seafood species for consumption.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). Human health benchmarks relating to the exposure of PAHs shall be used to determine health effects as per Yender et al. (2002).

SMP10 – Seafood Quality	
	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 predict or observes contact of oil to target species for consumption as defined in **Table 1**.
Termination criteria	The following termination criteria will be adopted in consultation with responsible fisheries and human health agencies. Hydrocarbon concentrations in seafood tissues are not above levels considered a human health risk; AND Flesh taint is not detected from olfactory testing of seafood samples; AND Target species are no longer exposed to hydrocarbons in the water column.
Receptor impact	Impact to seafood quality from hydrocarbons is measured through change in: + Toxicity indicators + Olfactory taint. Other pressures to these states are: + Accidental chemical spillage + Disease.
Methodological approach	Target fish species determined from water quality monitoring results and relevant and available commercial and recreational-fished species. Sampling of target species will follow a gradient design (Gagnon and Rawson 2012) ranging from impacted to non-impacted (or non-suspect) catches using commercial and recreational fishing techniques undertaken by commercial and recreational fishers. Sampling method (netting, trawling, baited fish traps, spear fishing, line fishing) will be determined by habitat, target species and spill location. If more than one target species is affected, replicate samples of each species shall be collected, with a minimum of five replicate samples. Olfactory testing will follow Rawson et al. (Rawson et al. 2011), following the duo-trio method (Standards Australia 2005).
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Marine vessel + Sample containers and preservative + NATA accredited laboratory for sample analysis + Decontamination/washing facilities
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).

SMP10 – Seafood Quality	
	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 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.

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 to the Baseline Data Review (SO-91-RF-20022). In addition, available relevant survey databases shall be reviewed for applicable baseline data.
Initiation criteria	+ Operational monitoring indicates fish, fisheries or aquaculture are contacted or likely to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	Fish assemblages are not statistically significantly different than those of baseline or similar non-impacted assemblages; AND Hydrocarbon concentrations, physiological condition indices, and biomarker levels in affected fish and aquaculture species are not statistically significantly different from those of non-impacted samples; AND Termination of monitoring is done in consultation with the responsible fisheries agencies.
Receptor impact	Impact to fish, fisheries and aquaculture from pressures including hydrocarbon concentrations is measured through change in: + Species diversity + Abundance of indicator taxa

SMP11 – Fish, Fisheries and Aquaculture	
	+ Assemblage structure + Health. Other pressures to these states are: + Accidental chemical spillage + Overfishing + Introduction of marine pests + Habitat disturbance + Climate change.
Methodological approach	Fish assemblages will be assessed using the stereo-baited remote underwater videos (BRUVs) following Shortis et al. (2009). 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: 13. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 14. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 15. If baseline data is not available, a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). Where relevant, data available from responsible fisheries agencies 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 work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Marine scientist trained in fish identification and necropsy + Marine scientist with BRUV experience + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities

SMP11 – Fish, Fisheries and Aquaculture	
	+ Safety aircraft/rescue vessels on standby + Resources to analyse BRUV data.
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	BRUV imagery will be processed using EventMeasure (SeaGIS) software. NATA-accredited laboratories will be employed for health analyses. Data will be entered to spatially explicit database and analysed to test for statistically significant differences between non-impacted and impacted fish assemblages. Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

SMP12 Whale Sharks

SMP12 – Whale Sharks	
Rationale	The whale shark (*Rhincodon typus*) is known to occur within the region. One of the best known aggregation sites occurs along the central and north-west coast of Western Australia from March to July. Whale sharks are also known to be highly migratory and a biologically important area for foraging extending into the Kimberley region of Western Australia also overlaps with the environment that may be affected. Effects to the whale shark due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.
Aim	To quantify impacts of an oil spill on whale sharks within Biologically Important Areas (BIAs) along the north-west and north Western Australian coastline.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE - http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and Pilbara Region Oiled Wildlife Response Plan (Department of Parks and Wildlife and Australian Marine Oil Spill Centre 2014) should also be consulted.

SMP12 – Whale Sharks	
Initiation criteria	Operational monitoring indicates that whale shark aggregations are contacted or likely to be contacted by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Measured parameters of whale shark abundance and distribution are not significantly different to baseline levels; AND The water quality at feeding/aggregation sites has been measured as not significantly different to baseline levels.
Receptor impact	Impact to whale sharks from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Intentional and unintentional mortality from fishing outside Australian waters + Boat strike + Habitat disruption from mineral exploration, production and transportation + Marine debris + Climate change.
Methodological approach	During spill activities may require the following surveys and sampling: + Aerial surveys + Satellite tagging + Toxicology + Food chain studies + Photo-identification + Vessel and plane logs + Acoustic tagging. The methodologies adopted will follow the approaches of those baseline studies identified allowing consistency of data from baseline to impact and recovery phases.
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities

SMP12 – Whale Sharks	
	+ Safety aircraft/rescue vessels on standby
Implementation	Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

3 Receptor Description, Impact and Baseline Data

A values and sensitivities assessment is undertaken that describes the environmental receptors that occur within the particular EMBA. This includes their general distribution within the EMBA, as well as Biologically Important Areas, Key Ecological Features and habitat critical, and their potential response to hydrocarbon spills.

Potential baseline data which may be used to support monitoring for the sensitive receptors identified during the values and sensitivities assessment are reviewed and assessed for its suitability to provide a meaningful baseline from which to assess the impact of a hydrocarbon spill. The most up-to-date and spatially relevant baseline studies are detailed in the Baseline Data Review (SO-91-RF-20022). These baseline data are not intended as a static list, but are continually updated, and augmented by co-operation amongst resource companies and other agencies. During the standby phase, data quality are progressively and critically assessed following a data governance framework. These data will be accessed in the event of a spill in order to develop the most reliable monitoring program. The Baseline Data Review forms a basis for determining the level of priority for obtaining baseline data prior to oil contact, in the event of a hydrocarbon spill.

4 Scientific Monitoring Principles

4.1 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 2**). A structured decision-making framework for allocating monitoring effort in both time and space is described in **Figure 1**.

Table 2: Guiding Principles for Oil Spill Monitoring Design and Methodologies.

Principle	Explanation	Key guiding references
Match baseline	Designs and methodologies should follow those used in appropriate baseline studies wherever possible.	N/A
Comprehensive sampling	Sampling methods should seek to sample the full range of taxa within each assemblage. This may require the use of several complimentary techniques (the exception is if indicator taxa are employed; see below).	N/A
Reliable indicator taxa	If indicator taxa are targeted then the choice of indicator should be defensible, and a link to the response of the broader assemblage demonstrated. Indicators of ecosystem function should also be considered.	Hilty and Merenlender (2000)
Appropriate sample area or volume	Size of sampling unit should be determined based on the level of clustering of individuals and whether the goal is to quantify this clustering, or establish low inter-sample variability (probably more the latter for oil spill studies).	Kenkel et al. (1989)
Reduce within sample variation over time	Wherever possible repeated measures are carried out on the same sample space in order to reduce within treatment variation.	N/A
Compositing of samples	Appropriate compositing to increase statistical power should be considered.	Carey and Keough (2002)
Account for environmental gradients and partition variations	Sources of variation are considered and compartmentalised to best reduce within treatment variation, and thereby maximise power to detect an impact. This is managed through several means:	English et al. (1997), Snedecor and Cochran (1989)

Principle	Explanation	Key guiding references
	Environmental covariates are considered in sampling design recorded and incorporated statistically. A hierarchical or stratified sampling design is used to address variation at multiple scales Design is standardized, by sampling equivalent strata (e.g., level of exposure, depth etc.).	
Assess statistical power	Where null-hypothesis tests are planned, statistical power of the design is assessed prior to execution.	Gerrodette (1987) Legg and Nagy (2006) Toft and Shea (1982)
Appropriate sampling extent	Sample the range of hydrocarbon concentration (and at least the upper end).	Skalski (1995)
Independence amongst samples	Site selection should aim for independence amongst samples and potential spatial or temporal autocorrelation should be considered.	Hurlbert (1984)
Reduce observation error	Observer bias and amongst observer variation should be considered.	Thompson and Mapstone (1997)
Appropriate spatial replication	Sites are replicated. A limitation is that there is only one spill, but control sites should be replicated and spatially Interspersed. Ideally, the design should be able to detect an impact at several possible scales.	Underwood (Underwood 1991, 1992, 1994)
Appropriate temporal replication	Sampling should account for natural temporal variation.	Underwood (Underwood 1991, 1992, 1994)

Santos

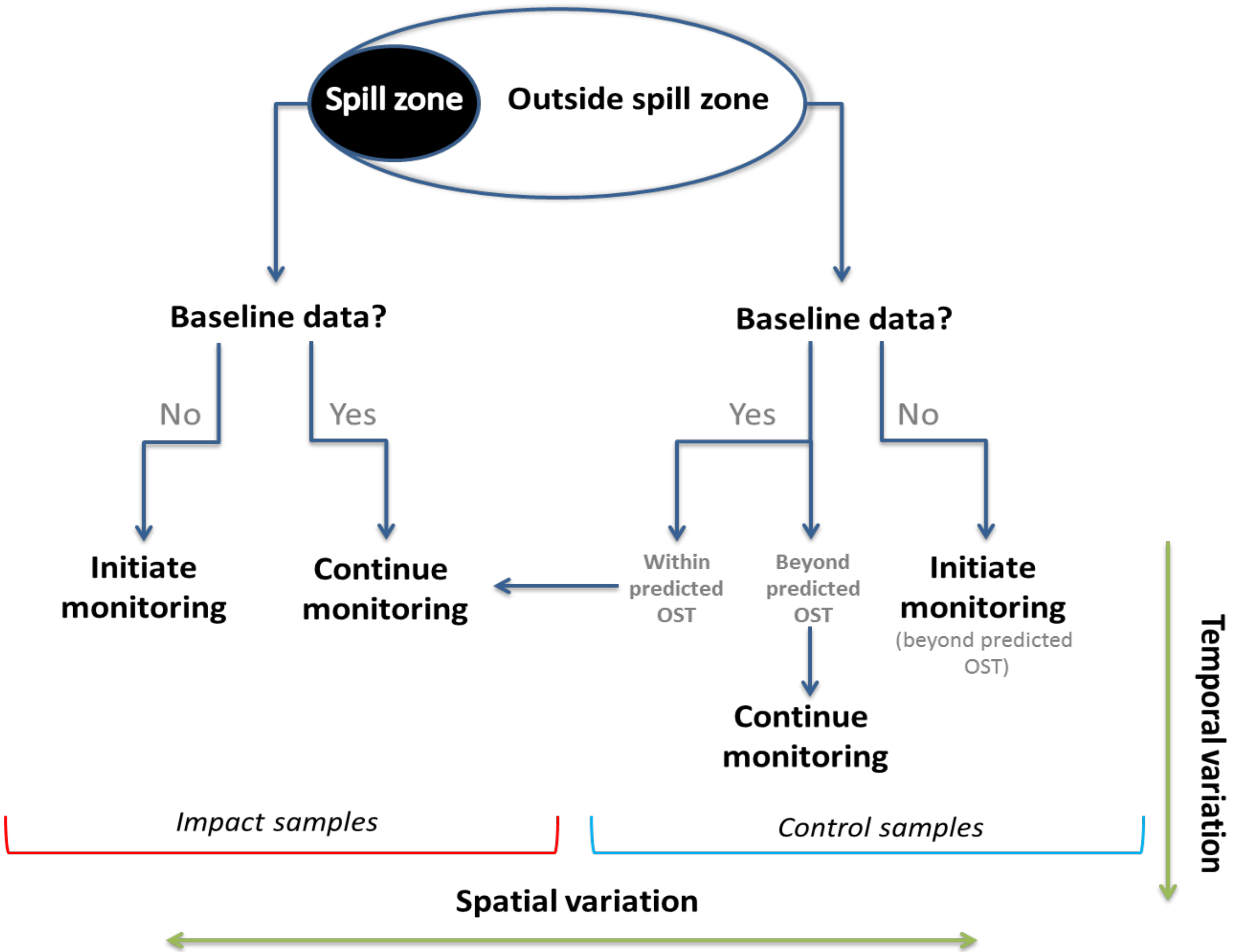


Figure 1: Structured Decision Making Process Based on Gregory et al. (2012) in Reference to Monitoring Programs, the Availability of Baseline Data, and Oil Spill Trajectory. An ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

4.2 Data Analysis

Appendix A details the most important approaches to statistical analysis and related sampling design. These approaches are summarised in Table 3 (below). An important consideration is how this information is best summarised and communicated to guide further decision making and management. **Appendix A** also describes the reporting of environmental outcomes through the use of report card systems and includes a summary of their structure and design.

Table 3: Summary of Data Analysis Techniques.

Analysis type		Description	Strength	Limitations	Addressing limitations
Gradient analysis		Impact is quantified in terms of distance from spill.	Can be established post-spill.	Doesn't account for inherent spatial patterns present prior to spill.	Include spatial covariates in model. Incorporate a temporal component.
Control chart	Univariate	Single variable is monitored and plotted over time, and breaching of control limits tested.	Control sites are not required. Takes account of natural variation in system.	Control limits do not necessarily have biological meaning. Doesn't control for broader spatial scale temporal variation.	Include control charts for control sites which incorporate broad scale temporal variation.
	Multivariate	Multiple variables are combined, monitored and plotted over time, and breaching of control limits tested.	Ability to combine suite of data (e.g. community composition) into one variable. Sites plots not required.	Individual responses are masked. Control limits do not necessarily have biological meaning. Significant control limits challenging to define. Direction of change is undefined.	Compliment with graphical approaches to identify direction of change and individual species responses.
	Reference	Control limits are based on knowledge of biological system (e.g. minimum viable population size, toxicity).	Control limits have recognised biological meaning or consequence.	Control limits may be considered arbitrary.	Use established standards for control limits.

Analysis type	Description	Strength	Limitations	Addressing limitations
BACI	Quantifies state before and after potential impact, and also at impacted and control sites. Impact is tested by statistical interaction of terms.	Controls for natural variation, by incorporating control sites.	Limited power to detect significant impact. Requires appropriate matching of control (non-impacted) sites. Requires pre-impact data.	Increase power by increasing temporal component. Choose indicators with low natural variability.

4.3 Data Governance

Under NOPSEMA guidelines, data governance refers to the management of data and its quality, generation and enforcement of data policies and standards surrounding the handling of environmental and biodiversity data in the unlikely event of an incident (National Offshore Petroleum Safety and Environmental Management Authority 2016). **Appendix B** provides a description of the key requirements for data governance of oil spill-related data and suggests a suitable framework.

5 Mobilising Scientific Response Teams

Detailed information for activating and implementing a scientific monitoring response is provided in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162).

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Appendix P: SMP and Operational Monitoring Activation Process

P-1: SMP Activation Form

Instructions

In the event of a spill requiring a response from RPS follow these steps:

1. Activate a response – call **1300 424 115** and leave a voicemail if there is no answer.
2. Immediately complete this Activation Form and email to osmp.response@rpsgroup.com.au.

You will either talk directly with or receive a call back from the Monitoring Coordinator. In the event that a call back is not received after 30 minutes, please call **1300 424 115** again.

Note: If new information should become available after submitting this form, or the situation changes, please advise the RPS Monitoring Coordinator as soon as possible.

Section 1: Contact Details of notifying person

Name of notifying person		
Position in Incident Command Team		
Direct phone		
Mobile		
Email address		
Command centre location		
Command centre direct phone		
Date and time of notification	Click here to enter a date.	Enter time, i.e. 1400 WST

Section 2: Spill Details

<table>
<tr><td colspan="2">Date and time of spill</td><td colspan="3">Click here to enter a date.</td><td colspan="3">Enter time, i.e. 1400 WST</td></tr>
<tr><td colspan="2" rowspan="2">Spill source location (GDA94, MGA Zone 50)</td><td colspan="6">Insert coordinates in GDA94 format (easting and northing).</td></tr>
<tr><td colspan="6">Insert location description</td></tr>
<tr><td colspan="2">Source of spill / hydrocarbon type</td><td colspan="6"></td></tr>
<tr><td colspan="2">Cause of spill (if known)</td><td colspan="6"></td></tr>
<tr><td colspan="2">Status of spill</td><td colspan="2">☐ Secured</td><td colspan="2">☐ Uncontrolled</td><td>☐ Unknown</td><td></td></tr>
<tr><td rowspan="3">Release rate</td><td>Instantaneous release</td><td colspan="5"></td><td rowspan="3">State units</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Continuous release</td><td></td><td>per hour for</td><td></td><td>☐ Hours</td><td>☐ Days</td></tr>
<tr><td rowspan="4">Spill Description</td><td>Estimated quantity</td><td colspan="5"></td><td rowspan="4">State units</td></tr>
<tr><td>Incident tier</td><td colspan="5">☐ 1 ☐ 2 ☐ 3</td></tr>
<tr><td>Direction of travel</td><td colspan="5"></td></tr>
<tr><td>Trajectory</td><td colspan="5"></td></tr>
<tr><td colspan="2">Modelling provider log in details</td><td colspan="6"></td></tr>
</table>

Section 3: OMP/SMP activation

SMPs to be activated. **Where there is doubt whether an SMP should be activated the SMP should be selected. Refer to the Oil Spill Scientific Monitoring Plan (EA- 00-RI-10099) for initiation criteria for SMPS.**	☒ SMP1 – Water quality ☒ Operational water quality monitoring
	☐ SMP2 – Sediment quality ☐ SMP3 – Sandy beaches and rocky shores ☐ SMP4 – Mangroves ☐ SMP5 – Intertidal mudflats ☐ SMP6 – Benthic habitats ☐ SMP7 – Seabirds and shorebirds ☐ SMP8 – Marine megafauna ☐ SMP9 – Marine reptiles ☐ SMP10 – Seafood quality ☐ SMP11 – Fish, fisheries and aquaculture ☐ Yet to be determined ☐ Other:_____

Section 4: Safety

Detail any known safety or security risks	
Weather conditions on site and short-term forecast	

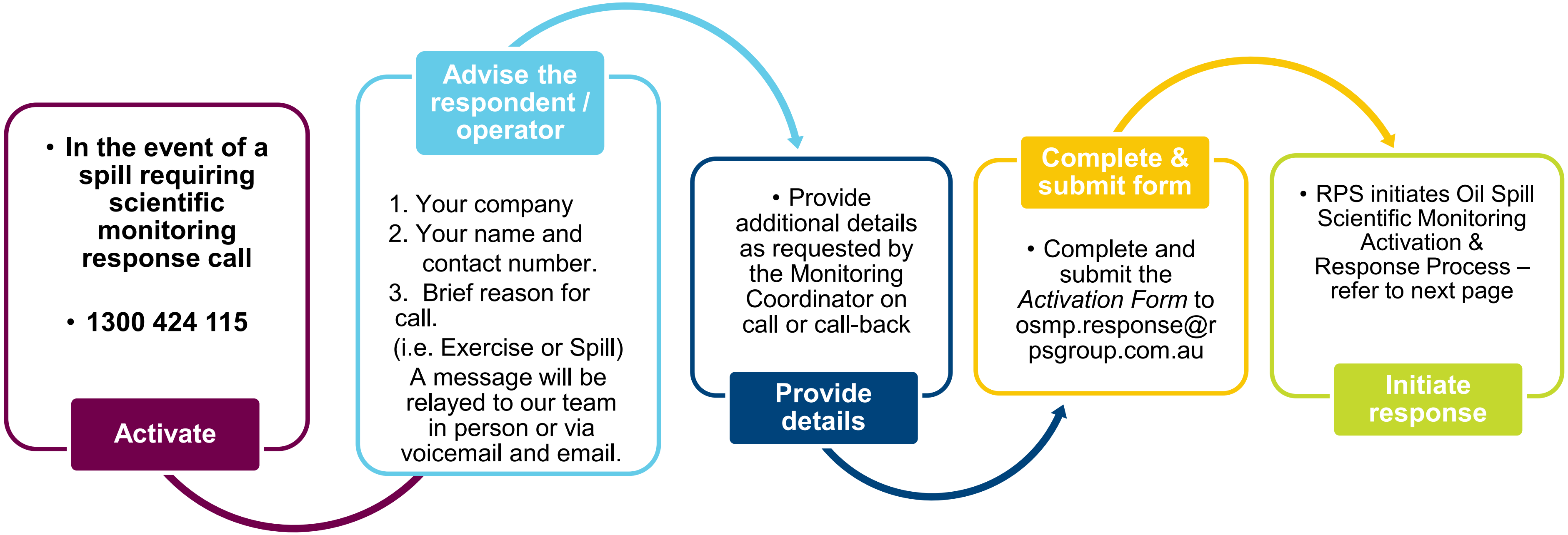
Section 5: Approval

I authorise the activation of a response by RPS Australia Group Pty Ltd in connection with the above incident under the terms of Contract #7686 and authorise expenditure against the pre-approved emergency mobilisation budget.

Signature:	
Position:	
Date and Time:	

P-2: SMP Activation Process

ACTIVATE OUR TEAM



OIL SPILL SCIENTIFIC MONITORING ACTIVATION AND RESPONSE PROCESS

Phase 1: Activation

- Monitoring provider activated

0-2 hours

Phase 2: Response Planning and Preparation

- Briefings
- Review of spill modelling and receptors
- Determine scale and objectives of response
- Determine personnel/equipment/ induction and medical requirements
- Monitoring Action Plan & logistics request
- License applications

2-53 hours

Phase 3: Mobilisation

- Inductions/medicals
- Review/update HSE documentation and risk assessment
- Equipment preparation and freighting
- Pre-mob briefings
- Mobilisation
- **Target 48 hrs in field for SMP1**

29 hours – 5 days

Phase 4: Response Operations

- Daily field monitoring activity reports to Santos
- Field debriefs and reporting

5 days +

Table i: Activation and response process and timeframes. Tasks for Santos are colour coded in grey, tasks for RPS are coloured in purple.

Phase 1 – Activation

Step	Responsibility	Action	Timeframe	Resources	Date/Time complete
1	Santos IMT (Environmental Unit Leader (EUL))	RPS Monitoring Coordinator notified of incident.	On approval from Santos Incident Commander	RPS oil spill response phone number and answering service (1300 424 115)	
2	Santos IMT (EUL)	Complete *Activation Form* and submit to RPS via email to osmp.response@rpsgroup.com.au	Within one hour following initial notification (Step 2)	Activation Form	
2	RPS Monitoring Coordinator (MC)	Call back client for further details, and request *Activation Form* if not received.	Within 30 minutes of receiving initial notification	Activation Form	
3	RPS MC	Call Planning & Logistics Officer to advise of incident.	Immediately following Step 2	Mobile phone	
5	RPS Planning & Logistics Officer (PLO)	Notify MCT, Technical Advisors and key subcontractors via SMS, email or phone.	Within 30 minutes of Step 3	RPS OSM Resource Register	
6	RPS PLO	Notify relevant staff of incident via email or phone.	Within one hour of receiving Activation Form	RPS OSM Resource Register	
7	RPS MC	Provide twice daily email updates to Santos IMT including: • latest progress • plan for next 24-48 hours • key logistical requirements/constraints • info required from Santos • any other business.	(1200 and 1700) or as agreed with Santos IMT	n/a	
8	RPS MC, Operations Officer and PLO	Maintain Incident Log throughout response.	Daily	Functional Log	

0-2 hours

Phase 2 – Response Planning

Step	Responsibility	Action	Timeframe	Resources	Date/Time complete	Timeline
9	RPS MC and RPS PLO	Determine location of monitoring coordination operations (in office or remote) and ensure team is equipped to operate remotely if necessary.	Within 2 hours of activation form (Step 4)			2-7 hours
10	Santos IMT (EUL)	Provide spill trajectory modelling (access link to portal) and sensitive receptor information to RPS.	Within 4 hours of activation form (Step 4)	RPS OST modelling Department of Transport database: WAMOPRA (navigatusconsulting.com) Santos GIS Mapping		
11	RPS MC, PLO and Operations Officer	Attend Santos incident briefing if required and relay information to MCT.	As advised by the Santos IMT (EUL)	n/a		
12	MCT and Technical advisors	MCT and Technical Advisors to convene to review personnel and equipment resource status.	Within 6 hours of activation form (Step 4)	Capability report Training matrix Resource chart		
13	RPS PLO RPS Operations officer	Confirm availability of additional personnel and equipment resources.	Within 8 hours of activation form (Step 4)	External Supplier Details RPS OSM Resource Register		
14	RPS MC in consultation with Santos EUL	Define the scale of response - identify which SMPs are activated and if a First Strike Response[2] approach is necessary. Identify if operational water quality monitoring is required.	Within 2 hours of receiving spill and receptor information (Step 10).	Scientific Monitoring Plan[4] Relevant OPEP Spill trajectory modelling Operational monitoring results.		

15	RPS Technical Advisors in consultation with Santos EUL	**Determine monitoring locations for activated SMPs:** Identify monitoring locations in order of priority for activated SMPs based on: • nature of hydrocarbon spill • spill trajectory modelling and time to shoreline impacts • sensitive receptors impacted or potentially at risk of being impacted • state of current baseline data • current environmental conditions • current results of operational monitoring. Determine if post-spill pre-impact data is required to be collected from any locations. Refer to SMP Work Method Statements for decision making process when considering availability of baseline data.	Within 12 hours of receiving spill modelling (Step 10).	Relevant SMPs Information from RPS: • baseline information for relevant receptors. Information from Santos IMT: • sensitive receptor information (including relevant conservation/ management plans) from relevant EP, Santos GIS mapping and online resources (DoT oil spill response atlas, DoE conservation values atlas, DoE species profile and threats database) • oil spill trajectory modelling • response strategies and priority protection areas • results from OMPs currently activated baseline information for relevant receptors as referenced in the relevant SMP.	**17 hours**
16	RPS Operations Officer, PLO & Technical Advisors in consultation with Santos EUL	**Determine personnel requirements:** • Identify number and competencies of personnel required for monitoring teams for each SMP based on: – activated SMPs – number of locations to be monitored – number of locations where pre-spill baseline data needs to be collected – timing of hydrocarbon spill and overlap with sensitive receptors in activated SMPs – logistical and equipment resource constraints.	Within 12 hours of receiving spill modelling (Step 10).	Information from RPS: • Capability report • Training matrix • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • sensitive receptor information • oil spill trajectory modelling	

		Arrange additional personnel if required. Determine status of required Santos induction/medicals for personnel and request online training profiles and medical bookings if required.		• response strategies and priority protection areas • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc).	17 hours
17	RPS Operations Officer, PLO & Technical Advisors in consultation with Santos EUL	**Determine equipment requirements:** • Identify number and competencies of equipment required for each SMP based on: – activated SMPs – number of locations to be monitored – number of field teams and timing of mobilisation to the field – logistical and equipment resource constraints. • Arrange additional equipment resources if required.	Within 12 hours of receiving spill modelling (Step 10).	Information from RPS: • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation etc).	
18	RPS MC, Operations Officer, PLO & Technical Advisors	**Submit Monitoring Action Plan (MAP)** (mission, objectives, strategies, tactics, tasks), including scope of works and spatial information for survey locations to inform Santos SIMOPS and other permission requirements. **Prepare and submit cost estimate.** **Prepare and submit logistics request:** • Allocate personnel and equipment resources to field teams for relevant SMPs. Submit scope of work (SoW) and logistics request for each activated SMP to Santos IMT for approval.	Within 24 hours of receiving spill modelling (Step 10) for relevant SMPs.	Information from RPS: • 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.	17 – 53 hours
19	RPS Technical Advisors in consultation with Santos EUL	Submit fauna licence applications	Within 24 hours of receiving spill modelling (Step 10).	• Proposed monitoring locations • SMP methods	

20	Santos IMT (EUL)	Santos to approve MAP, provide purchase order and initiate logistical arrangements.	Within 24 hours of MAP submission (Step 18) [5]	RPS Mobilisation and Logistics Request	**17 – 53 hours**
21	RPS MC	Advise field personnel by email meeting invite, or phone if not in office. Delegate and initiate tasks for field preparation.	Preliminary notification prior to submission of MAP, then confirm once approved by Santos	Field team allocation	

Step	Responsibility	Action	Timeframe	Resources	Date/Time complete	Timeline

Phase 3 - Mobilisation

Step	Responsibility	Action	Timeframe	Resources	Date/Time complete	Timeline
24	RPS PLO	GIS and device preparation requests (field maps, data capture) submitted, and discussed with Geospatial team.	To be initiated during MAP preparation	https://voyager/		29 -hours – 5 days
26	Field Team Leaders	Compile SMP field documentation, forms, GIS information, field equipment, and prepare and submit HSE documentation to Santos IMT.	Commence once MAP submitted (Step 18). Submit HSE documentation 24 hours prior to mobilisation.	Information from RPS: • SoW • Grab packs, SMP WMS and HSE documentation • GIS information/field maps • field equipment. Information from Santos IMT: • booking and logistics confirmations.		
27	RPS Technical Advisors	Conduct scope specific pre-mobilisation briefings.	24 hours prior to mobilisation.	Pre-mob Briefing Template		
28	Santos EUL	Santos to approve HSE plan.	8 hours prior to mobilisation.	• Mobilisation and Logistics Form • HSE plan		
29	RPS PLO	Personnel mobilised to site for First Strike Response.	Within 72 hrs of MAP approval (Step 20)	Approved SoW		

Step	Responsibility	Action	Timeframe	Resources	Date/Time complete	Timeline
Phase 4 – Response Operations						5 days +
30	RPS MC	Conduct Monitoring Action Plan review with MCT and Technical Advisors and communicate to Santos IMT (EUL).	Daily	Monitoring Action Plan template		
31	RPS PLO	Hold post-demobilisation debrief with field teams.	Within 3 days of demobilisation.	Demob. Meeting Template		
32	Santos EUL	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	RPS Field Team Leaders	Provide activity reports to Santos EUL.	Daily	Daily Activity Report Template		

[1] Timeframes are indicative and may be require adjustment where activities are dependent on information availability or affected by logistical constraints.

[2] First Strike Response is a rapid initial mobilisation of personnel and equipment following an oil spill incident to undertake priority scientific monitoring. Objectives of this first strike response may include:

- collection of pre-impact baseline data,
- collection of impact data for areas or receptors of high environmental significance,
- rapid assessment to determine impacts on receptors to inform operational monitoring or the future scientific monitoring requirements, if required.

The initial first strike response may not include monitoring of all activated SMPs and may include a smaller contingent of personnel and equipment, depending on the objective. The objectives and approach of the first strike response will be determined in consultation with Santos.

[3] 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.

[4] Approval of the MAP in a timeframe longer than 24 hours after submission may result in delays to mobilisation.

Santos

P-3: Dispersant Operational Monitoring Activation Form

Advisian
Worley Group

Operational Monitoring – Dispersants Activation Form

Activation Summary
In the event of a spill requiring a response from Advisian: 1. **Phone (03) 9389 3637 to alert the Advisian Operational Standby Response.** 2. **Complete the Activation Form below and email to spillresponse@advisian.com** **If you do not receive a response from the Advisian Operational Standby Response Team within 60 minutes, please call again.**

A. Activation Contact			
Date/Time of Activation (AWST)			
Notification Contact Name			
Position in ICT			
Phone		Mobile	
Email		ICT Link	
CC		ICT Phone	

B. Spill Details			
Date/Time of spill (AWST)			
Spill source location coordinates		Geographic Coordinate System	
Spill Status & Details if Known: • Quantity • Release rate • Source & cause • Trajectory • Controlled/uncontrolled			

<table>
<tr><th colspan="4">C. Activation Details</th></tr>
<tr><td>Operational Monitoring Scope</td><td colspan="3">Operational water quality monitoring – Dispersant monitoring</td></tr>
<tr><td>Dispersant Application (Surface/Subtidal)</td><td colspan="3"></td></tr>
<tr><td>Survey Vessel (if known)</td><td colspan="3"></td></tr>
<tr><td>Mobilisation Port (if known)/Via vessel/Helo</td><td></td><td>12/24 hour ops?</td><td></td></tr>
<tr><td>Other Notes on Mobilisation/Logistics:</td><td colspan="3"></td></tr>
</table>

Santos

P-4: Dispersant Operational Monitoring Activation Process

Advisian
Worley Group

Operational Monitoring – Dispersants Activation Summary

1.1 Introduction

The Santos operational and scientific monitoring plan (OSMP) would be activated after a level two or three unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. One of the response options available as part of a response is to apply chemical dispersants either surface or subsurface. Monitoring the effectiveness, distribution and fate of any application of chemical dispersants is essential to verify impact and contact predictions for response planning and other monitoring plans.

1.2 Scope

Advisian will provide a response that is scalable to the size, type and duration of the spill, and chosen dispersant application response. Advisian will mobilise resources and expertise to undertake the operational monitoring required to implement both the SMART protocol for surface-applied dispersants and (with minor modification) the subsea dispersant monitoring plan, as described in the API Technical Report 1152.

Advisian will:

- provide a 24/7 spill response standby service
- participate in an annual exercise as requested
- provide monthly resourcing and capability reports
- maintain pool of equipment dedicated to oil spill response and ready for rapid mobilisation
- mobilise resources in alignment with the implemented strategy (SMART or API 1152).

1.3 Activation

Advisian maintains a maintain a call service number and dedicated email address, twenty-four hours a day, seven days a week (24/7), to contact in the event that a spill has occurred, and the response option of dispersant application has been decided on. Advisian spill response resource activation is summarised below:

Activation Summary
In the event of a spill requiring a response from Advisian: 1. **Phone (03) 9389 3637 to alert the Advisian Operational Standby Response.** 2. **Complete the Activation Form (Attachment 1) and email to spillresponse@advisian.com** **If you do not receive a response from the Advisian Operational Standby Response Team within 60 minutes, please call again.**

1.4 Mobilisation

Mobilisation times will algin with existing monitoring plans. Advisian will make all reasonable endeavors to mobilise Personnel for at least 1 team will be ready to deploy (ex-Perth) within 72 hours of receipt of approved Monitoring Action Plan (MAP), subject to contractual agreements (PO), logistics (Non-Advisian equipment preparation, consumables and freight) and deployment documentation being in place (Field plans, HSE documentation and risk assessments).

1.5 Contractual Arrangements

Advisian has agreement with Santos for the provision of operational monitoring – dispersants (Purchase Order: 4800010987) and would deliver works under the existing Outline Agreement between Santos Ltd and Advisian Pty Ltd (Contract No.4821176).

Activation of monitoring services will be via verbal authorisation by the Santos IMT to the Advisian Operational Standby Response, submission of an Activation Form, and by a purchase order as soon as possible after activation.

1.6 Proposed approach to delivering the operational monitoring program – dispersants

Operational monitoring will be undertaken aligned with sampling strategies outlined in the SMART protocol for surface dispersant application or API for subsurface dispersant application, specifically:

- The Special Monitoring of Applied Response Technologies (SMART) program for monitoring of dispersant application
- The Industry Recommended Subsea Dispersant Monitoring Plan form the American Petroleum Institute (API 1152 2020),

Together these plans represent industry best-practice for monitoring dispersant application during a significant hydrocarbon spill response.

Where practicable, the standard operating procedures for monitoring activities will be aligned with existing standards and processes, including:

- CSIRO Oil Spill Monitoring Handbook
- Australian Marine Safety Authority (AMSA) sampling guides
- Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines
- revised ANZECC/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Sediment Quality Guidelines.

The main scope of operational and scientific spill response will be managed by a separate contractual arrangement (currently with Astron/BMT). The data obtained from these scopes may be used to inform this scope, potentially providing required baseline, reactive baseline, reference and additional operational data for the dispersant application monitoring.

Appendix Q: Scientific Monitoring Capability

Scientific Monitoring Assurance and Capability Assessment

Assurance arrangements

Santos has a primary Monitoring Service Provider (MSP) for the implementation of SMPs 1-12. A contractual arrangement exists between Santos and the MSP to maintain standby arrangements as per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162); The MSP has the resourcing capability to implement a first-strike response at all times. The MSP maintains a relationship with primary sub-contractors for the provision of scientific monitoring for those SMPs where the MSP does not have the required capability. Between the MSP and primary sub-contractors, capability exists to deliver first strike resourcing against SMPs 1-11 and SMP 12 will be conducted by capability obtained through the Australian Institute of Marine Science (AIMS).

Assurance on the continued maintenance of capability is provided through the delivery of monthly capability reports. These reports are generated by the MSP and sub-contractor 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 the MSP 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 MSP standby arrangements are adequate through its exercise and auditing program. Santos regularly conducts exercises and tests with the MSP and its sub-contractors to ensure that Santos IMT roles and MSP/sub-contractor monitoring roles are familiar with the SMP activation arrangements while providing spot checks on resource availability. Santos has previously also undertaken an audit of the MSP against its Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162). Assurance activities to date have demonstrated a high degree of compliance with standby service requirements.

Continuous improvement

Santos is committed to further improving its oil spill scientific monitoring capability. To that end, Santos is participating in a Joint Industry Operational and Scientific Monitoring Plans project, governed through an APPEA-Industry Steering Committee. This project, being progressed throughout 2023, is working towards a joint-industry capability for implementing a common suite of oil spill operational and scientific monitoring plans. The project aims to deliver efficiencies in implementing and testing oil spill scientific monitoring arrangements while increasing the level of resourcing and capability available to participating companies.

Baseline Data and Capability Assessment

Santos has identified suitable sources/ methods to obtain information through its baseline data review and in the development of Scientific Monitoring Plans (SMPs) for all environmental sensitivities. The SMPs outline the methods that would be used to collect information from key receptors that are potentially impacted by Santos activities (e.g. oil spill incidents).

Santos is committed to undertaking a review of the status, availability, currency and suitability of existing baseline data for oil spill scientific monitoring sources every 2 years. The latest review was undertaken in 2023 by the MSP (Baseline Data Review document SO-91-RF-20022) and looked at all high biodiversity value receptors in the Santos EMBA. An 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.

The assessment of baseline data included:

1: A review of the following parameters for each program identified:

- Integrated Marine and Coastal Regionalisation of Australia
- Custodian- contact point for data
- Spatial extent
- Variables available for monitoring
- Methods applied to monitoring
- Year of most recent data capture
- Total duration of monitoring program
- Data completeness (number of years monitored as proportion of program duration)
- How often data is captured
- Appropriateness of variables (Judgement as to whether variables are appropriate for future oil spill monitoring)
- Is there any clear indication that the monitoring will continue?

2: The quality of the following parameters was then ranked as high, medium, low or unknown:

I. Year of most recent capture:
   - 2015-2018 (if a single data capture has occurred in the last two years, then the overall program can be considered of high quality) = high
   - 2009-2014 = medium
   - <2009 = low

II. Duration:
   - >4 years = high
   - 2-4 years = medium
   - 1 year = low

III. Data completeness:
   - 100% = high
   - 75-99% = medium
   - <75% = low

IV. Frequency of capture
   - Annually = high
   - Bi-annually = medium
   - <Bi-annually = low

V. Appropriateness of parameters
   - High/medium/low

Appropriateness of parameters was based on reference to the Scientific Monitoring Plan's targeted states for each receptor and considering whether the monitoring parameters were sufficient to compare against these states. Parameters were considered highly appropriate if all targeted states for a receptor could be quantified, of medium appropriateness if only some states could be quantified and low if the monitored parameters had little relevance to the targeted states of an individual receptor.

3: An overall assessment of each study program was then made as follows:

- All parameters rated high = overall 'good'
- At least one parameter rated medium = overall 'fair'
- At least one parameter rated low = overall 'poor'
- Unknown = overall not enough data to rate

The above assessment process was also performed across monitoring programs which specified at least one of the priority protection areas within their monitoring sites. For Priority protection areas, the above assessment was then used to determine if 1) the baseline data available could be used to detect change in the state in the event of a significant impact - Classified as "good" in the above assessment (i.e. data was current, of reasonable duration and frequency, and employed appropriate methodologies) or 2) the existing baseline data is unlikely to be suitable to detect change in state – classified as "fair" or "poor" by the above assessment (i.e. the data was dated, infrequent, of limited duration and/or relied on inappropriate methodologies). Following this assessment a Protection Priority Area by SMP matrix summarising recommendations on baseline data status and recommendations for further action was developed (**Table Q-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.

A comprehensive review of the baseline data was completed in February 2023 and included all receptors within the overall Santos EMBA. The baseline data reviews are scheduled every two years.

The assessment determined for the majority of sensitive receptors within the priority protection areas (Montebello Islands, Barrow Island, Lowendal Islands, Ningaloo, Muiron Islands) 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 (**Table Q-1**). These experimental design approaches are described within the Oil Spill Scientific Monitoring Plan (EA-00-RI-10099).

Table Q-1: Summary of recommendations for further action based on review of available baseline data for priority protection areas.

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	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Seabirds/ shorebirds (SMP7)	Priority survey	Priority survey	Survey	Priority survey	Priority survey	Priority survey
Marine megafauna (SMP8)	Survey	Survey	Priority survey	Survey	Survey	Survey
Marine reptiles (SMP9)	Priority survey	Priority survey	Survey	Survey	Priority survey	Survey
Seafood Quality (SMP10)	Survey	Survey	Survey	Survey	Survey	Survey
Fish, Fisheries & Aquaculture (SMP11)	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey	Priority survey
Whale sharks(SMP12)	Not applicable	Not applicable	Not applicable	Survey	Not applicable	Not applicable

Based on the assessment of priority survey areas/receptors outlined in **Table Q-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 Q-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 Q-2 outlines the required scientific monitoring capability for rapid response in Scenario 1 (Barrow/ Montebello/ Lowendal Islands), and the MSP'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 (SO-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 Q-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 team of 2 personnel[1] + at least one member in each team tohave experience in water sampling + at least one member in each team to have experience in deep sea sedimentsampling	3 teams of 2 personnel[1]
Sediment Quality (SMP2)	Priority survey	Priority survey	Priority survey		
Sandy Beaches/Rocky Shorelines (SMP3)	Priority survey	Priority survey	Priority survey	1 team of 2 personnel[2] + at least one team member with experience in shoreline macrofauna/infauna assessment	3 teams of 2 personnel[2]
Intertidal Mudflats (SMP5)	Priority survey	Priority survey	Priority survey		
Mangroves (SMP4)	Survey	Survey	Survey	Not required[3]	Not required[3]
Benthic Habitats (SMP6)	Priority survey	Priority survey	Priority survey	1 team of 2 personnel + at least one team member withexperience in benthic habitat assessment + ROV operator or divers	2 teams of 2 personnel
Seabirds/ shorebirds (SMP7)	Priority survey	Priority survey	Survey	1 ground-based survey team of 2 personnel[4] + at least one member be experienced ornithologist	4 teams of 2 available[4]
Marine megafauna (SMP8)	Survey	Survey	Priority survey	1 aerial survey team of 2 personnel[5] + both to be experienced wildlife observers 1 vessel-based survey team of 2 personnel[5] + both to be experienced wildlife observers	2 teams of 2 available (aerial) [5] 2 teams of 2 available (vessel) [5]

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	Priority survey	Survey	1 aerial survey team of 2 personnel[5,6] + both to be experienced wildlife observers 1 vessel-based survey team of 2 personnel[5,7] + both to be experienced wildlife observers 1 ground-based survey team of 2 personnel[4] + At least one member with experience in turtle survey techniques	2 teams of 2 available (aerial) [5,6] 3 teams of 2 available (vessel) [5,7] 3 teams of 2 available (ground-based) [4]
Seafood quality (SMP10)	Survey	Survey	Survey	+ Not required[8]	Not required[8]
Fish, Fisheries & Aquaculture (SMP11)	Priority survey	Priority survey	Priority survey	1 team of 3 personnel[8] + at least one member to have experience in fish identification and necropsy + at least one member to have baited remote underwater video (BRUV) experience	3 teams of 3 personnel[8]
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: OMP1 Water Quality, SMP1 Water Quality and SMP2 Sediment Quality are conducted by the same team.
2: SMP3 Sandy Beaches/Rocky Shores and SMP5 Intertidal Mudflats are conducted by the same team.
3: Remote sensing data would be collected for SMP4 Mangroves, with no field team required to mobilise.
4: Ground-based surveys for SMP7 Seabirds and Shorebirds and SMP9 Marine Reptiles at Montebello Islands could be conducted by the same survey team.
5: Aerial and vessel surveys could be conducted by the same team. Aerial-based surveys would be conducted first, which would then inform target areas for vessel-based surveys.
6: Aerial surveys for SMP8 Marine Megafauna and SMP9 Marine Reptiles could be conducted by the same team across multiple priority survey areas to enable efficiency in resourcing.
7: Vessel-based surveys for SMP8 Marine Megafauna and SMP9 Marine Reptiles could be conducted by the same team across multiple priority survey areas to enable efficiency in resourcing.
8: SMP11 Fish, Fisheries and Aquaculture surveys could be conducted by the same team across multiple priority survey areas to enable efficiency in resourcing

Appendix R: Forward Operations Guidance

Forward Operating Base (FOB)

The IMT operate from Perth within the Santos IMT room. These rooms are equipped and subject to reviews and updates as detailed in the Santos Incident Management Plan – Upstream Offshore (SO-00-ZF-00025) and the Santos Incident Management Handbook.

To facilitate a streamlined response, forward operational bases are required close to the response operational areas equipped with near duplicated IMT equipment and personnel. Further information on FOBs is provided in the Santos Oil Spill Response – Forward Operating Base Guideline (SO-91-IF-20017).

For a significant Level 2/3 response requiring coordination of resources to be deployed to the field, Santos will establish an FOB. For a level 2/3 spill crossing from Commonwealth to State waters (cross-jurisdictional spills) DoT will establish an FOB.

For 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, Santos will establish an FOB at the Santos Dampier facilities leased from Toll Energy. These facilities are located in Toll Energy's Yard 1 and Yard 2 on Streckfuus Road Dampier; the facilities consist of a conference room and multiple offices that could be used as break-out rooms. The Toll Energy Dampier facilities are connected to the Santos internet and telephone system. These facilities are also available to the DoT to establish an FOB for State based response.

Additional FOBs may be set up as operational requirements dictate. Based on shoreline areas that might be impacted, potential additional FOB locations include Port Hedland, and Exmouth. **Table R-1** to **Table R-3** list local facilities with operational value for response in Dampier, Exmouth and Port Hedland, respectively.

The IMT will develop a communication strategy to support the FOB/s and forward staging areas.

Table R-1: Dampier facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Dampier Cargo Wharf	Pilbara Ports Authority	+ Staging area for vessel loading for spill response equipment and waste management + Storage of oil spill response equipment + Vessel loading for spill response equipment and waste management + Office facilities for Marine-based Command Centre
Toll Dampier Supply Base	Toll Energy Logistics Pty Ltd	Staging area for vessel loading for spill response equipment and waste management
Karratha Airport	Australian Government Department of Defence	Air freight spill response equipment
Devil Creek accommodation Searipple Village	Santos /ESS 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

Facility	Owner/Operator	Potential Uses
		+ Marine equipment storage, staging & repairs + Oiled wildlife response centre + Laydown / storage area + Bunded washing facility for oil booms
Local boat ramp at Dampier Yacht Club	Leased to Dampier Yacht Club	+ Load out for near-shore marine-based operations + Boat launching

Table R-2: Exmouth facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Harold E. Holt Naval Base	Australian Government Department of Defence	+ Forward Operations Base + Storage of oil spill response equipment + Vessel loading for spill response equipment and waste management
Exmouth Marina	Shire of Exmouth	Staging area for vessel loading for spill response equipment and waste management
Learmonth Airport	Australian Government Department of Defence	Air freight spill response equipment.
Exmouth light airstrip	Exmouth council	Air freight spill response equipment.
Logistic Services Yard	Exmouth Freight Services	+ Transfer yard for truck-based equipment deliveries and waste management, + Boom Maintenance and Cleaning Facility + Response equipment storage
Tantabiddi/Bundegi Boat Ramp areas	Shire of Exmouth	+ Staging/storage area + Load out for near-shore marine-based operations + Boat launching
Bhagwan/Jetwave/Base Marine Yards Exmouth	Exmouth	+ Storage/Laydown and Staging Area + Materials consolidation + Marine equipment storage, staging & repairs

Table R-3: Port Hedland facilities with operational values for response

Facility	Owner/Operator	Potential Uses
Port of Port Hedland	Pilbara Ports Authority	Staging area for vessel loading for spill response and equipment and waste management

Facility	Owner/Operator	Potential Uses
		Storage of oil spill response equipment + Vessel loading for spill response equipment and waste management + Office facilities for Marine-based Command Centre
Port Hedland International Airport	Australian Government	+ Air freight spill response equipment. + Storage sheds for oil spill response equipment + Office facilities for Aviation-based Command Centre
The Esplanade Hospitality Inn Ibis Styles Cooke Point Holiday Park Kings at the Landing The Lodge Motel South Hedland Motel Others	Various (independent)	+ Spill responders and IMT accommodation + Accommodation and messing for clean-up crew
Toll Ipec Freight Transport	Toll	+ Transfer yard for truck-based equipment deliveries and waste management, Boom Maintenance and Cleaning Facility + Materials consolidation + Marine equipment storage, staging and repairs + Oiled wildlife response centre + Laydown/storage area + Bunded washing facility
Go Marine Group Offices	Go Marine	FOB OCC Offices

Forward Staging Areas

Staging areas for shoreline operations will be set up at shoreline response locations under the direction of the DoT as the Control Agency for shoreline response activities. Wildlife treatment facilities may also be set-up under the direction of DoT and DBCA to clean and rehabilitate oiled wildlife.

Transport

Transportation on shoreline locations will be supported by 4x4 vehicles and all-terrain vehicles. These can be supplied by locally and nationally through hire/purchase 3rd parties.

Mobile plant

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

Decontamination

Decontamination areas (HDPE lining provided through the provider of PPE) will be constructed for maintaining the integrity of the 'Zones' at shoreline Staging Areas, location and terrain permitting and as directed by the DoT as Control Agency for the shoreline response. Contaminated water from the decontamination areas will be regularly pumped out. All contaminated wastewater will be decanted into suitable transportable medium provided by Santos' WSP for removal.

Ablutions

Staging Areas may be supported by toilet / ablution solutions; these solutions will be dictated by the location and terrain of the clean-up operations. Available facilities include:

+ Portable Toilets;
+ Trailer Mounted Toilets; and
+ Transportable Toilets.

These solutions are chemical and fresh water based and supported by weekly / fortnightly flushing servicing. The requirement of the situation will dictate if this service is supplied out of Karratha or Perth. Santos' WSP can provide disposal as required of wastewater from ablutions.

Security

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

Messing

Messing and catering facilities can be provided through one of Santos' current service providers, under local arrangements as determined by capacity and facilities geographically available.

Freight movement

The transportation of all equipment and service from all stockpiles and centres can be facilitated through Santos' third-party logistics providers.

Cleaning and repair

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

Suppliers

All material, associated equipment and services will be sourced, where possible, through existing Santos suppliers. Service Orders will be raised if other/new suppliers are to be engaged to provide services etc. in the event of an oil spill.

Accommodation

There are four key components to the clean-up operations: marine, aviation, land and emergency response team. Accommodation options for field responders and FOB personnel will be dictated by proximity to their respective activity areas, to ensure maximum utilisation of the shift time available.

Mainland accommodation is available at Dampier/ Karratha, Onslow and Exmouth. Santos' Devil Creek accommodation close to Karratha may also be used.

Where possible local facilities will be utilised to accommodate response personnel, however transportable accommodation and messing facilities can be supplied through contract suppliers if required.

Transportation to respective work sites would be facilitated via modal and multimodal transport solutions, dictated by the geographical constraints of each site. Under current contractual arrangements, Santos has access to transportation providers for Land, Air and Marine operations. In general, from accommodation locations to operational areas transport would be via road using the services of our third-party supplier. Should additional services be required to meet the demand, this would be engaged under a Service Agreement as determined and authorised by the IMT.

Providoring

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

The providoring requirements for transportable and remote messing would be provided directly through ESS and BRT respectively, including the transportation thereof.

Personal protective equipment (PPE)

Santos would utilise the services of specialist providers of PPE for clean-up operations. All PPE would be sourced in Perth and transported by one of Santos' third-party logistics providers to the forward operating centres.

In the event of a spill incident Santos would engage the services of a third party to provide and maintain inventory for the duration of oil spill operations.

The disposal of contaminated PPE is provided by Santos' WSP.

PPE requirements for spill responders is detailed in the Santos Oil Spill Response HSE Management Manual (SO-91-RF-10016).

Radio communications

Santos would utilise the services of a specialist communication provider to hire hand-held and vehicle mounted UHF radios to support response and clean-up personnel. Portable deployed repeater stations (battery or mains powered) can be positioned along the shoreline to provide a 'voting' system for transmitting and receiving during the clean-up operation. Communication equipment will be supplied through local, national, and international suppliers as the operational situation dictates.

For Exmouth region response operations Santos would request the use of Woodsides radio communication trailers based in Perth. These trailers are licenced for locations in Exmouth and along the Ningaloo coast and permit land, sea and air radio communications.

Appendix S: Response Capability Assessment

Table S-1 below shows the total cumulative worst-case response needs for the VI Hub Operations. The table assesses the accumulative requirement for personnel based on a spill of HFO or VI crude blend against the Santos resource capability. It must be noted, that during a real event, the resourcing may be different to below based on operational NEBA. This is for assessment purposes only, to ensure adequate resources are available for response strategy implementation.

It will be evaluated during the response whether Just-In-Time training programs will also be implemented for protection and deflection team leader roles. This will depend on whether trainees with the required prior skill sets, such as maritime experience, are accessible. Trainees will be primarily sourced from Australian maritime industry personnel. Just-In-Time training for containment and recovery team leaders is not advisable, due to the potential complexity of containment and recovery operations, including multiple vessels in close proximity, towing equipment under tension and variable weather conditions in the open ocean.

Training will be provided using a combination of online and practical training by training providers including OSRL and Response Resource Management (RRM). Training is likely to be an ongoing feature of the response, depending on the skill requirements of the most effective response techniques.

The personnel numbers in **Table S-1** represent the operational requirements. Additionally, to cover shift arrangements to manage responder fatigue, it is assumed the number of personnel required would be approximately 50% greater. It is estimated that an additional 24 skilled field response personnel will be required to allow for shift changes across the response. Additional personnel requirements will be met through existing arrangements, including case-by-case approvals with OSROs.

Table S-1: Response Capability Assessment

Function	Response Strategy	VI Hub Operations Peak Response Need Requirement	Providers					
			Santos	AMOSC staff	Industry Core Group	OSRL	The Response Group	Mutual Aid, Contractors and Service Providers
Source control [30]		**39**[31]	**39**	**-**	**-**	**-**	**-**	**Additional personnel available from WWC and Oceaneering** [32]
Monitor and Evaluate	Vessel surveillance	2 vessel crew	-	-	-	-	-	2 vessel crew
	Aerial surveillance[33]	2 aerial observers 1 flight crew	-	1	1	-	-	1 flight crew
	Tracking buoys	1 vessel crew	-	-	-	-	-	1 vessel crew
	Oil spill trajectory modelling	Services provided with no specific personnel numbers required.						
	Satellite imagery	Services provided with no specific personnel numbers required.						
	Initial oil characterisation	1 vessel crew	-	-	-		-	1 vessel crew (Santos contracted vessel provider)
	Operational water quality monitoring	1 field team 1 vessel crew	-	-	-	-	-	1 field team of 2 personnel (1 Team Leader/ 1 Team Member) 1 vessel crew

[30] The Cumulative capability for Source Control is assessed on its own, as the resources do not impact other strategy implementation. 60 Santos source control personnel available.

[31] Inclusive of Source Control IMT personnel counted in Appendix J.

[32] WWC has confirmed availability of 34 source control personnel

[33] Based on 1 aircraft conducting 2 sorties per day.

Function	Response Strategy	VI Hub Operations Peak Response Need Requirement	Providers					
			Santos	AMOSC staff	Industry Core Group	OSRL	The Response Group	Mutual Aid, Contractors and Service Providers
	Shoreline clean-up assessment technique (SCAT)	9 Teams (1 Team Leader/ 1-2 Team Members)	4 Team Leaders	4 Team Leaders	-	1 Team Leader	-	Labour hire: 18 Up to 2,000 Team Members who can complete shoreline assessment training, working under direction of Team Leader (contracted work force hire company)
Containment and recovery		2 C&R units, each with 1 x vessel master, 1 x Supervisor, 4 x deployment crew	-	-	2	-	-	Vessel contracted: Vessel masters and deployment crew (10)
Mechanical dispersion		n/a – personnel as per vessel availability	-	-	-	-	-	As per in-field vessel availability
Shoreline protection and deflection		6 team leaders 9 operatives per team (54 personnel) 12 shallow draft vessel masters and crew	-	-	3	3	-	Labour Hire: 54 Vessel personnel as per contract.
Shoreline clean-up		30 team leaders 150 team members (5 per team	-	-	20	10	-	Labour Hire: 150 team members, working under direction of team leader
Oiled wildlife response		93	Sourced as per the WAOWRP arrangements (High magnitude impact)					
Waste management		n/a – personnel as per shoreline clean-up resourcing	-	-	-	-	-	WSP to provide personnel under existing contract to collect and transport waste

Function	Response Strategy	VI Hub Operations Peak Response Need Requirement	Providers					
			Santos	AMOSC staff	Industry Core Group	OSRL	The Response Group	Mutual Aid, Contractors and Service Providers
Scientific monitoring		21[34]	-	-	-	-	-	21 from MSP
Response need (excluding Source Control)			4	5	26	14	-	Santos has either contracts in place, or can appoint ad-hoc contracts, to resource the above numbers required.
Response need including +50% for shift change.			6	8	39	21	-	
Total Available (excluding Source Control)			16[35]	16[36]	84[37]	80[38]	60[39]	
Total Required Source Control			39	-	-	-		Additional personnel available from WWC (34) and Oceaneering
Total Santos Source Control			60					

[34] As per the resourcing requirements in Appendix Q.

[35] Personnel trained in SCAT. This figure does not include Santos Core Group members.

[36] AMOSC has a permanent staff of sixteen available on a 24/7 basis (AMOSPlan, 2021), 12 of which are available for field response, and 4 for admin/management support roles.

[37] The target number of AMOSC Core Group members is 100 (minimum 84) (AMOSPlan 2021). This value includes the 12 Santos Core Group members.

[38] 18 trained oil spill responders guaranteed. A pool of 80 dedicated spill response specialists approved on a case-by-case basis (oilspillresponse.com, SLA).

[39] The response needs of this OPEP do not identify that personnel from TRG will be required. However, Santos has access to personnel through TRG in the event that additional trained personnel are needed.

Appendix T: Oiled wildlife response personnel and equipment

In the event of a spill impacting wildlife, Santos will commence arrangements to mobilise personnel and equipment to fill responder positions as identified in the Santos Oiled Wildlife Response Framework Plan (7700-650-PLA-0017) and WAOWRP.

This appendix outlines the current OWR equipment, personnel and services available to Santos through current arrangements.

Overall oiled wildlife response capability per OWR Strategy

The overall OWR capability of Santos is outlined in **Table T-1**. Santos has access to aircraft that could be used for wildlife reconnaissance within hours of a spill. This would be followed by further access to vessels and Santos personnel trained in OWR that could be mobilised within 24 hours for vessel and wildlife shoreline reconnaissance, demonstrating Santos' ability to mount a swift response that could also be sustained as long as required.

Santos has the capability to set up oiled wildlife field stations within 3-4 days of a spill through access to AMOSC equipment and equipment purchased at the time of a spill. Santos could also arrange the transport of wildlife from the field to a primary care facility.

The indicative personnel required for a high impact-rated response is 93 personnel (as per the WAOWRP) (DBCA, 2022a), however depending on the number and species impacted, may require many more. Santos' current arrangements could support a large scale OWR (requiring >93 personnel) mainly through support staff, such as, non-technical wildlife support roles (management, logistics, planning, human resourcing, transporter, cleaners, trades persons, security etc). These roles could be filled by Santos personnel and labour hire agencies that can provide workers that undergo an induction and basic training. In addition, many of the roles required for an OWR require technical expertise and Santos will need to activate OWR arrangements with AMOSC and OSRL to fulfil roles, as well as make contractor arrangements for accessing skilled wildlife personnel at the time of a spill.

Table T-1: Santos oiled wildlife response capability per OWR strategy

OWR Strategy	Considerations	Equipment/Personnel	Location	Mobilisation Timeframe
Reconnaissance	Identify opportunities to create synergies with surveys required for Monitor and Evaluate and Scientific Monitoring activities	Rotary Wing Aircraft & flight Crew	Karratha Learmonth Onslow	Wheels up within 1 hour for Emergency Response.
		Drones and pilots	Local WA hire companies	1-2 days
		Contracted vessels and vessels of opportunity Santos Contracted Vessel Providers Vessels of opportunity identified through AIS Vessel Tracking.	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS Vessel Tracking Software.	Pending availability and location. Expected within 12 hours.
		Aerial surveillance crew Santos staff AMOSC staff AMOSC Core Group personnel available Additional trained industry mutual aid personnel available	Perth and Varanus Island (VI) (Santos aerial observers) Australia wide	Santos trained personnel - next day mobilisation to airbase <24 hours
Preventative actions	Mainly effective for bird species Requires DBCA permit/licence approval	2 x AMOSC Wildlife fauna hazing and exclusion kits 3 x AMOSC Wildlife fauna hazing and capture kits 1x AMOSC Breco buoy	1 x Fremantle, 1 x Geelong Fremantle Fremantle	48 hours

OWR Strategy	Considerations	Equipment/Personnel	Location	Mobilisation Timeframe
Rescue and field processing	Wildlife handling and first aid should only be done by persons with appropriate skills and experience or under the direction of DBCA	4 x AMOSC Oiled Fauna Kits (basic medical supplies, cleaning/rehab, PPE)	1 x Fremantle, 1 x Exmouth, 1 x Broome, 1 x Geelong	48 hours
		50 % of OSRL OWR response packages (Wildlife Search and Rescue kits / Cleaning and Rehab. kits (including field first aid)	5 x Singapore, 3 x Bahrain, 5 x Fort Lauderdale, 7 x Southampton	Location dependent
Transport	Transport of oiled animals by aeroplane or helicopter may be restricted due to Civil Aviation Safety Authority (CASA) regulations; such transport will depend on the level of oiling remaining on animals. Therefore, consultation with the air transport provider must take place before transport to ensure the safest and most efficient means	Contracted vessels and vessels of opportunity Santos Contracted Vessel Providers Vessels of opportunity identified through AIS Vessel Tracking.	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. Locations verified through AIS Vessel Tracking Software.	Pending availability and location. Expected within 12 hours.
Primary care facility	OWR container could be placed on the deck of a suitably sized vessel for field processing in remote locations (benefits associated with temperature regulation and access to water and electricity) An OWR container on a vessel could also be used to aide transport form offshore islands	OWR container/mobile washing facility 2 x AMOSC 4 x AMSA	AMOSC – 1 x Fremantle, 1 x Geelong AMSA 1 x Dampier, 1 x Darwin, 1 x Devonport, 1 x Townsville	Location dependent
		AMOSC call off contract with DWYERTech NZ – a facilities management group	New Zealand	Availability within 24 hrs of call-off

OWR Strategy	Considerations	Equipment/Personnel	Location	Mobilisation Timeframe
Personnel				
As required	Untrained personnel would receive an induction, on-the-job training and work under the supervision of an experienced supervisor	Santos provides OWR training to staff, and to-date, approximately 20 personnel have received OWR training.	Perth and Varanus Island	< 24 hours
		Santos maintains labour hire arrangements for access to untrained personnel		
		1x AMOSC Oiled Wildlife Advisor	Victoria, Australia	<48 hours
		60 x AMOSC OWR Strike Team Members		<48 hours
		AMOSC MOU with Phillip Island National Park (PINP) (best-endeavours availability)	Victoria, Australia	Best-endeavour availability
As required	Sea Alarm staff act in a technical advisory role and do not engage in hands-on OWR activities but work impartially with all parties (titleholder, local authorities, mobilised experts and local experts, and response groups), aiming to maximise the effectiveness of the wildlife response.	Via OSRL Access to 24/7 technical advice (remote or on-site) from the Sea Alarm Foundation Access to OWR assessment service from the Global Oiled Wildlife Response Service (GOWRS) consisting of a ready-to-deploy team of 4 specialists in Operations/Planning, Field & Capture, Rehab & Facilities, Vet/Incident-specifics.	Belgium Various locations in northern and southern hemisphere	Sea Alarm: Upon notification able to provide remote advice and option to mobilise a Sea Alarm Technical Advisor on-site during an incident GOWRS: Mobilised on a best endeavours basis

Australian Maritime Safety Authority (AMSA)

AMSA maintains four oiled wildlife response containers/ mobile washing facilities in Dampier, Darwin, Devonport and Townsville. All resources under the National Plan (including the four OWR containers) are available to Santos through formal request to AMSA under the arrangements of the National Plan. The containers also include some limited PPE and fresh and wastewater pools.

Western Australia Department of Transport (DoT)

The WA DoT maintains one OWR container/ mobile washing facility which is available through the State Hazard Plan for Maritime Environmental Emergencies and the National Plan on request.

Australian Marine Oil Spill Centre (AMOSC)

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

Equipment

Table T-2 provides a summary of the oiled wildlife response equipment maintained by AMOSC.

Table T-2: AMOSC Wildlife Equipment

Location	Oiled fauna kits (basic medical supplies, cleaning/rehab, PPE)	Fauna hazing and exclusion equipment	Oiled wildlife washdown container (mobile washing facility)
Fremantle	-	1 x fauna hazing & exclusion kit 3 x fauna hazing & capture kit 1 x Breco bird hazing buoy	1 x Oiled Wildlife Response Container
Exmouth	1 x Oiled fauna kit	-	-
Broome	1 x Oiled fauna kit	-	-
Geelong	2 x Oiled fauna kit	1 x fauna hazing & exclusion kit	1 x Oiled Wildlife Response Container
Total	**4 x Oiled fauna kit**	**2 x fauna hazing & exclusion kits** **3 x fauna hazing & capture kits** **1 x Breco bird hazing buoy**	**2 x Oiled Wildlife response Containers**

Personnel

AMOSC currently has the following arrangements in place for OWR personnel:

+ 1 x AMOSC OWR Officer available to act as an Industry Oiled Wildlife Advisor (OWA)
+ AMOSC call off contract with DWYERtech Response NZ
  – A facilities management group with availability within 24 hours of call off
+ 60 x AMOSC OWR Strike Team members
  – Volunteer OWR trained industry personnel

- MOU with Phillip Island National Park (PINP), Victoria (best-endeavours availability)
- Approx. 39 PINP staff – collection/facility ops/rehabilitation
  - Approx. 45 volunteers – collection/facility ops/rehabilitation
  - Approx. 20 staff – animal feeding
  - 6 x PINP staff - wildlife emergency response including cetacean stranding/entanglement
  - 13 x PINP staff - wildlife team leaders

Oil Spill Response Limited (OSRL)

Through the associate membership, Santos has access to the following OWR equipment and personnel services from OSRL.

Equipment

OSRL maintains a Level 3 wildlife equipment stockpile. This equipment is stored across the OSRL base locations and is designed to support the first 48 hours of the response and to ensure availability of critical equipment items that may be difficult to source locally (Note: this equipment does not provide everything that will be required to successfully operate a primary care facility and is focussed primarily on bird casualties (n=100)). Equipment is sorted according to search and rescue (including field first aid), medical, and cleaning and rehabilitation (**Table T-3**).

Table T-3: OSRL Wildlife Equipment (as per OSRL Equipment Stockpile Status Report, September 2023)

OWR Response Package	UK	Singapore	Bahrain	Fort Lauderdale
Wildlife Search and Rescue	1	1	1	1
Wildlife Search and Rescue Medical	1	1	-	1
Cleaning and Rehabilitation	-	-	1	-
Wildlife Cleaning and Rehabilitation Part 1	2	1	-	-
Wildlife Cleaning and Rehabilitation Part 2	2	1	-	2
Wildlife Cleaning and Rehab. Medical	1	1	-	1

Personnel

Through the OSRL Oiled Wildlife SLA, Santos has access to 24/7 technical advice (remote or on-site) from the Sea Alarm Foundation, a small non-governmental organisation based in Brussels, Belgium that works to improve global preparedness and response for oiled wildlife incidents. Santos has the option to mobilise a Sea Alarm Technical Advisor during an incident. Sea Alarm staff will act in a technical advisory role at the incident management level and will work impartially with all parties (titleholder, local authorities, mobilised experts and local experts, and response groups), with the aim of maximising the effectiveness of the wildlife response.

In 2023, the Global Oiled Wildlife Response Service (GOWRS) will become part of OSRL's SLA. GOWRS is a ready-to-deploy Assessment Team of 4 x wildlife response experts, drawn from ten leading international wildlife response organisations. The Assessment Team will be available 24-7-365 to deploy for a four-day in-country incident assessment. Before formal integration into the SLA, this service is available from OSRL on a best endeavours basis.

In addition, through the SLA, Santos has the option to access OSRL's internal staff with OWR expertise (1 x UK) as part of the 18 personnel commitment for any single incident.