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WANDOO FIELD OIL SPILL CONTINGENCY PLAN

DOCUMENT 2: OIL POLLUTION EMERGENCY PLAN

WAN-2000-RD-0001.02

Revision	Date	Originator	Checker	Approver
14	03/01/2020	Environmental Advisor	HSE Manager	Operations Manager

Revision history

Revision	Date	Description
0	03.08.05	Issued for use
1	10.03.09	Routine review
2	23.06.10	Routine review
3	15.03.11	Includes DMP comments
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13	16.11.18	Routine review
14	03.01.20	Issued for NOPSEMA Acceptance

In the event of a spill go to DOCUMENT TWO: OPEP

The Wandoo Field Oil Spill Contingency Plan (OSCP) is divided into two documents, including the following parts and associated appendices:

OIL SPILL CONTINGENCY PLAN

Document One: PLANNING AND PREPAREDNESS

PART 1 OSCP OVERVIEW
- Statutory requirements
- Approach to response planning
- Establishing the risk and context

PART 2 INCIDENT MANAGEMENT PROCESS
- Emergency and crisis management response
- Incident response cycle
- Response strategies

PART 3 PERFORMANCE MANAGEMENT
- Assurance and capability management
- Continuous improvement

Document Two: OIL POLLUTION EMERGENCY PLAN

PART 4 ACTIVATION OF OIL POLLUTION EMERGENCY PLAN
- Activation and notification flowcharts

PART 5 OIL POLLUTION PLANS
- OPP 1 - Category A, B and C spills
- OPP 2 - Category D, E and F spills
- Oiled Wildlife Response Plan
- Termination and recovery

PART 6 SUPPORT PLANS
- Waste management
- Stakeholder engagement
- Operational and scientific monitoring
- Health and safety
- Logistics management

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Abbreviations and acronyms

µg	micro-gram
µm	micro-metre
AAC	Aerial Attack Coordinator
ADIOS	Automated Data Inquiry for Oil Spills
AHTS	Anchor Handling Transport Supply
AIIMS	Australasian Inter-Service Incident Management System
ALARP	As Low As Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMOS Plan	Australian Marine Oil Spill Plan
AMSA	Australian Maritime Safety Authority
RPS	Asia Pacific Applied Science Associates Pty Ltd
APPEA	Australian Petroleum Production and Exploration Association
BAOAC	Bonn Agreement Oil Appearance Code
bbl	barrels
BER	Boom Encounter Rate
BoM	Bureau of Meteorology
BOP	Blowout Preventer
CALM Buoy	Catenary Anchor Leg Mooring Buoy
CAMBA	China-Australia Migratory Bird Agreement
CCT	Corporate Command Team
CGS	Concrete Gravity Substructure
DBCA	Department of Biodiversity, Conservation and Attractions (formerly DPaW)
DER	Department of Environmental Regulation
DFAT	Department of Foreign Affairs and Trade
DMP	Department of Mines and Petroleum
DoF	Department of Fisheries
DoT	Department of Transport
DPaW	Department of Parks and Wildlife
EP	Environment Plan
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
ERP	Emergency Response Plan
ESC	Environmental and Scientific Coordinator
FWADC	Fixed Wing Aerial Dispersant Capability
GIS	Geographic Information System
GSI	Great Sandy Island
HFO	Heavy Fuel Oil
HMA	Hazard Management Agency
hr	hour

HSES	Health, Safety, Environment and Security
HSE MS	Health, Safety and Environment Management System
Hydrocarbon Area	The worst-case extent of predicted hydrocarbon exposure from planned and unplanned activities at exposure values that may have ecological or social impacts
IAP	Incident Action Plan
IBC	Intermediate Bulk Container
IC	Incident Commander
ICC	Incident Command Centre
ICT	Incident Command Team
IMO	International Maritime Organisation
JAMBA	Japan-Australia Migratory Bird Agreement
JHA	Job Hazard Analysis
JIP	Joint Industry Practice
kg	kilograms
km	kilometres
kPa	kilopascals
KPI	Key Performance Indicator
L	litres
m	metre
MBI	Montebello Islands
MEER Unit	Maritime Environmental Emergency Response Unit (within WA Department of Transport)
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
National Plan	National Plan for Maritime Environmental Emergencies
NDVI	Normalised Difference Vegetation Index
NES	National Environmental Significance
nm	nautical mile
NOPSEMA	National Offshore Petroleum, Safety & Environmental Management Authority
NRT	National Response Team
NWS	North-West Shelf
OH&S	Occupational Health and Safety
OMP	Operational Monitoring Plan
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPP	Oil Pollution Plan
OPRC	Oil Pollution Preparedness, Response and Cooperation
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation 1990
OSCA	Oil Spill Control Agents (Register)
OSCP	Oil Spill Contingency Plan
OSMP	Operational and Scientific Monitoring Plan

OSR	Oil Spill Response
OSRA	Oil Spill Response Atlas or Agency
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organisation
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
OWRP	Oiled Wildlife Response Plan
PEAR	People, Environment, Assets and Reputation
PIC	Person in Charge
POB	Persons on-board
POLREP	Pollution Report (Form)
PPE	Personal Protective Equipment
ppm	parts per million
psi	Pounds Per Square Inch = 0.068 atmospheres
P(SL)A	*Petroleum (Submerged Lands) Act 1982*
Ref	Reference
ROV	Remotely Operated Vehicle
SCAT	Shoreline Clean-up Assessment Technique
SDS	Safety Data Sheet
SIMA	Spill Impact Mitigation Assessment
SIMOPS	Simultaneous Operations
SITREP	Situation Report (Form)
SMEACS	Situation, Mission, Execution, Administration and Logistics, Command, Control and Communication, Safety
SMEERC	State Maritime Environmental Emergency Response Committee
SMP	Scientific Monitoring Plan
SOPEP	Shipboard Oil Pollution Emergency Plan
T	tonnes
US	United States
VFR	Visual Flight Rules
VOGA	Vermillion Oil & Gas Australia Pty Ltd
WA	Western Australia
WAOWRP	Western Australia Oiled Wildlife Response Plan
WestPlan	Western Australian Offshore Petroleum Operations (Exploration and Production) Emergency Management Plan
WestPlan-HAZMAT	Western Australian Hazardous Materials Emergency Management Plan
WestPlan-MOP	Western Australian Marine Oil Pollution Emergency Management Plan

PART 4: Activation of Oil Pollution Emergency Plan

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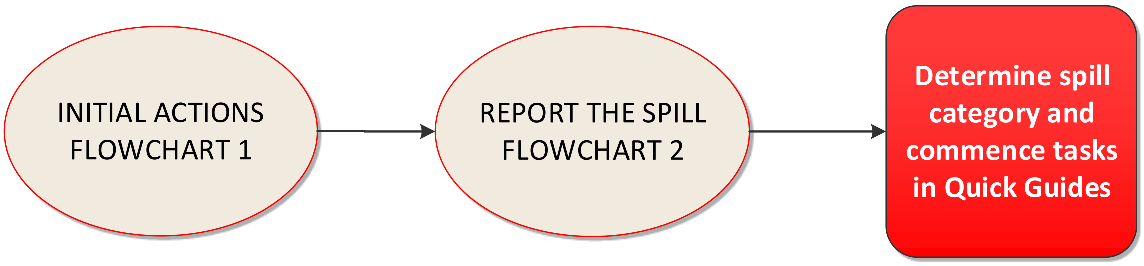
WHAT TO DO IF AN OIL SPILL OCCURS

OIL SPILL RESPONSE ACTIONS



OIL SPILL RESPONSE PRIORITIES -

Consistent with the NatPlan, the priorities for VOGA in responding to an oil spill will be:

1. Human health and safety
2. Habitat and cultural resources
3. Rare and/or endangered flora and fauna
4. Commercial resources
5. Amenities

SPILL CATEGORIES AND CORRESPONDING QUICK GUIDE

Spill Category	WC EP Risk Element No.	Wandoo Field EP Risk Element No.	Possible Cause	Credible Upper Spill Volume	Product Type	VOGA ERP Incident Level	National Plan Incident Level
A	EP-WC-R02	EP-OP-R02; EP-OP-R17 EP-OP-R22	Surface spill	$300m^3$	Wandoo Crude	Level 1/2/3	2
B	EP-WC-R03	EP-OP-R05	Bunkering or tank spill	$700m^3$	Diesel	Level 1/2/3	1
C		EP-OP-R02	Ship bunker tank spill	$1,300m^3$	Heavy Fuel Oil	Level 2/3	2
D		EP-OP-R02	Oil tanker cell spill	$10,000m^3$	Wandoo Crude	Level 3	3
E	EP-WC-R01		Well blowout continuous spill over 43 days	$594m^3$/day	Wandoo Crude	Level 3	3
E		EP-OP-R01	Well blowout continuous spill over 60 days	$595m^3$/day	Wandoo Crude	Level 3	3
F		EP-OP-R03	CGS spill	250,000bbl ($39,747m^3$)	Wandoo Crude	Level 3	3

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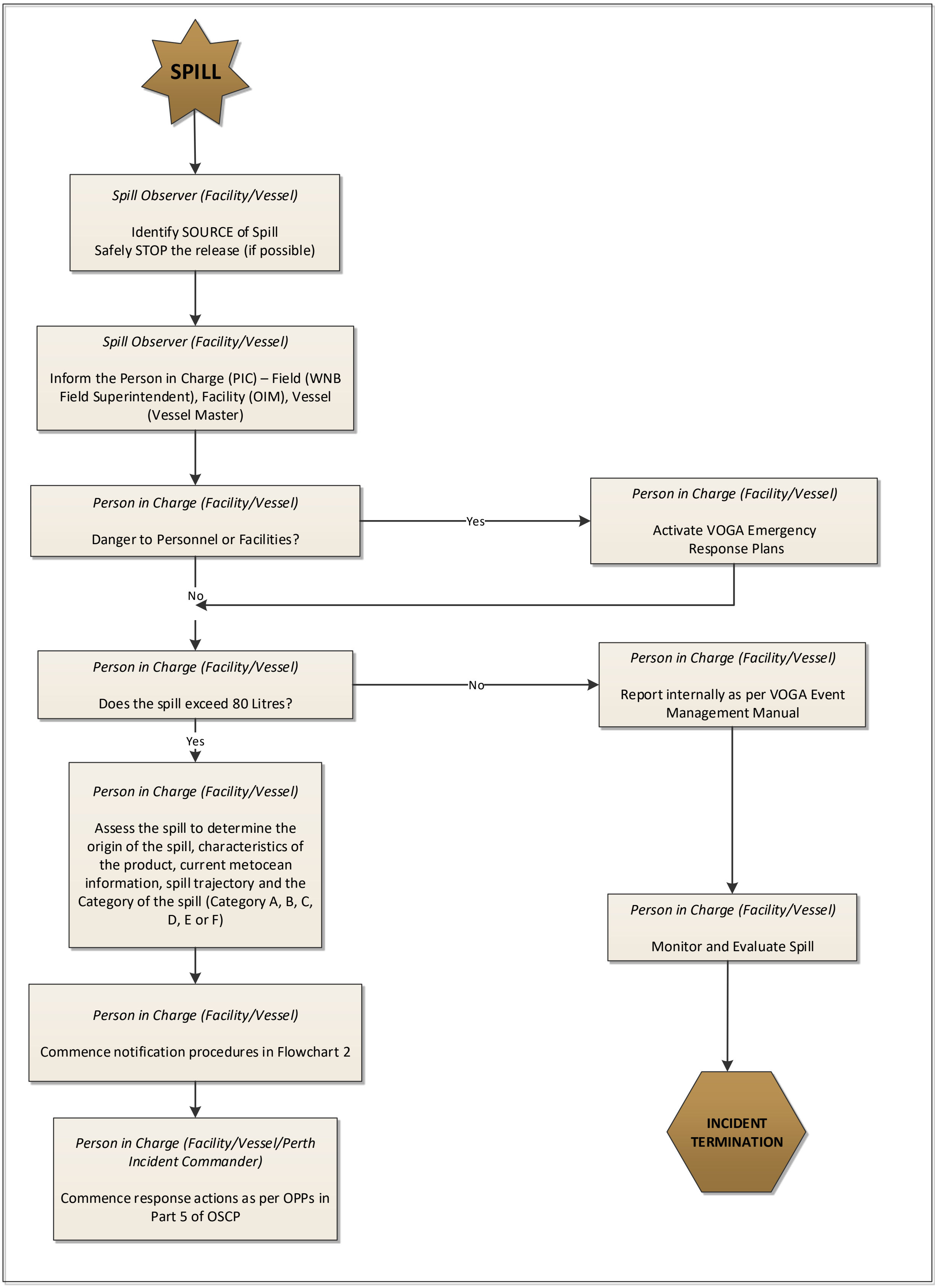
FLOWCHART 1: OIL SPILL RESPONSE INITIAL ACTIONS AND ASSESSMENT



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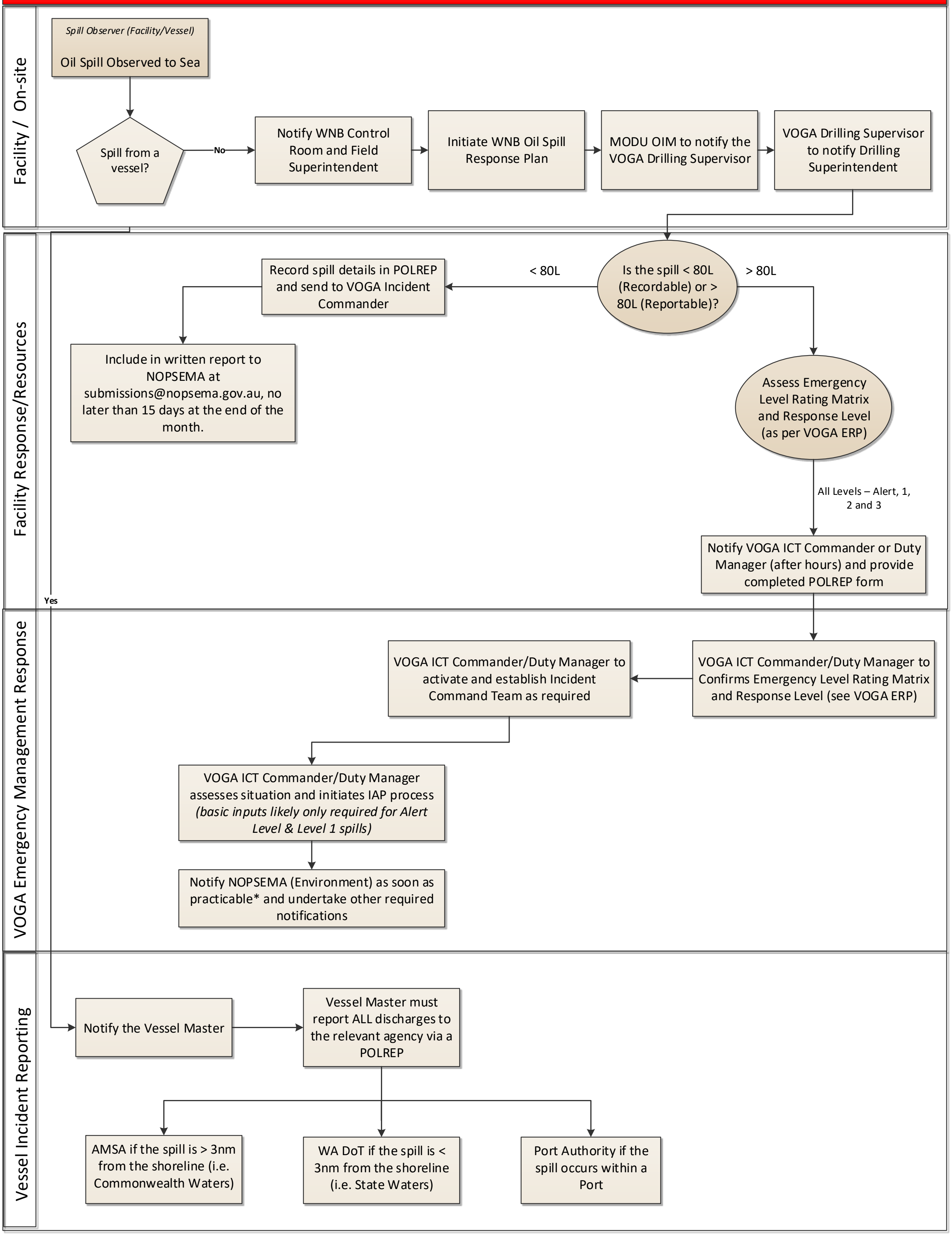
FLOWCHART 2: OIL SPILL RESPONSE REPORTING



* MODU Operator is responsible for all safety notifications to NOPSEMA for incidents resulting from activities under the control of the MODU operator.

PART 5: Oil Pollution Plans

1 Oil Pollution Plans

1.1 Purpose

Two Oil Pollution Plans (OPPs) have been prepared to assist VOGA to initiate an oil spill response through an initial IAP.

The OPPs provides support to enable first response actions to be undertaken and the resources for ongoing response to be initiated. Subsequent planning for extended response operations will need to be made as part of the continuous IAP process.

The intention is to support mobilisation of state, national and international resources required to implement response strategies in the initial phase of an event whilst the complexity and scale of the incident is determined. If the response has a surplus of resources for the required activities then the resources can be scaled back accordingly.

OPPs contain:

- objectives, strategies, tactics and tasks for first response activities;
- guidance material on how to complete the tasks; and
- resource list to allow a scaling up and down of response operations as an appreciation of the situation is gained.

The OPPs are supported by an environmental impact assessment of the spill and response, and a SIMA process. A Strategic SIMA has been generated utilising the impact assessment information within the EP (including OSTM data and identified environmental sensitivities) and provides recommendations on response strategies based on spill size, type and time of year (Appendix C).

Twenty days has been chosen as the operational period for the basis of the oil pollution plans because that is the extent to which modelling provides some certainty as to the likely fate of oil in the scenarios modelled, any further beyond this time is not useful because of the statistical uncertainty encountered. This is not to say that VOGA is only able respond to the first 20 days of a spill, we will prepare for the first 20 days as best as possible from the modelling outputs and then during an incident base resource requirements on real-time modelling and monitoring of the spill as per the IAP cycle.

1.2 Activation

The activation of the OPPs is outlined in Flowchart 1.

Specific response strategies will be activated through the OPPs and suitability confirmed by a SIMA spreadsheet tool that sits within the VOGA's oil spill response tools.

Activation of resources to support response activities is detailed in the VOGA Emergency Response Logistics Management Plan (VOG-7000-RH-0008) and is supported by a contracts database managed by the Logistics Chief which details suppliers, VOGA Agreement numbers, contact details and services provided.

1.3 OPP 1 – Category A, B and C spills

- **Category A** is described as an instantaneous spill of Wandoo Crude up to 300m^3. Response rationale: trajectory modelling for this scenario was not undertaken however from trajectory modelling undertaken for other scenarios the general movement of oil due to winds and currents is northwest for an oil spill occurring during summer and transitional conditions; and in winter is generally in a westerly direction. Category A spills are expected to remain offshore and not impact shorelines.
- **Category B** is described as small surface diesel spills, instantaneous in nature up to 700m^3. Response rational: diesel spills evaporate and spread rapidly meaning that response options are limited to monitor and evaluation.
- **Category C** is described as, an instantaneous spill of HFO from an off-take tanker up to 1,300m^3. Trajectory modelling for this scenario was not undertaken however from trajectory modelling undertaken for other scenarios the general movement of oil due to winds and currents is northwest for an oil spill occurring during summer and transitional conditions; and in winter is generally in a westerly direction. Category C spills are expected to remain offshore and not impact shorelines.

1.4 OPP 2 – Category D, E and F spills

- **Category D spills** are described as surface Wandoo Crude spills, instantaneous in nature up to 10,000m^3. Shoreline impact varies with season, modelling indicates a 49% probability of contact to any shoreline during summer within about three days.
- **Category E spills** are described as continuous Wandoo Crude spills, up to 595m^3 per day for up to 60 days. Modelling indicates a greater than 80% probability of contact to any shoreline throughout all seasons within about three to four days.
- **Category F spills** are described as an instantaneous spill of 250,000bbl (39,747m^3) of Wandoo Crude over 24 hours from the Wandoo Production Platform CGS. Modelling indicates a probability of 21% for shoreline impact during summer within about four days.

1.5 Oil pollution plan toolbox

A number of decision support tools, response tools and handbooks are available for the ICT members and responders in the field. The purpose of the toolbox is to provide a centralised location for the ICT and responders' resources that may assist them in undertaking their specific functions within the response.

Having resources prepared before a response, provides the opportunity for familiarisation during exercises, and assists members of the response when using the OPPs in a response.

Resources included in the toolbox include:

- OSR handbooks and technical guides;
- SIMA spreadsheet
- templates and forms;
- websites with links to OSR organisations, research bodies and government departments;

- standard operating procedures for equipment;
- contractor and service provider details; and
- training material.

2 OPP1 – Category A, B and C spills

2.1 Instructions

- Complete the initial actions and notifications in Part 4 for activating the OSCP;
- Work through the initial incident action plan Table 2-1 using the guidance and resources described in Table 2-3 to Table 2-12;
- Check off tasks that have been undertaken using Table 2-2;
- Generate a SIMA utilising the VOGA oil response tools;
- Check which OSMPs are required to be activated; and
- Transition into incident IAP process.

2.2 Initial incident action plan

Table 2-1: OPP1 initial incident action plan

INCIDENT OBJECTIVE/S:	Ascertain extent of spill
	Prevent impact to sensitive resources
PROTECTION PRIORITIES	**OIL SPILL RESPONSE STRATEGIES** (Means of accomplishing objectives)
Shoreline impact is not predicted for spill categories A, B and C, however trajectory modelling will be undertaken with real-time spill data to verify this assumption. If shoreline impact was predicted through real-time modelling, then protection priorities would be identified via the SIMA process to determine the most appropriate response strategies relating to shoreline protection and clean-up.	1. Monitor and evaluate (for all spill categories)
	2. Chemical dispersion (Category A and C only)
	3. Mechanical dispersion (Category A and C only)
	4. Containment and recovery (Category A and C only)

STRATEGIES	**TACTICS** (What is planned to be done)	**TASKS** (See Table 2-4 to Table 2-12 for guidance on how to complete tasks)
Monitor and evaluate (for all spill categories if applicable)	Visual observation from vessel or facility (OMP1 and OMP2)	Provide an initial situational awareness to the PIC
		Ongoing situational awareness
	Deploy satellite tracking buoy (OMP1 and OMP2)	Deploy unit – PIC
		Access real-time data
		Interpret data
	Oil spill trajectory modelling (OMP1 and OMP2)	Activate RPS contract
		Manual trajectory model

STRATEGIES	TACTICS (What is planned to be done)	TASKS (See Table 2-4 to Table 2-12 for guidance on how to complete tasks)
	Aerial observation (OMP1 and OMP2)	Activate assets to fly as soon as possible in daylight hours only
		Secure observers
		Data to be collected – conduct flight as soon as possible in daylight hours only
		Ongoing surveillance
	Situational awareness (OMP1 and OMP2)	Collect real-time and predicted data to enter on status boards in ICT
		Preliminary SIMA and incident action planning for indicative protection priorites and reponse options
		Effectiveness guidance for response strategy
Chemical dispersion (Category A and C only)	Aerial dispersant operations	Activate aircraft within six hours of the spill
		Mobilise dispersant to Karratha Airport within six hours of the spill
		Set up operating post at Karratha Airport
		Monitoring dispersant effectiveness of test spray runs using visual observation (refer to OMP4)
		Arrange for a spotter plane to accompany air tractor
		Arrange for trained Aerial Attack Coordinator (AAC) to be available for test spray run
		Pre-flight briefing
		Test spray run by air tractor
		Monitoring dispersant effectiveness of test spray runs using visual observation (refer to OMP4)
		Planning Chief to undertake a SIMA of chemical dispersion operations – operational activities
		Secure trained personnel to run dispersant operation
		Pre-flight briefing
		Ongoing dispersant operations
		Volume of dispersant and number of aircraft required
		Monitoring dispersant effectiveness – ongoing operations (refer to OMP4)
		Debriefing
		Stockpile management
		Incident action planning
		Effectiveness guidance for response strategy
	Marine dispersant operations	Identify marine operating base
		Source vessel
		Dispersant stocks
		Dispersant spray system

STRATEGIES	TACTICS (What is planned to be done)	TASKS (See Table 2-4 to Table 2-12 for guidance on how to complete tasks)
		Arrange for a spotter plane to accompany marine vessel
		Arrange for trained AAC to be available for test spray run
		Planning Chief to undertake a SIMA of chemical dispersion operations – test run activities
		Test run by marine vessel
		Monitoring dispersant effectiveness (refer to OMP4)
		Planning Chief to undertake a SIMA of chemical dispersion operations – operational activities
		Ongoing dispersant operations
		Debriefing
		Stockpile management
		Incident action planning
		Effectiveness guidance for response strategy
Mechanical dispersion (Category A and C only)	Marine based mechanical dispersion	Planning Chief to undertake a SIMA of mechanical dispersion operations
		Secure offshore work vessel
		Secure spotter aircraft
		Deploy vessels
		Incident action planning
		Effectiveness guidance for response strategy
Containment and recovery (Category A and C only)	Offshore and near shore containment and recovery	Planning Chief undertakes a SIMA of containment and recovery operations
		Do weather conditions and sea state permit safe and effective deployment of booms and skimmers?
		Does containment and recovery appear feasible?
		If the decision is made in the ICT to proceed with containment and recovery (based on Planning Chief's recommendation) the following tasks are to be completed.
		Mobilise vessels suitable for either offshore or near shore operations
		Mobilise booms and skimmers
		Mobilise trained equipment operators
		Spotter plane to direct operations
		Establish a forward operating base for temporary storage of equipment and waste
		Deploy booms, skimmers and temporary waste storage
		Develop waste storage and transport plan
		Incident action planning
		Effectiveness guidance for response strategy

Table 2-2: Task checklist Category A, B and C spills

Categories A, B and C – Task checklist initial incident action plan (First 24 Hours)			
	Timeframe	**Who**	**Completed**
Tasking checklist facility/on site			
Start and maintain personal log.	Immediately	PIC Wandoo B	
Undertake visual observation from off-take vessel, platform and/or vessels of opportunity immediately.	Immediately	Observer on site	
Activate and deploy satellite tracking buoy.	Within 30 minutes of spill	PIC Wandoo B	
Verify that relevant notifications have been made (i.e. NOPSEMA).	Within two hours of spill	PIC Wandoo B	
Tasking checklist VOGA Emergency Management Response – Perth ICT			
Visual observation from aircraft (in daylight hours only) has been arranged.	Within two hours of spill	Logistics Chief Perth ICT	
Convene planning meeting to confirm and document: • Incident response aim; • Priorities and objectives; and Strategies as per Section 7.	Within three hours of the spill	Planning Chief Perth ICT	
Commission RPS to undertake real-time modelling to determine trajectory and fate of oil.	Within three hours of spill	Planning Chief Perth ICT	
Obtain available data re: • Weather; • Tides/currents; • Topography and shoreline; • Environmental sensitivity data; • Spill trajectory (observed or by modelling); • Oil data (character and behaviour); • Community issues; and • Action taken to date.	Within three hours of spill	Planning Chief Perth ICT	
Complete Preliminary SIMA to identify indicative response options and protection priorities (based on Strategic SIMA).	Within six hours of spill	Planning Chief Perth ICT	
Activate FWADC via AMSA to conduct test spray run for Category A and C spills.	Within 24 hours of spill	Incident Commander in consultation with Planning Chief Perth ICT	
Mobilise dispersant.	1m^3 available within 24 hours of spill	Logistics Chief in consultation with Planning Officer Perth ICT	
Determine preliminary resources list (labour, equipment, transport and other support) based on outcomes of planning meeting and the agreed IAP.	Within six hours of spill	Planning Chief in consultation with Operations and Logistics Chiefs Perth ICT	

Categories A, B and C – Task checklist initial incident action plan (First 24 Hours)			
	Timeframe	**Who**	**Completed**
Monitor the response by scheduling and undertaking regular briefings/debriefings of ICT using SMEACS format.	Every six hours after spill or as necessary	Incident Commander in conjunction with Planning Chief ICT	
Issue regular Situation Reports (SITREPS).	Every six hours after spill or as necessary	Planning Chief Perth ICT	
Monitor OH&S performance through Section 8 within Part 6.	Ongoing	Safety Officer	
Monitor waste volumes and management as per Section 15. If necessary, arrange for the development of a Waste Management Plan.	Ongoing	Planning and Operations Chiefs Perth ICT	
Use information from monitoring and evaluation to transition to formal IAP cycle as per Section 6.	Within 24 hours of spill	Incident Commander Perth ICT	

2.2.1 Monitor and evaluate response plan strategy

Table 2-3: Monitor and evaluate

Task	Guidance
Visual observation from vessel or facility (OMP1 and OMP2)	
Provide an initial situational awareness to the PIC	To initiate this strategy, the PIC of a vessel or the Wandoo facility where the spill has occurred will (if safe to do so) organise for an observer to monitor the spill and communicate information regarding the appearance of the oil, area covered and if the spill has ceased. This process is depicted in Flowchart 1. Observer on scene to record and report to PIC on facility or vessel (who then provides information to Planning Chief) the following. Estimate the percentage cover by colour: • silver; rainbow; black/dark brown; or brown/orange. Is there wildlife in or near the spill? Are there other vessels or activities occurring within or near the spill? Is it possible to confirm if the spill is continuous?
Ongoing situational awareness	As directed by Planning Chief, provide updates on what the spill looks like, area covered, presence of wildlife or other activities.
Deploy satellite tracking buoy (OMP1 and OMP2)	
Deploy unit – PIC	It is important to deploy a satellite tracking buoy from the facility as soon as possible after the spill has occurred, so that real-time data can be collected to verify pre-spill trajectory modelling and also be inputted into real-time modelling. The PIC on Wandoo B (or delegate) deploys tracking buoy by removing from storage on Wandoo B, turning it on and releasing as close to the spill as possible. Planning Chief to check that this has been done. Additional units deployed every three days.
Access real-time data	Planning Chief accesses data from: [redacted] Access details available in ICT Toolbox
Interpret data	Planning Chief uses real-time data and knowledge of sensitivities to estimate spill trajectory and resources that could be impacted. Real-time data is also provided to RPS to validate OSTM data.

Task	Guidance
Oil spill trajectory modelling (OMP1 and OMP2)	
Activate RPS contract	OSTM is an essential tool used by the Environment Unit in the Planning Team to determine resources at risk and protection priorities. Planning Chief in liaison with Logistics Chief activates the RPS contract for real time trajectory modelling: (1) Complete the modelling request form (editable .pdf request form provided). Please complete as much detail as possible to allow for generation of modelling results and outputs. (2) Call the RPS Duty Officers on [redacted] to advise the RPS Duty Officers that they are now activated and a trajectory modelling request will be sent to them via email. Please note that the call to the RPS Duty Officers must be made as the email account is not monitored 24/7. (3) Send completed request form to RPS Duty Officers via email at [redacted] (4) Follow up the email with a phone call to the RPS Duty Officers to confirm email receipt and contents of the email (i.e. the modelling request form) are correct. In the event the email was not received a secondary/backup email address can be used ([redacted]). (5) The RPS Duty Officers will undertake the modelling as per the modelling request form provided. Should any of the incident details change, as further information becomes available, please call the RPS Duty Officers to inform them of the change. Follow this call up with an email confirming the change in details for the modelling. (6) Model outputs will be forwarded from the RPS Duty Officers to the requesting client officer as quickly as possible. The results will be transmitted by email to the requesting client officer and copied to the designated parties as identified by the client officer. The results may be passed on via a number of means including email attachment and/or FTP site. Access details to the FTP site is via the ICT Toolbox. (7) Once the modelling results have been received from RPS, call or email the RPS Duty Officer to inform them that the results have been received. (8) If extra advice is sought in regards to interpreting the trajectory modelling output, please follow up with a call to the RPS Duty Officers for further clarification. RPS will require details collected through the situational awareness task such as real time weather, sea state, and oil type spilled.
Manual trajectory model	While waiting for the RPS output, use a navigation chart to manually plot the anticipated trajectory of the spill. Trajectory = 3% of the wind vector plus the current vector. Procedure: for each hour add the current velocity vector (in m or km) to 3% of the wind vector.
Aerial observation (OMP1 and OMP2)	

Task	Guidance
Activate assets to fly as soon as possible in daylight hours only	Upon notification of a spill the Planning Chief requests the Logistics Chief to activate contracts with CHC and Karratha Flying Services. Fixed wing aircraft (preferably over wing configuration) or helicopters to provide personnel with the means to observe and record details of oil on water. Request flight as soon as possible. Pilots or observers be provided with information on the anticipated location of the slick (e.g. from OSTM output). If possible use aircraft already in the area to provide situational awareness. Flight time to the Wandoo B platform is 20 minutes (48nm) based on S76 helicopter (@140 knots).
Secure observers	If trained observers are not available within the timeframe for initial reconnaissance flight, use untrained aerial observers for initial situational awareness. Secure trained aerial observers to quantify amount of oil on water and geographical spread from the resource list in the VOGA Emergency Response Logistics Management Plan (VOG-7000-RH-0008).
Data to be collected – conduct flight as soon as possible in daylight hours only	Aerial observation template forms are to be provided to observers, along with a digital camera for video and photos. Observer is to obtain location details (coordinates) from pilot and note these for images and extent of slick. Information is to be provided back to the Planning Chief as soon as possible after the flight has landed. This could be done initially via verbal briefing from the observer and followed up by email or fax of completed observation template.
Ongoing surveillance	Logistics Chief secures appropriate aircraft to undertake aerial observation activities twice a day – morning and afternoon until advised otherwise by Planning Chief. The information collected during aerial observations must be relayed back to the ICT for analysis by the Situation and Environment Units.

Task	Guidance
Situational awareness (OMP1 and OMP2)	
Collect real-time and predicted data to enter on status boards in ICT. Ongoing update	Status boards in ICT require the following information (sourced and entered by situation unit leader): • Real-time and predicted weather and sea-state conditions – source from Bureau of Meteorology (BoM); • Real-time and predicted tidal and current movements – source from BoM, websites; • Oil characteristics – properties of the oil spilled and predicted behaviour after weathering; • Predicted trajectory of oil based on modelling conducted for planning and verified by real-time modelling; • Resources at risk of being oiled sourced from OSCP; and • Navigation charts to plot location of vessel/MODU/facility.
Incident action planning	At the completion of the monitoring and evaluation tasks, the Planning Chief will review information gathered provide a recommendation to the Incident Commander for future monitoring and evaluation tasks.
Effectiveness guidance for response strategy	Information available is: • of sufficient quality; • consistent in reporting; • regular; and • required to inform other response strategies.

Table 2-4: OPP 1 monitor and evaluate minimum resources required

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Visual observation – from platform	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Observer.	1 x Observer.	1 x Observer.	Immediate.			
Visual observation – from chartered vessels	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.	Mobilise immediately.	1 x Vessel. 2 x Observers.	1 x Vessel. 4 x Observers.	1 x Vessel. 8 x Observers.
Visual observation – from aircraft	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Observer. 1 x Aircraft.	1 x Observer. 1 x Aircraft.	1 x Observer. 1 x Aircraft.	Daylight only, two hours after	2 x Observers. 1 x Aircraft.	4 x Observers. 1 x Aircraft.	8 x Observers. 1 x Aircraft.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
		1 x Aerial support base.	1 x Aerial support base.	1 x Aerial support base.	notification of a spill.	2 x Aerial support bases.	4 x Aerial support bases.	4 x Aerial support bases.
Determination of surface and dispersed oil trajectory and fate	Identify the likely trajectory and fate of the spill and dispersed oil, timeframes for the oil (surface or dispersed) to interact with environmental sensitivities.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	Requested within three hours of notification a spill.	2 x On-site Incident Commanders with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	2 x On-site Incident Commanders with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	2 x On-site Incident Commanders with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.
Satellite tracking buoys	Identification of the leading edge/rear edge of the spill.	At least two operational on facility or vessels within the field. Data site 'back end' to Geographic Information System (GIS). Current contract with satellite provider.	At least two operational on facility or vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	At least two operational on facility or vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	Deployed within 30 minutes.	At least two operational on Vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	At least two operational on Vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	At least two operational on Vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.

LEGEND:	Resource required	Resource possibly required	Resource unlikely to be required

2.2.2 Chemical dispersant application

2.2.2.1 Aerial strategy

Table 2-5: Aerial dispersant

Task	Guidance
Activate aircraft within six hours of the spill	Planning Chief to advise Logistics Chief to activate Fixed Wing Aerial Dispersant Capability (FWADC) by advising AMOSC to call AMSA RCC on **1800 641 792**. Planning Chief to complete the AMSA/AMOSC JSOP for FWADC [see VOGA Emergency Response Logistics Management Plan -VOG-7000-RH-0008]. Request one air tractor for Category A spills. Request two air tractors for Category C spills. Mobilise to Karratha Airport.
Mobilise dispersant to Karratha Airport within six hours of the spill	Planning Chief to confirm with Logistics Chief the volume of dispersant to be mobilised to Karratha Airport. Only dispersant listed on the AMSA OSCA register and transitional register will be used until the efficacy and suitability of other dispersants is known. Mobilise at least 7.5m^3 of dispersant for Category A; or 37.5m^3 for Category C spills (Category C can be split into delivery over two days). Mobilise a dispersant transfer pump to be able to transfer dispersant from Intermediate Bulk Containers (IBCs) to aircraft. Consult the OSR Capability Review [VOG-7000-RH-0009] for additional dispersant calculation and stockpile information.
Set up operating post at Karratha Airport	Logistics Chief to liaise with Karratha Airport to set up a staging area for dispersant stockpile and transferring dispersant to aircraft. Managed by the Aerotech Liaison Officer (provided by the FWADC contractor).
Complete SIMA to justify test run	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for testing dispersant. SIMA template and process detailed in Appendix C. The VOGA Excel SIMA tool will also assist with this assessment.
Arrange for a spotter plane to accompany air tractor	Logistics Chief to secure a helicopter or alternative aircraft to provide aerial dispersant spotter duties. Aircraft will be required to fly above the air tractor and to advise pilot when to turn spray on and off. Requires communication plan between the two aircraft.
Arrange for trained AAC to be available for test spray run	Aerial Attack Coordinator (ACC) to communicate with pilot of air tractor to direct spray operations over the oil slick and to complete the Aerial Dispersant Monitoring Log (OSRL Handbook).

Task	Guidance
Pre-flight briefing	Flight planning forms and manifests to be lodged prior to sorties departure. Communications will be agreed upon during the pre-operational briefings taking into account all aircraft utilised on-site at time for operations. This is most likely to comprise: • two aircraft VHF channels air-to-air with local Airfield CTAF also used/monitored; and • aircraft also to have marine radios which also can be utilised.
Test spray run by air tractor	Loading and fuelling of the aircraft will be under the supervision of the Loading Supervisor, and to the satisfaction of the pilot. Dispersant application rate is to be set at 50L per hectare with a swath width of 22m (dependent on aircraft). The spray area will be determined by the movement of oil and as directed by the AAC in [insert spotter platform call sign]. When tasked, the spotter platform with AAC [insert helicopter or plane call sign, most likely to be CHC] will proceed to the target area and identify the target site. It will then call in [insert aircraft call sign(s) or aircraft type/Operator] and direct the dispersant attack. Dispersant will be applied within the dispersant application zones (Figure 7-3). Other constraints include: • metocean conditions; • thickness of the slick; and • weather conditions and available daylight. Seasonal environmental conditions and sensitivities will dictate spray runs and areas. An analysis to determine these specific sectors will be undertaken at the time by the Planning Chief and implemented by the Aviation and Marine Units in Operations. Test application runs of approximately 100m in length will be made and several passes may be required to determine dispersant effectiveness. The AAC will direct the air tractor to make another pass if required. The AAC will observe the effectiveness of the dispersant on the oil slick and will report if dispersant is having a mixing effect on the oil and complete the Dispersant Monitoring Application Log (OSRL Handbook). Photographs will be taken by the AAC to provide to the Planning Chief and Environment Unit. The pilot of the air tractor will complete a Dispersant Application Log and provide this to the Operations Chief upon completion of the mission. The Operations Chief provides this detail to the Planning Chief. Visual Flight Rules (VFR) shall be observed at all times, along with standard radio protocols and monitoring. Pilots will maintain separation.
Monitoring dispersant effectiveness of test spray runs using visual observation (OMP4)	The spray run may be run several times to determine the most appropriate dispersant to oil ratio. Full dispersant operations will commence once this test run has been reported achieving some dispersion, which will be determined visually by parties monitoring the test run in the field. It is extremely difficult to quantify the percentage of oil dispersed so visual observation of effectiveness will assess if the dispersant is having a positive effective of dispersing oil into the water column or if it is not working as intended.

Task	Guidance
	The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect.
Complete SIMA to justify ongoing dispersant use	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for ongoing dispersant use based on the results of the test runs.
Secure trained personnel to run dispersant operation	Dispersant application equipment and trained personnel are available from the AMOSC stockpile and Core Group; the AMSA National Plan stockpiles and NRT and the OSRL stockpiles and responders. Resourcing requirements for this strategy are outlined in Table 2-8.
Pre-flight briefing	Flight planning forms and manifests to be lodged prior to sorties departure. Communications will be agreed upon during the pre-operational briefings taking into account all aircraft utilised on-site at time for operations. This is most likely to comprise: • two aircraft VHF channels air to air with local Airfield CTAF also used/monitored; • aircraft also have to have Marine Radios which can also be utilised. As the owner of the FWADC, overall control will be via AMSA. Similarly, OSRL will be in overall control of their aircraft. Daily operations will be directed by the Operations Chief in consultation with AMSA, OSRL (if involved) and AMOSC. The Incident Commander remains in control of all incident response activities. Communications will be in accordance with the agreed communications plan. A Job Hazard Analysis (JHA) will be completed prior to each activity and will be signed by all personnel involved. All aircraft and aircrew involved with the operation are to be certified fit to conduct the task in accordance with CASA regulations. The Aerotech Liaison Officer is to confirm the serviceability and sign-off aircraft sea survival equipment. This will be audited by AMSA before the first flight. Individuals will supply their own Personal Protective Equipment (PPE) relevant to the task. Fuel and dispersant handling PPE requirements will be specified in relevant SDS'. As a minimum, all other activities PPE requirement will be full cover, steel caps, high visibility and sun protection. Additional controls will be implemented as necessary. In case of an emergency on the airstrip or field, the muster area will be at the standard Karratha Airport muster location(s).
Ongoing dispersant operations	Aerial dispersant operations will be directed, as part of the IAP, to operate in situations where the greatest effectiveness of the dispersant is likely to result; and operations can be conducted in such a manner as to allow for other oil spill marine operations. Loading and fuelling of the aircraft will be under the supervision of the Loading Supervisor, and to the satisfaction of the pilot. Dispersant application rate is to be set at 50L per hectare with a swath width of 22m unless otherwise determined by test spray runs. The spray area will be determined by the movement of oil and as directed by the AAC in [insert spotter platform call sign].

Task	Guidance
	When tasked, the spotter platform [insert helicopter or plane call sign, most likely to be CHC] will proceed to the target area and identify the target site. It will then call in [insert aircraft call sign(s) or aircraft type/Operator] and direct the dispersant attack. After spray is exhausted or endurance of aircraft is reached [insert Aircraft call sign(s)] will return for resupply. The AAC will complete the Aerial Dispersant Monitoring Log and provide this information to the Operations Chief who then provides this to the Planning Chief to incorporate into the IAP process. The pilot of the air tractor will complete an Aerial Dispersant Application Log and provide this to the Operations Chief, who then passes this information onto the Planning Chief. Final number of spray runs shall be determined by consultation between AMSA, VOGA, AMOSC and Aerotech. VFR shall be observed at all times, along with standard radio protocols and monitoring. Pilots will maintain separation. Personnel lists will be finalised at the time of the spill. All personnel will be logged on and off site, and all personnel in aircraft will be noted before departure. Typical functions required in FWADC operations are: • Air base manager; • Dispersant loading supervisor and crew; • Pilots; and • Aerial spotter to direct application of dispersant. During the operational phase, only personnel with an operational need will be allowed on the airfield unless authorised by the Aerotech Liaison Officer.
Volume of dispersant and number of aircraft required	The volume of dispersant required for an operation depends on the application rate which is the ratio of dispersant to oil required for effective dispersion (which is dependent on average slick thickness) and the size of the target area to be sprayed. A trial application of 1:20 is used as a starting point in which to determine the most appropriate application rate. Instantaneous spills spread rapidly, meaning that the thickness required for effective dispersant application is often difficult to achieve. In recognising that oil spreads at variable rates and thickness is not consistent across the slick, ITOPF (2013) suggest that the most practical and efficient solution is to target the thickest parts of the slick. For the purposes of planning, an application rate of 50L of dispersant per hectare (which is a dispersant to oil ratio of 1:20) is used because this has been proven as an appropriate starting point from which the application rate can be adjusted according to effectiveness. For planning purposes application target volumes have been estimated and are documented in the OSR Capability Review [VOG-7000-RH-0009].
Monitoring dispersant effectiveness – ongoing operations. Refer to OMP4	It is extremely difficult to quantify the percentage of oil dispersed so visual observation of effectiveness will assess if the dispersant is having a positive effective of dispersing oil into the water column or if it is not working as intended.

Task	Guidance
	The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect. Refer to OMP4 for additional dispersant related operational monitoring tactics that could be implemented.
Debriefing	A debrief of the operation is to be conducted with the Operations Chief to confirm appropriate actions were undertaken and to identify issues/concerns/improvements to operations. This will occur on a daily basis. Findings from the debrief and completed Aerial Dispersant Application Logs must be reported back to the Planning Chief so that situational awareness can be maintained for incident action planning. On completion of air operations respective maintenance procedures are to be conducted by individual organisations if necessary. Any serviceability issues are to be reported to the Area Staging Manager at Karratha Airport.
Stockpile management	At the end of each day the Planning Chief (via the Resources Unit in the Planning section) compiles the records of dispersant use and determines the amount of dispersant on hand and what is required for the next mission. Delivery of extra stocks is organised by the Logistics Chief. WA stockpiles will be accessed first while the need for interstate and international stockpiles is evaluated in the IAP process.
Incident action planning	At the completion of the aerial missions, the Planning Chief will review the aerial dispersant operations and provide a recommendation to the Incident Commander for future aerial dispersant operations. The ICT will require information from the field as to the effectiveness of this strategy so that longer-term IAPs can be made including a spill impact and mitigation assessment (SIMA).
Effectiveness guidance for response strategy	Visual observation of the colour of the dispersed oil plume is a reliable indicator of effective dispersant application via aerial and vessel observers (using tools such as the OSRL field guide for dispersant use and monitoring) (OMP4). Fluorometry using 'effective' and 'non-effective' thresholds (OMP4) The application method (aerial and vessel) and dose rate of dispersant tool, may increase effectiveness of dispersant (OMP5). Monitoring and modelling of dispersed oil within the water column (OMP4). Planning Chief will use outputs from OMP1 and OMP4 to consider if dispersant operations affect the following: • Time to shoreline impact is increased; • Average and maximum volume of oil ashore is reduced; • Average and maximum length of shoreline contacted is reduced; and • Probability of oil contact to shorelines is reduced. The impacts and accumulation of entrained oil is compared to the reduction and impacts of surface oil (OMP3).

Table 2-6: Chemical dispersant application minimum resources required – aerial operations

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Aerial operations								
Air base support	Aircraft refuelling and dispersant loading facilities. Briefing facility for aviation operations teams.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/maintain aerial operations.		Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	24 hours post-spill.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/maintain aerial operations.		
Dispersant stocks	Dispersant available at the air base for loading into the aircraft when needed over the period of the spill.	7.5m^3. Delivered over four sorties.		18m^3 delivered by two air tractors completing five sorties each.	1m^3 available in 24 hours for test spraying.	18m^3 delivered by two air tractors completing five sorties each.		
Spotter aircraft	For each sortie, a helicopter or fixed wing aircraft is able to accurately direct the air tractor pilot when apply dispersant.	1 x Trained spotter. 1 x Aerial platform.		1 x Trained spotter. 1 x Aerial platform.	36 hours post-spill on site.	2 x Trained spotters. 1 x Aerial platform.		
Aerial application means	Dispersant rapidly applied to the thickest part of the slick at the rate of 1:20 (dispersant oil ratio).	1 x Air tractor (1.8m^3 dispersant capacity). Pilots for the same.		2 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	1 x Air tractor spraying dispersant – 36 hours post-spill on site.	0 (Category A) 2 x Air tractors (1.8m^3 dispersant capacity) (Category C). Pilots for the same.		

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Safety aircraft/rescue vessels	For each sortie, a helicopter is available to be used for search and rescue.	Helicopter. Responding vessels.		Helicopter. Responding vessels.	36 hours post-spill on site.	Helicopter. Responding vessels.		

2.2.2.2 *Marine strategy*

Table 2-7: Marine dispersant application

Task	Guidance
Marine delivery of dispersant will take place if aerial application is not possible or if there are parts of the slick that are better targeted by a vessel. Marine dispersant operations will be used to treat oil that has 'built-up' over preceding days in continuous spill events. The objective of the marine dispersant operations will be to disperse oil that has formed windrows and through trajectory modelling may imminently impact environmental sensitivities, in particular the Dampier Archipelago and the other shorelines. The output will be to have vessels continuously 'chasing' and spraying dispersant onto the oil. The Planning and Operations Chiefs will decide according to the situational awareness gained if marine based dispersant use is activated.	
Identify marine operating base	Logistics Chief to identify marine operating base that can accommodate vessel and crews is close to the response site – most likely to be Mermaid Marine with support from TOLL for storage.
Source vessel	Logistics Chief to source offshore vessel that either has dispersant spray equipment already fitted; or is able to secure an afedo dispersant spray system to the vessel. Afedo spray systems located in Dampier (AMSA).
Dispersant stocks	Planning Chief to confirm with Logistics Chief the volume of dispersant to be mobilised to marine operating base. Only dispersant listed on the AMSA OSCA Register and transitional register will be used until the efficacy and suitability of other dispersants is known. Mobilise dispersant and a dispersant transfer pump to be able to transfer dispersant from IBCs to vessel storage. Consult the OSR Capability Review [VOG-7000-RH-0009] for additional dispersant calculation and stockpile information.
Dispersant spray system	Logistics Chief to source a dispersant spray system from the National Plan Dampier stockpile or the AMOSC stockpile in Exmouth.
Arrange for a spotter plane to accompany air tractor	Logistics Chief to secure a helicopter to or alternative aircraft to provide aerial dispersant spotter duties. Aircraft will be required to fly above the air tractor and to advise pilot when to turn spray on and off. Requires communication plan between the two aircraft.

Task	Guidance
Arrange for trained AAC to be available for test spray run	AAC to communicate with pilot of air tractor to direct spray operations over the oil slick and to complete the Aerial Dispersant Monitoring Log (OSRL Handbook).
Complete SIMA to justify test run	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for testing dispersant. SIMA template available in Appendix C.
Test run by marine vessel	Dispersant will be applied within the dispersant application zones (Figure 7-3). Other constraints include: • metocean conditions; • thickness of the slick; and • weather conditions and available daylight. Seasonal environmental conditions and sensitivities will dictate application of dispersant from marine vessels. An analysis to determine these specific sectors will be undertaken at the time by the Planning Chief and implemented by the Aviation and Marine Units in Operations. Test application runs of approximately 100m in length will be made and several passes may be required to determine dispersant effectiveness. The AAC will direct the marine vessel to make another pass if required. The AAC will observe the effectiveness of the dispersant on the oil slick and will report if dispersant is having a mixing effect on the oil and complete the Dispersant Monitoring Application Log (OSRL Handbook). Photographs will be taken by the AAC to provide to the Planning Chief and Environment Unit. The master of the marine vessel will complete a Dispersant Application Log and provide this to the Operations Chief upon completion of the mission. The Operations Chief provides this detail to the Planning Chief.
Monitoring dispersant effectiveness. Refer to OMP4	The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect. Refer to OMP4 for additional dispersant related operational monitoring tactics that could be implemented.
Operational SIMA	To determine if ongoing dispersant application should continue.
Ongoing dispersant operations	Marine dispersant operations will be directed, as part of the IAP, to operate in situations where the greatest effectiveness of the dispersant is likely to result; and operations can be conducted in such a manner as to allow for other oil spill marine operations.
Debriefing	A debrief of the operation is to be conducted with the Operations Chief to confirm appropriate actions were undertaken and to identify issues/concerns/improvements to operations. This will occur on a daily basis. Findings from the debrief and completed Dispersant Application Logs must be reported back to the Planning Chief so that situational awareness can be maintained for incident action planning.

Task	Guidance
	On completion of air and marine operations respective maintenance procedures are to be conducted by individual organisations if necessary.
Stockpile management	At the end of each day the Planning Chief (via the Resources Unit in the Planning section) compiles the records of dispersant use and determines the amount of dispersant on hand and what is required for the next mission. Delivery of extra stocks is organised by the Logistics Chief.
Incident action planning	At the completion of the dispersant operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future dispersant operations. The ICT will require information from the field as to the effectiveness of this strategy so that longer term IAPs can be made including a SIMA. .
Effectiveness guidance for response strategy	Visual observation of the colour of the dispersed oil plume is a reliable indicator of effective dispersant application via aerial and vessel observers (using tools such as the OSRL field guide for dispersant use and monitoring) (OMP4). Fluorometry using 'effective' and 'non-effective' thresholds (OMP4). The application method (aerial and vessel) and dose rate of dispersant to oil, may increase effectiveness of dispersant (OMP5). Monitoring and modelling of dispersed oil within the water column (OMP4). Planning Chief will use outputs from OMP1 and OMP4 to consider if dispersant operations affect the following: • Time to shoreline impact is increased; • Average and maximum volume of oil ashore is reduced; • Average and maximum length of shoreline contacted is reduced; and • Probability of oil contact to shorelines is reduced. The impacts and accumulation of entrained oil is compared to the reduction and impacts of surface oil (OMP3).

Table 2-8: Chemical dispersant application minimum resources required – marine application

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Marine operations								
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.		Wharf space. Loading areas. Forward operating area.	24 hours.	Wharf space. Loading areas. Forward operating area.		
Dispersant stocks	Dispersant available at the marine base for loading when needed over the period of the oil spill. Dispersant available for if FWADC is unable to apply dispersant or it is more efficient and effective to spray from a marine vessel.	2m^3 of dispersant.		2m^3 of dispersant.	1m^3 available in 24 hours for test spraying.	2m^3 of dispersant.		
Marine delivery	Logistics to locate a vessel and the dispersant spray system to mount a response for up to five days at sea.	2 x Work vessels suitable for the NWS. Crew and master for the same.		2 x Work vessels suitable for the NWS. Crew and master for the same.	Deployed to spill site for spraying operations 36 hours post-spill.	2 x Work vessels suitable for the NWS. Crew and master for the same.		
Dispersant spray system	A system that can effectively and efficiently apply dispersant from IBCs on deck.	2 x Dispersant spray sets and ancillaries. Two PAX to operate the same (per pack).		2 x Dispersant spray sets and ancillaries. Two PAX to operate the same (per pack).	36 hours post-spill on site.	2 x Dispersant spray sets and ancillaries. Two PAX to operate the same (per pack).		

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Spotter aircraft	A helicopter or fixed wing is able to accurately direct the vessel operator where the oil is.	2 x Trained spotter. 2 x Aerial platform. Pilots for the same.		2 x Trained spotter. 2 x Aerial platform. Pilots for the same.	36 hours post-spill on site.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.		

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

2.2.3 Mechanical dispersion strategy

Table 2-9: Mechanical dispersion

Task	Guidance
The Planning Chief will recommend this strategy be implemented based on information collected through monitoring and evaluation. If chemical dispersant is working mechanical dispersion may not be required. If small areas of the slick have separated from the main chemical dispersant application zone then marine vessels may chase this to apply dispersant or conduct mechanical dispersion activities.	
Conduct SIMA	The Environment Unit within the Planning Team of the ICT will use the outputs from monitoring and evaluation to determine the environmental sensitivities likely to be impacted by oil. Mechanical dispersion activities may be directed to areas of oil that could potentially impact a receptor which is unable to be treated by other response strategies. Mechanical dispersion activities will only be conducted in water deeper than 20m.
Secure offshore work vessel	Logistics Chief to secure vessel through current contracts or vessels of opportunity to: • Prop wash the spilled products (if permitted by vessel master and owner); and • Agitate using the fire monitor or alternative spray system. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.
Secure spotter aircraft	Logistics Chief to secure helicopter or fixed wing aircraft to direct vessels into areas of the slick that require manual dispersion. Spotter aircraft pilot to be able to communicate with marine vessel. Operations Chief to brief pilot on what parts of the slick should be targeted.
Deploy vessels	Vessels will be deployed from Dampier. Masters of vessels being used for this operation will have communication with aerial surveillance so that the leading edge of a slick can be targeted.
Develop waste management plan	Planning Chief to develop waste management plan that prevents translocation of oil from hot zones to warm and cold zones. The Planning Team will be cognisant of the potential for transferring oily waste when the vessel returns to Dampier, and will ensure that provisions have been made in the waste management plan to manage the risk of secondary contamination. It is possible that the resources for this response strategy may be combined with that of monitoring and evaluation or transportation for shoreline clean-up so that maximum resource efficiencies can be achieved.
Incident action planning	At the completion of the mechanical dispersion operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future mechanical dispersion activities.

Task	Guidance
Effectiveness guidance for response strategy	OMP4 – water quality OMP3 – effects on fisheries Visual observation to determine whether oil is dispersing into the water column from the vessel and aerial observations: • Oil is mixing within the water column. • Surface oil is reduced.

Table 2-10: Mechanical dispersion minimum resource requirements

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Vessel	Prop wash the spilled products. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.	Opportunistic offshore support vessel.		Opportunistic offshore support vessel.	N/A		Opportunistic offshore support vessel/s.	Opportunistic offshore support vessel/s.
Fire hose	Agitate using the fire monitor or alternative spray system. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.	Working fire monitor/spray system. Crew to operate.		Working fire monitor/spray system. Crew to operate.	N/A		Working fire monitor/ spray system. Crew to operate.	Working fire monitor/ spray system. Crew to operate.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

2.2.4 Containment and recovery strategy

Table 2-11: Offshore and near shore containment and recovery

<table>
<tr><th>Task</th><th>Guidance</th></tr>
<tr><td>Planning Chief undertakes a SIMA of containment and recovery operations and considers the following:</td><td>Is the slick is moving toward a sensitive receptor – consider time to impact, volume and probability?
Is the sea-state and weather conditions amenable for effective boom and skimmer deployment?
Is the weathered oil able to be recovered with skimmers?
Is there a safe operating environment for responders?</td></tr>
<tr><td>Do weather conditions and sea state permit safe and effective deployment of booms and skimmers?</td><td>Metocean conditions required for safe and effective boom and skimmer deployment:
<table><tr><th>Equipment</th><th>Maximum sea state (Beaufort scale)</th><th>Maximum current (knots)</th><th>Winds (knots)</th></tr><tr><td>Booms</td><td>3-4</td><td>1</td><td>14-22</td></tr><tr><td>Weir skimmer</td><td>1</td><td>1</td><td>7</td></tr><tr><td>Disc skimmer</td><td>2-3</td><td>1</td><td>11-14</td></tr><tr><td>Vacuum skimmer</td><td>1</td><td>1</td><td>7</td></tr></table></td></tr>
<tr><td>Does containment and recovery appear feasible?</td><td>BER is a limiting factor of effective containment and recovery operations. Refer to the OSR Capability Review [VOG-7000-RH-0009] for estimation of the resources required and potential volume of oil able to be recovered.
Is the oil thick enough for effective recovery?
Will containment and recovery treat a notable portion of the spill volume?</td></tr>
<tr><td colspan="2">If the decision is made in the ICT to proceed with containment and recovery (based on Planning Chief’s recommendation) the following tasks are to be completed.</td></tr>
<tr><td>Mobilise vessels suitable for either offshore or near shore operations</td><td>Work vessels that can carry and deploy offshore booms and skimmers are required for this strategy along with a mechanism for storing and transporting waste.
Logistics Chief to secure two offshore work vessels; or a vessel from AMSNOR based in Dampier. Ideally vessels would have the ability to carry, deploy and retrieve booms and skimmers up to the size of ro-boom and the GT-185 weir skimmers (i.e. GT-185 and Desmi 250), as well as temporary waste storage.
Deployment of ro-boom, large skimmers and at-sea waste storage equipment requires vessels that can maintain the correct configuration of the towed booms at very low speeds through the water. The OSRL Containment and Recovery Field Guide provides some guidance on the ideal vessel specifications required for this type of operation.
The operational time of the vessels on the water conducting this response activity will be dictated by the available waste collection capacity; once waste tanks are full the vessels will demobilise from the oil site to unload collected waste. To maintain longer operational periods, the Planning Chief may consider an application to AMSA (Commonwealth waters) or DoT (State waters) to</td></tr>
</table>

Task	Guidance
	decant oily water from waste collection tanks back into the oil plume collected behind the boom. The total amount of oily waste water returned to shore may be reduced by at-sea decanting (allowing oil to settle on the surface of the waste storage container and decanting water from the bottom). The IPIECA Oil Spill JIP report, The Use of Decanting during Offshore Oil Spill Recovery Operations, provides some guidance on this practice.
Mobilise booms and skimmers	Logistics Chief to mobilise booms, skimmers and temporary waste storage equipment from AMSNOR, the AMOSC stockpiles in Broome and Exmouth, as well as the AMSA National Plan stockpiles in Dampier and Fremantle. Ongoing response efforts may require the mobilisation of equipment from interstate stockpiles. Specifications regarding the type of booms, skimmers and waste storage required are described in the OSR Capability Review [VOG-7000-RH-0009].
Mobilise trained equipment operators	Logistics Chief to source people with experience and training operating equipment from marine vessels from: • AMSNOR; • AMOSC core group members; • AMSA NRT; and • WA DoT State Response Team. Logistics Chief to ensure that personnel forms and information is completed and forwarded to the Finance Chief for cost tracking. This equipment will only be deployed and retrieved by trained personnel such as those available through the AMOSC Core Group, AMSA NRT, DoT State Response Team or OSRL. Standard Operating Procedures are available in the AMSA OSR OH&S Manual.
Spotter plane to direct operations	Logistics Chief to activate a helicopter or fixed wing aircraft to direct vessels to thickest part of slick to contain and recover oil. CHC or Karratha Flying Service Aircraft will need ability to communicate with marine vessels and a communication plan as well as observation logs to report back to the Operations Chief.
Establish a forward operating base for temporary storage of equipment and waste	Logistics Chief to activate a Forward Operating Post at Toll in Dampier where VOGA has personnel who can manage the receipt and deployment of equipment. It is in this yard where equipment can be stored and readied for deployment. Toll will manage the transport of equipment that VOGA requires to Dampier. For example, Toll could transport equipment from the AMOSC stockpile in Fremantle to Dampier within 16 hours and make it ready for deployment onto a vessel.

Task	Guidance
Develop waste storage and transport plan	Logistics Chief in consultation with Planning Chief activates temporary waste storage capacity held by Toll (IBCs through ToxFree); evaluate the feasibility of securing the Caltex 2 x 16KT tankers on charter and rotate between Dampier and Singapore; and activate towable storage barges such as lancer barges held by AMSA in Dampier and Fremantle. Consideration will be made in the waste management plan for how to best manage contaminated equipment when it returns from operations to Dampier. A hot, warm and cold zone will be established in the laydown area along with a decontamination station and plan to manage the risk of secondary contamination. The operational time of the vessels on the water conducting this response activity will be dictated by the available waste collection capacity; once waste tanks are full the vessels will demobilise from the oil site to unload collected waste. To maintain longer operational periods, an application will be made by the ICT to AMSA (Commonwealth waters) or DoT (State waters) to decant oily water from waste collection tanks back into the oil plume collected behind the boom. The total amount of oily waste water returned to shore may be reduced by at-sea decanting (allowing oil to settle on the surface of the waste storage container and decanting water from the bottom). The IPIECA Oil Spill JIP report, The Use of Decanting during Offshore Oil Spill Recovery Operations, provides some guidance on this practice.
Incident action planning	At the completion of the containment and recovery operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future containment and recovery operations. The ICT will require information from the field as to the effectiveness of this strategy so that longer-term IAPs can be made including a SIMA.
Effectiveness guidance for response strategy	OMP5 – oil encounter rate. Visual observation to determine whether booming operations are effective, more specifically is there no evidence of undercutting (losing hydrocarbon beneath the skirt of the boom), splash over (hydrocarbon splashing over the top of the boom due to wave energy) and entrainment issues (recovery is too slow resulting in too much hydrocarbon collecting in the apex of the boom). Boom type, towing speed, weather, containment configuration and currents can all affect the effectiveness of the above. Visual observation to determine whether recovery operations are effective, more specifically is hydrocarbon being recovered. Is the type of recovery system appropriate for the hydrocarbon product and its fate? What is the ratio of hydrocarbon to water? Are the temporary storage operations sufficient to maintain recovery? Recovery system type, recovery methodology (skimming while vessels are moving) and timing can be altered to increase effectiveness. The Planning Chief will consider the: • potential to contain oil contained booms; • potential for oil recovery – weir skimmers recovering more than 10% oil; oleophilic skimmers recovering more than 50% oil; • Availability of waste storage of required capacity.

Table 2-12: Containment and recovery minimum resources required

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Two vessel booming tasking (U sweep or V sweep); and/or NOFI current buster operations								
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.		Wharf space. Loading areas. Forward operating area.	24 hours.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	
Booming systems	A system that can effectively and efficiently corral oil offshore.	1 x 400m ro-boom (or similar). NOFI current buster boom system		1 x 400m ro-boom (or similar). NOFI current buster boom system	48 hours to marine operating base post-spill.	1 x 400m ro-boom (or similar). NOFI current buster boom system	1 x 400m ro-boom (or similar). NOFI current buster boom system	
Recovery systems	High-capacity skimmers that can recover both fresh and weathered crudes.	1 x Active weir or brush skimmer recovery system.		1 x Active weir or brush skimmer recovery system.	48 hours to marine operating base post-spill.	1 x Active weir or brush skimmer recovery system.	1 x Active weir or brush skimmer recovery system.	
Waste storage	100m³ of on-board or towable storage for Category C.	Varying capacities of IBCs, totalling 100m³, or other suitable combined storage.		Varying capacities of IBCs, totalling 100m³, or other suitable combined storage.	48 hours to marine operating base post-spill.	Varying capacities of IBCs, totalling 100m³, or other suitable combined storage.	Varying capacities of IBCs, totalling 100m³, or other suitable combined storage.	

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Spotter aircraft	A fixed wing or helo is able to accurately direct the vessel operator where the oil is.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.		1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	72 hours on site post-spill.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter x 1. 1 x Aerial platform x 1. Pilots for the same.	
Marine delivery	Vessels that can store up to 100m^3 (Category A and C) Vessel to lead the boom operation, 4-tonne bollard pull.	2 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.		2 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	72 hours on site post-spill.	2 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	2 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	
Single vessel side sweep operation and/or NOFI current buster system								
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.		Wharf space. Loading areas. Forward operating area.	24 hours.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Booming systems	A system that can effectively and efficiently corral oil offshore.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster boom system 5 x Crew to operate the system.		Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster boom system 5 x Crew to operate the system.	48 hours to marine operating base post-spill.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster boom system 5 x Crew to operate the system.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster boom system 5 x Crew to operate the system.	
Recovery systems	High capacity skimmers that can recover both fresh and weathered crudes.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.		1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	48 hours to marine operating base post-spill.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	
Waste collection, storage and transport	100m^3 of on-board storage for Category C.	100m^3 IBCs, or on-board storage tanks, or Lancer barges.		100m^3 IBCs, or on-board storage tanks, or Lancer barges.	48 hours to marine operating base post-spill.	100m^3 IBCs, or on-board storage tanks, or Lancer barges.	100m^3 IBCs, or on-board storage tanks, or Lancer barges.	

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category A	Category B	Category C				
Spotter aircraft	A fixed wing or helo is able to accurately direct the vessel operator where the oil is.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.		1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	72 hours on site post-spill.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	
Marine delivery	Vessel that can carry 100m^3 of oil/water waste, skimmer system, and effectively 4 tonnes bollard pull.	1 x Large work vessel and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.		1 x Large work vessel and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	72 hours on site post-spill.	2 x Large work vessels and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	2 x Large work vessels and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

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3 OPP2 – Category D, E and F spills

3.1 Instructions

- Complete the initial actions and notifications in Part 4 for activating the OSCP;
- Work through the initial incident actin plan Table 3-1 using the guidance and resources described in Table 3-2 to Table 3-15;
- Check off tasks that have been undertaken using Table 3-2;
- Generate a SIMA utilising the VOGA oil response tools;
- Check which OSMPs are required to be activated; and
- Transition into incident IAP process.

3.2 Initial incident action plan

Table 3-1: OPP2 initial incident action plan

INCIDENT OBJECTIVE/S:	Ascertain extent of spill Prevent impact to sensitive resources
PROTECTION PRIORITIES	**OIL SPILL RESPONSE STRATEGIES** (Means of accomplishing objectives)
The focus for VOGA pre-planning of response activities for first strike response and initial resource mobilisation is the Pilbara coast and offshore islands between Robe River Mouth and Dampier Archipelago. This area is the most likely to be impacted first, most significantly and contains several sensitive locations. Dampier is the site most likely to be required for a forward base. For indicative planning, OSTM analysis indicates that several sensitive locations from Robe River Mouth down to North West Cape and from Dampier up to Eighty Mile Beach may be impacted to varying levels and require a response between Days 9 and 20. Between Days 20 and 30, from Eighty Mile Beach up to Broome is potentially impacted. Priorities will be verified in a response with real time trajectory data and analysis of seasonal vulnerabilities through the SIMA process.	1. Monitor and evaluate 2. Chemical dispersion 3. Mechanical dispersion 4. Containment and recovery 5. Protection and deflection 6. Shoreline clean-up. 7. Wildlife Response

STRATEGIES	TACTICS (What is planned to be done?)	TASKS (See Table 3-3 to Table 3-16 for guidance on how to complete tasks)
Monitor and evaluate	Visual observation from vessel or facility (OMP1 and OMP2)	Provide initial situational awareness to the PIC
		Ongoing situational awareness
	Deploy satellite tracking buoy (OMP1 and OMP2)	Deploy unit – PIC
		Access real-time data
		Interpret data
	Oil spill trajectory modelling (OMP1 and OMP2)	Activate RPS modelling contract
		Manual trajectory model
	Aerial observation (OMP1 and OMP2)	Activate assets to fly as soon as possible in daylight hours only
		Secure observers
		Data to be collected – conduct flight as soon as possible in daylight hours only
		Ongoing surveillance
	Situational awareness (OMP1 and OMP2)	Collect real-time and predicted data to enter on status boards in ICT
		Obtain satellite imagery
		Preliminary SIMA and incident action planning for guidance on response strategies and protection priorirites.
		Effectiveness guidance for response strategy
	Shoreline Assessment (OMP6)	Analysis of trajectory modelling (refer to OMP1)
		Analysis of aerial observation and current situational awareness (refer to OMP1)
		Consider constraints
		Decide on which shorelines will be surveyed
		Analysis of resources and logistics required
Chemical dispersion	Aerial dispersant operations	Activate aircraft within six hours of the spill
		Mobilise dispersant to Karratha Airport within six hours of the spill
		Set up operating post at Karratha Airport
		Monitoring dispersant effectiveness of test spray runs using visual observation (refer to OMP4)
		Arrange for a spotter plane to accompany air tractor
		Arrange for trained AAC to be available for test spray run
		Pre-flight briefing
		Test spray run by air tractor
		Monitoring dispersant effectiveness of test spray runs using visual observation (refer to OMP4)
		Planning Chief to undertake a SIMA of chemical dispersion operations – operational activities

STRATEGIES	TACTICS (What is planned to be done?)	TASKS (See Table 3-3 to Table 3-16 for guidance on how to complete tasks)
		Secure trained personnel to run dispersant operation
		Pre-flight briefing
		Ongoing dispersant operations
		Volume of dispersant and number of aircraft required
		Monitoring dispersant effectiveness – ongoing operations (refer to OMP4)
		Debriefing
		Stockpile management
		Incident action planning
		Effectiveness guidance for response strategy
	Marine dispersant operations	Identify marine operating base
		Source vessel
		Dispersant stocks
		Dispersant spray system
		Arrange for a spotter plane to accompany marine vessel
		Arrange for trained AAC to be available for test spray run
		Planning Chief to undertake a SIMA of chemical dispersion operations – test run activities
		Test run by marine vessel
		Monitoring dispersant effectiveness (refer to OMP4)
		Planning Chief to undertake a SIMA of chemical dispersion operations – operational activities
		Ongoing dispersant operations
		Debriefing
		Stockpile management
		Incident action planning
		Effectiveness guidance for response strategy
Mechanical dispersion	Mechanical dispersion operations	Planning Chief to undertake a SIMA of mechanical dispersion operations
		Secure offshore work vessel
		Secure spotter aircraft
		Deploy vessels
		Incident action planning
		Effectiveness guidance for response strategy
Containment and recovery	Offshore and near shore containment and recovery	Planning Chief to undertake a SIMA of containment and recovery operations
		Do weather conditions and sea state permit safe and effective deployment of booms and skimmers?
		Does containment and recovery appear feasible?

STRATEGIES	TACTICS (What is planned to be done?)	TASKS (See Table 3-3 to Table 3-16 for guidance on how to complete tasks)
		If the decision is made in the ICT to proceed with containment and recovery (based on Planning Chief's recommendation) the following tasks are to be completed.
		Mobilise vessels suitable for either offshore or near shore operations
		Mobilise booms and skimmers
		Mobilise trained equipment operators
		Spotter plane to direct operations
		Establish a forward operating base for temporary storage of equipment and waste
		Deploy booms, skimmers and temporary waste storage
		Develop waste storage and transport plan
		Incident action planning
		Effectiveness guidance for response strategy
Protection and deflection	Near shore protection and deflection operations	Analysis of trajectory modelling (refer to OMP1) and baseline monitoring data
		Analysis of aerial observation and current situational awareness (refer to OMP1)
		Understanding of real time currents and tides
		Planning Chief undertakes a SIMA for protection and deflection operations
		Determine and source resources required and booming configuration
		Induction
		Marine vessel transport of people and equipment
		Aerial surveillance and/or transport
		Consider constraints
		Incident action planning
		Effectiveness guidance for response strategy
Shoreline clean up	Shoreline clean-up operations	Analysis of trajectory modelling (refer to OMP1)
		Analysis of aerial observation and current situational awareness (refer to OMP1)
		Planning Chief undertakes a SIMA for shoreline clean-up operations
		Consider constraints
		Decide on which shorelines will be cleaned and monitored based on SCAT
		Analysis of resources required
		Logistics
		Induction

STRATEGIES	TACTICS (What is planned to be done?)	TASKS (See Table 3-3 to Table 3-16 for guidance on how to complete tasks)
		Marine vessel transport of people and equipment
		Aerial surveillance and/or transport
		Equipment
		Ongoing shoreline assessment
		Ongoing clean-up operations
		Waste collection and transport
		Incident action planning
		Effectiveness guidance for response strategy
Oiled Wildlife Response	Wildlife first strike response	Activate WAOWRP and POWRP
		Rapidly assess the situation
		Provide advice to the ICT in relation to the wildlife assets at risk
		Determine the response level
		Liaise with Oiled Wildlife Advisor
		Gather information from POWRP
		Activate first strike response kits
	Mobilisation of wildlife resources	Personnel
		Equipment
	Wildlife reconnaissance.	Aerial reconnaissance
		Marine reconnaissance
		Shoreline reconnaissance

Table 3-2: Task checklist for Category D, E and F spills

Categories D, E and F: OPP – Task checklist (first 24 hours)			
	Timeframe	**Who**	**Completed**
Tasking checklist facility/on site			
Start and maintain personal log.	Immediately	PIC Wandoo B	
Undertake visual observation from off-take vessel, platform and/or vessels of opportunity immediately.	Immediately	Observer on site	
Activate and deploy satellite tracking buoy.	Within 30 minutes of spill	PIC Wandoo B	
Verify that relevant notifications have been made (i.e. NOPSEMA, DoT if the potential for a State response).	Within two hours of spill	PIC Wandoo B	
Tasking checklist VOGA Emergency Management Response – Perth ICT			
Satellite imagery of the spill to be initiated.	Within two hours of a spill	Planning Chief Perth ICT	
Visual observation from aircraft (in daylight hours only) has been arranged.	Within two hours of spill	Logistics Chief Perth ICT	

Categories D, E and F: OPP – Task checklist (first 24 hours)			
	Timeframe	**Who**	**Completed**
Convene planning meeting to confirm and document: • Incident response aim; • Priorities and objectives; and Strategies as per Section 7 of Document 1: Planning and Preparedness.	Within three hours of the spill	Planning Chief Perth ICT	
Commission RPS to undertake real-time modelling to determine trajectory and fate of oil.	Within three hours of spill	Planning Chief Perth ICT	
Obtain available data re: • Weather; • Tides/currents; • Topography and shoreline; • Environmental sensitivity data; • Spill trajectory (observed or by modelling); • Oil data (character and behaviour); • Community issues; and • Action taken to date.	Within three hours of spill	Planning Chief Perth ICT	
Complete Preliminary SIMA to identify indicative response options and protection priorities (based on Strategic SIMA).	Within six hours of spill	Planning Chief Perth ICT	
Activate FWADC via AMSA to conduct test spray run.	Within 24 hours of spill	IC in consultation with Planning Chief Perth ICT	
Mobilise dispersant.	1m^3 available within 24 hours of spill	Logistics Chief in consultation with Planning Chief Perth ICT	
Undertake operational SIMA to determine if dispersant strategy will be implemented.	Within two hours of completion of test run	Environment Unit leader and Planning Chief Perth ICT	
Determine preliminary resources list (labour, equipment, transport and other support) based on outcomes of planning meeting and the initial IAP.	Within six hours of spill	Logistics Chief in consultation with Planning Chief Perth ICT	
Activate Oiled Wildlife Response (OWR) Emergency Response Plans (WAOWRP and POWRP) including: - VOGA Oiled Wildlife Commander (Wildlife Division Coordinator [WDC] activated)	Within six hours of a spill	Planning Chief	
Monitor the response by scheduling and undertaking regular briefings/debriefings of ICT using the SMEACS format.	Every six hours after spill or as necessary	IC in conjunction with Planning Chief ICT	
Issue regular SITREPS.	Every six hours after spill or as necessary	Planning Chief Perth ICT	

Categories D, E and F: OPP – Task checklist (first 24 hours)			
	Timeframe	**Who**	**Completed**
Monitor waste volumes and management as per Section 15. If necessary arrange for the development of a Waste Management Plan.	Ongoing	Planning and Operations Chiefs Perth ICT	
Monitor OH&S performance through Section 8 of Part 6.	Ongoing	Safety Officer	
Transition to IAP cycle as per Section 6.	Within 24 hours of spill	IC Perth ICT	
Activate operational and scientific monitoring consultants.	Within 24 hours of spill	IC in conjunction with Planning Chief ICT	
Determine OWR response level	Within 12 hours	Planning Chief	
Activate OWR first strike response kits to be delivered to the most appropriate staging areas for POWRP Operational Sectors 7-12. Locations will be confirmed based on OSTM at the time of the spill and the initial SIMA.	Within 24 hours	Logistics Chief	
Mobilise 2 x OWR containers to be delivered to Dampier	Within 24 hours	Logistics Chief	
Request aerial, marine and shoreline wildife surveillance	Within 24 hours	WDC through Logistics Chief	
Mobilise OWR personnel	Within 24 hours	WDC through Logistics Chief	

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3.2.1 Monitoring and evaluation response plan strategy

Table 3-3: Monitor and evaluate

Task	Guidance
Visual observation from vessel or facility (OMP1 and OMP2)	
Provide an initial situational awareness to the PIC	To initiate this strategy, the PIC of a vessel or the Wandoo Facility where the spill has occurred will (if safe to do so) organises for an observer to monitor the spill and communicate information regarding the appearance of the oil, area covered and if the spill has ceased. This process is depicted in Flowchart 1. Observer on scene to record and report to PIC on facility or vessel (who then provides information to Planning Chief) the following. Estimate the percentage cover by colour; silver, rainbow, black/dark brown, or brown/orange. Is there wildlife in or near the spill? Are there other vessels or activities occurring within or near the spill? Is it possible to confirm if the spill is continuous?
Ongoing situational awareness	As directed by Planning Chief, provide updates on what the spill looks like, area covered, presence of wildlife or other activities.
Deploy satellite tracking buoy (OMP1 and OMP2)	
Deploy unit – PIC	It is important to deploy a satellite tracking buoy from the Facility as soon as possible after the spill has occurred, so that real-time data can be collected to verify pre-spill trajectory modelling and also be inputted into real-time modelling. PIC on Wandoo B (or delegate) deploys tracking buoy by removing from storage on Wandoo B, turning it on and releasing as close to the spill as possible.Planning Chief to check that this has been done. Additional units deployed every three days.
Access real-time data	Planning Chief accesses data from: [redacted] Access details: Username: [redacted] Password: [redacted]
Interpret data	Planning Chief uses real-time data and knowledge of sensitivities to estimate spill trajectory and resources that could be impacted. Real time data is also provided to RPS to validate OSTM.

Task	Guidance
Oil spill trajectory modelling (OMP1 and OMP2)	
Activate RPS contract	OSTM is an essential tool used by the Environment Unit in the Planning Team to determine resources at risk and protection priorities. Planning Chief in liaison with Logistics Chief activates the RPS contract for real time trajectory modelling: (1) Complete the modelling request form (editable .pdf request form provided). Please complete as much detail as possible to allow for generation of modelling results and outputs. (2) Call the RPS Duty Officers on [redacted] to advise the RPS Duty Officers that they are now activated and a trajectory modelling request will be sent to them via email. Please note that the call to the RPS Duty Officers must be made as the email account is not monitored 24/7. (3) Send completed request form to RPS Duty Officers via email at [redacted] (4) Follow up the email with a phone call to the RPS Duty Officers to confirm email receipt and contents of the email (i.e. the modelling request form) are correct. In the event the email was not received a secondary/backup email address can be used (RPS.response@email.com). (5) The RPS Duty Officers will undertake the modelling as per the modelling request form provided. Should any of the incident details change, as further information becomes available, please call the RPS Duty Officers to inform them of the change. Follow this call up with an email confirming the change in details for the modelling. (6) Model outputs will be forwarded from the RPS Duty Officers to the requesting client officer as quickly as possible. The results will be transmitted by email to the requesting client officer and copied to the designated parties as identified by the client officer. The results may be passed on via a number of means including email attachment and/or FTP site. Access to the FTP site is via the following details: • Website: [redacted] Username: [redacted] Password: [redacted] (7) Once the modelling results have been received from RPS, call or email the RPS Duty Officer to inform them that the results have been received. (8) If extra advice is sought in regards to interpreting the trajectory modelling output, please follow up with a call to the RPS Duty Officers for further clarification. RPS will require details collected through the situational awareness task such as real time weather, sea state, and oil type spilled.

Task	Guidance
Manual trajectory model	While waiting for the RPS output use a navigation chart to manually plot the anticipated trajectory of the spill. Trajectory = 3% of the wind vector plus the current vector. Procedure: for each hour add the current velocity vector (in m or km) to 3% of the wind vector.
Aerial observation (OMP1 and OMP2)	
Activate assets to fly as soon as possible in daylight hours only	Upon notification of a spill the Planning Chief requests the Logistics Chief to activate contracts with CHC and Karratha Flying Services. Fixed wing aircraft (preferably over wing configuration) or helicopters to provide personnel with the means to observe and record details of oil on water. Request flight as soon as possible. Pilots or observers be provided with information on the anticipated location of the slick (e.g. from OSTM output). If possible use aircraft already in the area to provide situational awareness. Flight time to the Wandoo B platform is 20 minutes (48nm) based on S76 helicopter (@140 knots).
Secure observers	If trained observers are not available within the timeframe for initial reconnaissance flight use untrained aerial observers for initial situational awareness. Secure trained aerial observers to quantify amount of oil on water and geographical spread.
Data to be collected – conduct flight as soon as possible in daylight hours only	Aerial observation template forms are to be provided to observers along with a digital camera for video and photos. Observer is to obtain location details (coordinates) from pilot and note these for images and extent of slick. Information is to be provided back to the Planning Chief as soon as possible after the flight has landed. This could be done initially via verbal briefing from the observer and followed up by email or fax of completed observation template.
Ongoing surveillance	Logistics Chief secure appropriate aircraft to undertaken aerial observation activities twice a day – morning and afternoon until advised otherwise by Planning Chief.

Task	Guidance
Situational awareness (OMP1 and OMP2)	
Collect real-time and predicted data to enter on status boards in ICT. Ongoing updates	Status boards in ICT require the following information (sourced and entered by situation unit leader): • Real-time and predicted weather and sea-state conditions – source from BoM; • Real-time and predicted tidal and current movements – source from BoM, websites; • Oil characteristics – properties of the oil spilled and predicted behaviour after weathering; • Predicted trajectory of oil based on modelling conducted for planning and verified by real time modelling; • Resources at risk of being oiled sourced from OSCP; and • Navigation charts to plot location of vessel/MODU/facility.
Obtain satellite imagery	For Category E and F incidents, satellite imagery may be used to assist in ascertaining the extent of the spill. This imagery will be used within the Planning Section to assist in determining resources at risk and protection priorities. High fidelity photographs using different spectrums to identify the trajectory of the oil, ground truth the OSTM, sourced from Landgate or via OSRL. Time to acquire images depends on availability of satellites over the spill site. Landgate to be activated by the VOGA User Representative Contacts (URCs) only.
Incident action planning	At the completion of the monitoring and evaluation tasks, the Planning Chief will review information gathered provide a recommendation to the Incident Commander for future monitoring and evaluation tasks.
Effectiveness guidance for response strategy	Information is available for the ICT: • Quality of information; • Consistent reporting; • Regular up-to-date information; and • Methodology (satellite tracking buoy, visual observation) and frequency may be altered to increase effectiveness.
Decide on which shorelines will be surveyed	SCAT teams led by trained SCAT team leaders from AMOSC, DoT and AMSA identify shoreline oiling and provide advice back to the Planning Chief on recommended response strategies. Planning Chief is to brief Operations Chief on information that is required to be collected by the SCAT teams which sit within the Shoreline Operations Unit. Operational clean-up teams follow the SCAT teams to implement the recommendations of the SCAT teams (AMOSC, AMSA NRT, WA DoT SRT, OSRL, labour providers). They will require clean-up equipment, waste instructions, logistics and admin support. Scientific Monitoring teams are deployed to gather pre and post spill environmental data for utilisation in longer term environmental impact studies.

Task	Guidance
Ongoing shoreline assessment	OMP6 – Shoreline assessment. Shorelines are assessed as to their level of hydrocarbon stranding, and priority for clean-up on a daily basis if possible using the SCAT template. SCAT teams are to be deployed to provide situational awareness back to the Planning Chief via the shoreline oiling templates. Planning to provide the templates to be completed, the segmented shorelines on a map or aerial photo, camera, GPS unit and logbook to SCAT teams. The number of SCAT teams required depends on the size of the affected area and complexity of the habitats to be surveyed. The required turn-around time for the information can also influence the number of SCAT teams deployed. For example, if shoreline response/coordination centre requires data for an area to prepare the assignments for the next day, then all available teams may be deployed to that location. The UK SCAT Manual (2004) suggests that for a small-scale operation, where a spill that affects less than 50km of coast, it could be surveyed in one to two days with one or two teams. A spill in a larger area or one that would require a longer coastal survey probably would involve more field teams and office-based data management support. It is important to remember that some sections of shoreline may need to be resurveyed if oiling conditions change on a daily basis.
Analysis of resources required	For planning purposes in this OSCP, it is assumed that SCAT teams will be made up of three team members and that they can cover approximately 10km per day (based on similar numbers in The UK Scat Manual, 2004). This will depend on accessibility and environmental conditions however it provides a basis for resource planning. Based on these figures and OSTM outputs, all spill categories will require some degree of shoreline survey activity within the first four days. This may be able to be carried out by one to two teams with resurvey on a daily basis if required. Ground surveys can be guided and supplemented by aerial observation surveys. The cumulative number of teams and personnel required will need scaling according to the complexity and nature of the shoreline oiling. It is difficult to estimate the required resources for this type of response strategy without having real time spill data. For planning purposes, the worst case shoreline oiling results from the OSTM studies have been used to provide some direction as to the maximum resourcing that may potentially be required. Capability determination details are documented in the OSR Capability Review [VOG-7000-RH-0009]. Refine numbers by segment shoreline to work out where to send teams and then work out number of people required. Relies on OSRA and DoT environmental sensitivity data. A specialist Shoreline Division Commander will be used to: • coordinate basic training to clean-up contractors; • oversee the clean-up process to ensure appropriate procedures are used to minimise the impact on the environment; • provide advice on practical precautions to minimise contact with flora and fauna; and • assist with the SIMA process when selecting spill response strategies and to evaluate the impact of strategies. • The number of staff and teams required will vary according to the sensitivities being protected.

Table 3-4: Monitor and evaluate minimum resource requirements

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Visual observation – from platform	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Observer.	1 x Observer.	1 x Observer.	Immediate.	1 x Observer.	1 x Observer (Category E and F).	2 x Observers (Category E and F).
Visual observation – from chartered vessels	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.	Mobilise immediately.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.	1 x Vessel. 1 x Observer.
Visual observation – from aircraft	Identify extent and direction of oil, visual characteristics. Ground truth OSTM.	1 x Observer. 1 x Aircraft. 1 x Aerial support base.	1 x On-site Incident Commander with oil spill assessment training.	1 x Observer. 1 x Aircraft. 1 x Aerial support base.	Daylight only, two hours.	1 x Observer. 1 x Aircraft. 1 x Aerial support base.	1 x Observer. 1 x Aircraft. 1 x Aerial support base.	2 x Observers. 1 x Aircraft. 1 x Aerial support base.
Determination of surface and dispersed oil trajectory and fate	Identify the likely trajectory and fate of the spill and dispersed oil, timeframes for the oil (surface or dispersed) to interact with environmental sensitivities.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	Contract with technical provider, or in-house provision of OSTM.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	Requested within three hours of spill notification.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	1 x On-site Incident Commander with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.	2 x On-site Incident Commanders with oil spill assessment training. Contract with technical provider, or in-house provision of OSTM.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Satellite imagery	High fidelity photographs using different spectrums to identify the trajectory of the oil, ground truth the OSTM.	Contract with technical provider or access to AMSA technical provider.	Contract with technical provider or access to AMSA technical provider.	Contract with technical provider or access to AMSA technical provider.	Requested within two hours of notification of spill.	Contract with technical provider or access to AMSA technical provider.	Contract with technical provider or access to AMSA technical provider.	Contract with technical provider or access to AMSA technical provider.
Satellite tracking buoys	Identification of the leading edge/rear edge of the spill.	At least two operational on the facility or vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	At least two operational on the facility or vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	At least two operational on the facility or vessels within the field. Data site 'back end' to GIS system. Current contract with satellite provider.	Deployed within 30 minutes.	At least four operational on Vessels within the field (Category E spill). Data site 'back end' to GIS system. Current contract with satellite provider.	At least six operational on Vessels within the field (Category E spill). Data site 'back end' to GIS system. Current contract with satellite provider.	At least eight operational on Vessels within the field (Category E spill). Data site 'back end' to GIS system. Current contract with satellite provider.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Shoreline assessment (SCAT Teams)	Shorelines are assessed as to their level of hydrocarbon stranding, and priority for clean-up.	1 x Wildlife expert. 1 x Marine environmental specialist. 1 x Oil spill response.	1 x Wildlife expert. 1 x Marine environmental specialist. 1 x Oil spill response.	1 x Wildlife expert. 1 x Marine environmental specialist. 1 x Oil spill response.	72 hours on site post-spill.	3 teams made up of: Wildlife experts. Marine environment specialists. Oil spill response specialists	35 teams made up of: Wildlife experts. Marine environment specialists. Oil spill response specialists	35 teams made up of: Wildlife experts. Marine environment specialists. Oil spill response. speciialsits

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.2 Chemical dispersant application

3.2.2.1 Aerial dispersant operations

Table 3-5: Aerial dispersant application

Task	Guidance
Activate aircraft within 6 hours of the spill	Planning Chief to advise Logistics Chief to advise AMOSC to activate FWADC by calling AMSA RCC on **1800 641 792**. Request four air tractors – one to arrive for testing dispersant effectiveness followed by three to undertake full operations. Mobilise to Karratha Airport. The ICT will consider mobilising the OSRL aircraft to support air tractor operations for a Category F spill once situational awareness has been obtained. If it is activated, it will fly into Port Hedland for immigration and customs clearance before proceeding to Karratha to take part in dispersant application operations. The OSRL aircraft will be able to deliver half of the daily dispersant application required in five spray runs, complemented by the activities of four air tractors completing five sorties each. In all there would be 25 sorties (five for the OSRL aircraft, 20 for the air tractors) per day. Complete the AMSA/AMOSC Joint Standard Operating Procedure document – the FWADC aircraft won't be tasked for operations until this document is completed.
Mobilise dispersant to Karratha Airport within 6 hours of the spill	Planning Chief to confirm with Logistics Chief the volume of dispersant to be mobilised to Karratha Airport. Move $36m^3$ from available stockpiles. Mobilise a dispersant transfer pump to be able to transfer dispersant from IBCs to aircraft.
Set up operating post at Karratha Airport	Logistics Chief to liaise with Karratha Airport to set up a staging area for dispersant stockpile and transferring dispersant to aircraft. Managed by the Aerotech Liaison Officer (provided by the FWADC contractor).
Complete SIMA to justify test run	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for testing dispersant. See Appendix C.
Arrange for a spotter plane to accompany air tractor	Logistics Chief to secure a helicopter to or alternative aircraft to provide aerial dispersant spotter duties. Aircraft will be required to fly above the air tractor and advise pilot when to turn spray on and off. Requires communication plan between the two aircraft. Depending on the scale of the application area, additional spotter aircraft may be required to direct air tractors operating in separate areas. If one area of the slick is being treated by the four air tractors, then one spotter helicopter or plane will be used to direct spraying activities.
Arrange for trained AAC to be available for test spray run	AAC to communicate with pilot of air tractor to direct spray operations over the oil slick and to complete the Aerial Dispersant Monitoring Log (OSRL Handbook). Will need AACs for each area of operation if more than one spotter plane is being used.

Task	Guidance
Pre-flight briefing	Flight planning forms and manifests to be lodged prior to sorties departure. Communications will be agreed upon during the pre-operational briefings taking into account all aircraft utilised onsite at time for operations. This is most likely to comprise: • two aircraft VHF channels air to air with local Airfield CTAF also used/monitored; and • aircraft also have to have Marine Radios which can also be utilised.
Test spray run by air tractor	Loading and fuelling of the aircraft will be under the supervision of the Loading Supervisor, and to the satisfaction of the pilot. Dispersant application rate is to be set at 50L per hectare with a swath width of 22m [dependent on Aircraft]. The spray area will be determined by the movement of oil and as directed by the AAC in [insert spotter platform call sign]. When tasked, the spotter platform with AAC [insert helicopter or plane call sign, most likely to be CHC] will proceed to the target area and identify the target site. It will then call in [insert aircraft call sign(s) or aircraft type/Operator] and direct the dispersant attack. Dispersant will be applied within the dispersant application zone (Figure 7-3). Seasonal environmental conditions and sensitivities will dictate spray runs and areas. An analysis to determine these specific sectors will be undertaken at the time by the Planning Chief and implemented by the Aviation and Marine Units in Operations. Test application runs of approximately 100m in length will be made and several passes may be required to determine dispersant effectiveness. The AAC will direct the air tractor to make another pass if required. The AAC will observe the effectiveness of the dispersant on the oil slick and will report if dispersant is having a mixing effect on the oil and complete the Dispersant Monitoring Application Log (OSRL Handbook). Photographs will be taken by the AAC to provide to the Planning Chief and Environment Unit. The pilot of the air tractor will complete a Dispersant Application Log and provide this to the Operations Chief upon completion of the mission. The Operations Chief provides this detail to the Planning Chief. VFR shall be observed at all times, along with standard radio protocols and monitoring. Pilots will maintain separation.

Task	Guidance
Monitoring dispersant effectiveness (OMP4)	The spray run may be run several times to determine the most appropriate dispersant to oil ratio. Full dispersant operations will commence once this test run has been reported achieving some dispersion, which will be determined visually by parties monitoring the test run in the field. It is extremely difficult to quantify the percentage of oil dispersed so visual observation of effectiveness will assess if the dispersant is having a positive effective of dispersing oil into the water column or if it is not working as intended. The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect. Visual indications that dispersant is effective: • Yellow/coffee/grey colour plume present in the water (the exact colour will vary with the original colour of the oil); • Oil spill surface area reduced; • Oil rapidly disappearing from surface; • Oil in some areas being dispersed to leave only sheen on the surface. This colour change may not been seen immediately; time should be given to permit the dispersion process to take place. This is particularly important for more viscous oils. A milky white plume indicates dispersant is ineffective and will be present if: • too much dispersant is applied (overdosing); • there is poor targeting of spill area; • if the spilt oil is heavy or emulsified the dispersant may not penetrate the oil, running off into un oiled water; • dispersant is washed off the black oil as white, watery solution leaving oil on the surface; • quantity of oil on the sea surface is not altered by dispersant.
Complete SIMA to justify ongoing dispersant use	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for ongoing dispersant use based on the results of the test runs.
Secure trained personnel to run dispersant operation	Dispersant application equipment and trained personnel are available from the AMOSC stockpile and Core Group; the AMSA National Plan stockpiles and NRT and the OSRL stockpiles and responders. Resourcing requirements for this strategy are outlined in VOGA Emergency Response Logistics Management Plan [VOG-7000-RH-0008] .

Task	Guidance
Pre-flight briefing	Flight planning forms and manifests to be lodged prior to sorties departure. Communications will be agreed upon during the pre-operational briefings taking into account all aircraft utilised onsite at time for operations. This is most likely to comprise: • two aircraft VHF channels air to air with local Airfield CTAF also used/monitored; and • aircraft also have to have Marine Radios which can also be utilised. As the owner of the FWADC, overall control will be via AMSA. Similarly, OSRL will be in overall control of their aircraft. Daily operations will be directed by the Operations Chief in consultation with AMSA, OSRL (if involved) and AMOSC. The Incident Commander remains in control of all incident response activities. Communications will be in accordance with the agreed communications plan. A JHA will be completed prior to each activity and will be signed by all personnel involved. All aircraft and aircrew involved with the operation are to be certified fit to conduct the task in accordance with CASA regulations. The Aerotech Liaison Officer is to confirm the serviceability and sign off aircraft sea survival equipment. This will be audited by AMSA before the first flight. Individuals will supply their own PPE relevant to the task. Fuel and dispersant handling PPE requirements will be specified in relevant SDS'. As a minimum, all other activities PPE requirement will be full cover, steel caps, high visibility and sun protection. Additional controls will be implemented as necessary. In case of an emergency on the airstrip or field, the muster area will be at the standard Karratha Airport muster location(s).
Ongoing dispersant operations	Aerial dispersant operations will be directed, as part of the IAP, to operate in situations where the greatest effectiveness of the dispersant is likely to result; and operations can be conducted in such a manner as to allow for other oil spill marine operations. Loading and fuelling of the aircraft will be under the supervision of the Loading Supervisor, and to the satisfaction of the pilot. Dispersant application rate is to be set at 50L per hectare with a swath width of 22m unless otherwise determined by test spray runs. The spray area will be determined by the movement of oil and as directed by the AAC in [insert spotter platform call sign]. When tasked, the spotter platform [insert helicopter or plane call sign, most likely to be CHC] will proceed to the target area and identify the target site. It will then call in [insert aircraft call sign(s) or aircraft type/Operator] and direct the dispersant attack. After spray is exhausted or endurance of aircraft is reached [insert Aircraft call sign(s)] will return for resupply. The AAC will complete the Aerial Dispersant Monitoring Log and provide this information to the Operations Chief who then provides this to the Planning Chief to incorporate into the IAP process. The pilot of the air tractor will complete an Aerial Dispersant Application Log and provide this to the Operations Chief, who then passes this information onto the Planning Chief. Final number of spray runs shall be determined by consultation between AMSA, VOGA, AMOSC and Aerotech. VFR shall be observed at all times, along with standard radio protocols and monitoring. Pilots will maintain separation.

Task	Guidance
	Personnel lists will be finalised at the time of the spill. All personnel will be logged on and off site, and all personnel in aircraft will be noted before departure. Typical functions required in FWADC operations are: • Air base manager; • Dispersant loading supervisor and crew; • Pilots; and • Aerial spotter to direct application of dispersant. During the operational phase, only personnel with an operational need will be allowed on the airfield unless authorised by Aerotech Liaison Officer.
Volume of dispersant and number of aircraft required	The volume of dispersant required for an operation depends on the application rate which is the ratio of dispersant to oil required for effective dispersion (which is dependent on average slick thickness) and the size of the target area to be sprayed. A trial application of 1:20 is used as a starting point in which to determine the most appropriate application rate. Continuous spills however present an area of fresh oil that can be treated with dispersant on a daily basis until the spill is contained. In recognising that oil spreads at variable rates and thickness is not consistent across the slick, ITOPF (2013) suggest that the most practical and efficient solution is to target the thickest parts of the slick. For planning purposes, application target volumes have been conservatively estimated based on ITOPF Technical Information Paper 4. The number of days for the operation is based on the number of sorties and volume of dispersant required to be applied. Capability determination details are documented in the OSR Capability Review [VOG-7000-RH-0009].
Monitoring dispersant effectiveness (OMP4)	It is extremely difficult to quantify the percentage of oil dispersed so visual observation of effectiveness will assess if the dispersant is having a positive effective of dispersing oil into the water column or if it is not working as intended. The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect. Refer to OMP4 for additional dispersant related operational monitoring tactics that could be implemented.
Debriefing	A debrief of the operation is to be conducted with the Operations Chief to confirm appropriate actions were undertaken and to identify issues/concerns/improvements to operations. This will occur on a daily basis. Findings from the debrief and completed Aerial Dispersant Application Logs must be reported back to the Planning Chief so that situational awareness can be maintained for incident action planning. On completion of air operations respective maintenance procedures are to be conducted by individual organisations if necessary. Any serviceability issues are to be reported to the Area Staging Manager at Karratha Airport.

Task	Guidance
Stockpile management	At the end of each day the Planning Chief (via the Resources Unit in the Planning section) compiles the records of dispersant use and determines the amount of dispersant on hand and what is required for the next mission. Delivery of extra stocks is organised by the Logistics Chief. WA stockpiles will be accessed first while the need for interstate and international stockpiles is evaluated in the IAP process. All dispersants have been shown to be effective on Wandoo Crude. Stockpiles will need to be accessed for dispersant operations longer than five days or with more than one air tractor or if the OSRL aircraft is mobilised. Additional National Plan stockpiles may be accessed through AMSA and international stocks of dispersant may be accessed through OSRL. Manufacturing of dispersant in Australia is currently being investigated by AMOSC as a potential source of supplies for prolonged dispersant operations. Current lists of stockpile volumes and locations are available on the OSRL, AMSA and AMOSC websites. Application rates may be varied if considered appropriate to ensure longevity of dispersant stockpiles.
Incident action planning	At the completion of the aerial missions, the Planning Chief will review the aerial dispersant operations and provide a recommendation to the Incident Commander for future aerial dispersant operations.
Effectiveness guidance for response strategy	Visual observation of the colour of the dispersed oil plume is a reliable indicator of effective dispersant application via aerial and vessel observers (using tools such as the OSRL field guide for dispersant use and monitoring) (OMP4). Fluorometry using ‘effective’ and ‘non-effective’ thresholds (OMP4) The application method (aerial and vessel) and dose rate of dispersant tool, may increase effectiveness of dispersant (OMP5). Monitoring and modelling of dispersed oil within the water column (OMP4). Planning Chief will use outputs from OMP1 and OMP4 to consider if dispersant operations affect the following: • Time to shoreline impact is increased; • Average and maximum volume of oil ashore is reduced; • Average and maximum length of shoreline contacted is reduced; • Probability of oil contact to shorelines is reduced; • The impacts and accumulation of entrained oil is compared to the reduction and impacts of surface oil (OMP3).

Table 3-6: Chemical dispersant minimum resource requirements aerial operations

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Air base support	Aircraft refuelling and dispersant loading facilities. Briefing facility for aviation operations teams.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	24 hours post-spill.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.	Commercial air base close to Wandoo Platform, preferably Karratha Airport. Logistical support to sustain/ maintain aerial operations.
Dispersant stocks	Dispersant available at the air base for loading into the aircraft when needed over the period of the spill.	$36m^3$ delivered by four air tractors completing five sorties each.	$36m^3$ delivered by four air tractors completing five sorties each.	$36m^3$ delivered by four air tractors completing five sorties each.	$1m^3$ available in 24 hours for test spraying.	$180m^3$ delivered by air tractor or OSRL aircraft.	$360m^3$ delivered by air tractor or OSRL aircraft.	$760m^3$ delivered by air tractor or OSRL aircraft
Spotter aircraft	For each sortie, a helicopter or fixed wing aircraft is able to accurately direct the air tractor pilot when apply dispersant.	1 x Trained spotter. 1 x Aerial platform.	1 x Trained spotter. 1 x Aerial platform.	1 x Trained spotter. 1 x Aerial platform.	36 hours post-spill on site.	2 x Trained spotters. 2 x Aerial platforms.	2 x Trained spotters. 2 x Aerial platforms.	4 x Trained spotters. 2 x Aerial platforms.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Aerial application means	Dispersant rapidly applied to the thickest part of the slick at the rate of 1:20 (dispersant oil ratio).	4 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	4 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	4 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	1 x Air tractor spraying dispersant – 36 hours post-spill on site.	4 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	4 x Air tractors (1.8m^3 dispersant capacity). Pilots for the same.	4 x Air tractors (Category E and F) (1.8m^3 dispersant capacity). Pilots for the same.
	Availability of OSRL aircraft.					1 (Category F)	1 (Category E, F)	1 (Category E, F)
Safety aircraft/ rescue vessels	For each sortie, a helicopter is available to be used for search and rescue.	Helicopter. Responding vessels.	Helicopter. Responding vessels.	Helicopter. Responding vessels.	36 hours post-spill on site.	Helicopter. Responding vessels.	Helicopter. Responding vessels.	Helicopter. Responding vessels.

3.2.2.2 *Marine dispersant operations*

Table 3-7: Marine dispersant application

Task	Guidance
Marine delivery of dispersant will take place if aerial application is not possible or if there are parts of the slick that are better targeted by a vessel. Marine dispersant operations will be used to treat oil that has ‘built-up’ over preceding days in continuous spill events. The objective of the marine dispersant operations will be to disperse oil that has formed windrows and through trajectory modelling may imminently impact environmental sensitivities, in particular the Dampier Archipelago and the other shorelines. The output will be to have vessels continuously ‘chasing’ and spraying dispersant onto the oil. The Planning and Operations Chiefs will decide according to the situational awareness gained if marine based dispersant use is activated.	
Identify marine operating base	Logistics Chief to identify marine operating base that can accommodate vessel and crews is close to the response site – most likely to be Mermaid Marine with support from Toll for storage.
Source vessel	Logistics Chief to source offshore vessel that either has dispersant spray equipment already fitted; or a vessel from AMSNOR based in Dampier); or a vessel that is able to secure an afedo dispersant spray system to the vessel.

Task	Guidance
Dispersant stocks	Planning Chief to confirm with Logistics Chief the volume of dispersant to be mobilised to marine operating base. Move dispersant and mobilise a dispersant transfer pump to be able to transfer dispersant from IBCs to vessel storage. Consult the OSR Capability Review [VOG-7000-RH-0009] for additional dispersant calculation and stockpile information.
Dispersant spray system	Logistics Chief to source an afedo dispersant spray system from the National Plan stockpile or the AMOSC stockpile.
Arrange for a spotter plane to accompany marine vessel	Logistics Chief to secure a helicopter to or alternative aircraft to provide aerial dispersant spotter duties. Aircraft will be required to fly above the marine vessel and to advise pilot when to turn spray on and off. Requires communication plan between the aircraft and vessel.
Arrange for trained AAC to be available for test spray run	AAC to communicate with master of marine vessel to direct spray operations over the oil slick and to complete the Aerial Dispersant Monitoring Log (OSRL Handbook).
Complete SIMA to justify test run	Planning Chief completes SIMA pro-forma with what is known about the spill at the time to record justification for testing dispersant. SIMA template available in Appendix C.
Test run by marine vessel	Dispersant will be applied within the dispersant application zone (Figure 7-3). Seasonal environmental conditions and sensitivities will dictate application of dispersant from marine vessels. An analysis to determine these specific sectors will be undertaken at the time by the Planning Chief and implemented by the Aviation and Marine Units in Operations. Test application runs of approximately 100m in length will be made and several passes may be required to determine dispersant effectiveness. The AAC will direct the marine vessel to make another pass if required. The AAC will observe the effectiveness of the dispersant on the oil slick and will report if dispersant is having a mixing effect on the oil and complete the Dispersant Monitoring Application Log (OSRL Handbook). Photographs will be taken by the AAC to provide to the Planning Chief and Environment Unit. The master of the marine vessel will complete a Dispersant Application Log and provide this to the Operations Chief upon completion of the mission. The Operations Chief provides this detail to the Planning Chief.
Monitoring dispersant effectiveness (OMP4)	The AAC will brief the Operations Chief of the dispersant operations and observed effectiveness based on the Aerial Dispersant Monitoring Log and observations made of dispersant and oil mixing within the water column and the resultant colour of the oil mix. Use the OSRL Dispersant Application Monitoring Handbook to determine visually if the dispersant is having an effect. Refer to OMP4 for additional dispersant related tactics that could be implemented.
Operational SIMA	To determine if ongoing dispersant application should continue.
Ongoing dispersant operations	Marine dispersant operations will be directed, as part of the IAP, to operate in situations where the greatest effectiveness of the dispersant is likely to result; and operations can be conducted in such a manner as to allow for other oil spill marine operations.

Task	Guidance
Debriefing	A debrief of the operation is to be conducted with the Operations Chief to confirm appropriate actions were undertaken and to identify issues/concerns/improvements to operations. This will occur on a daily basis. Findings from the debrief and completed Dispersant Application Logs must be reported back to the Planning Chief so that situational awareness can be maintained for incident action planning. On completion of air and marine operations respective maintenance procedures are to be conducted by individual organisations if necessary.
Stockpile management	At the end of each day the Planning Chief (via the Resources Unit in the Planning section) compiles the records of dispersant use and determines the amount of dispersant on hand and what is required for the next mission. Delivery of extra stocks is organised by the Logistics Chief.
Incident action planning	At the completion of the dispersant operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future dispersant operations.
Effectiveness guidance for response strategy	Visual observation of the colour of the dispersed oil plume is a reliable indicator of effective dispersant application via aerial and vessel observers (using tools such as the OSRL field guide for dispersant use and monitoring) (OMP4). Fluorometry using 'effective' and 'non-effective' thresholds (OMP4) The application method (aerial and vessel) and dose rate of dispersant tool, may increase effectiveness of dispersant (OMP5). Monitoring and modelling of dispersed oil within the water column (OMP4). Planning Chief will use outputs from OMP1 and OMP4 to consider if dispersant operations affect the following: • Time to shoreline impact is increased; • Average and maximum volume of oil ashore is reduced; • Average and maximum length of shoreline contacted is reduced; • Probability of oil contact to shorelines is reduced. The impacts and accumulation of entrained oil is compared to the reduction and impacts of surface oil (OMP3).

Table 3-8: Chemical dispersant minimum resource requirements marine operations

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas.	Wharf space. Loading areas.	24 hours.	Wharf space. Loading areas.	Wharf space. Loading areas.	Wharf space. Loading areas. Forward operating area.

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
			Forward operating area.	Forward operating area.		Forward operating area.	Forward operating area.	
Dispersant stocks	Dispersant available at the marine base for loading when needed - if FWADC is unable to apply dispersant or more efficient and effective to spray from a marine vessel.	$1m^3$ per vessel	$1m^3$ per vessel	$1m^3$ per vessel	$1m^3$ available in 24 hours for test spraying.	$20m^3$	$40m^3$	$80m^3$
Marine delivery	Logistics to locate dispersant vessel and the dispersant spray system to mount a response for up to five days at sea.	2 x Work vessels suitable for the NWS. Crew and master for same.	2 x Work vessels suitable for the NWS. Crew and master for same.	2 x Work vessels suitable for NWS. Crew and master for same.	Deployed to spill site 36 hours post-spill.	4 x Work vessels suitable for the NWS. Crew and master for the same.	4 x Work vessels suitable for NWS. Crew and master for the same.	4 x Work vessels suitable for NWS. Crew and master for the same.
Dispersant spray system	A system that can effectively and efficiently apply dispersant from IBCs on deck.	2 x Afedo spray sets and ancillaries. Two PAX to operate the same	2 x Afedo spray sets and ancillaries. Two PAX to operate the same	2 x Afedo spray sets and ancillaries. Two PAX to operate the same	36 hours post-spill on site.	4 x Afedo spray sets & ancillaries. Two PAX to operate the same	4 x Afedo spray sets & ancillaries. Two PAX to operate the same	4 x Afedo spray sets & ancillaries. Two PAX to operate the same
Spotter aircraft	A helicopter or fixed wing is able to accurately direct the vessel operator where the oil is.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.	36 hours post-spill on site.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.	2 x Trained spotters. 2 x Aerial platforms. Pilots for same.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.3 Mechanical dispersion strategy

Table 3-9: Mechanical dispersion operations

Task	Guidance
The Planning Chief will recommend this strategy be implemented based on information collected through monitoring and evaluation. If chemical dispersant is working mechanical dispersion may not be required. If small areas of the slick have separated from the main chemical dispersant application zone then marine vessels may chase this to apply dispersant or conduct mechanical dispersion activities.	
Conduct SIMA	The Environment Unit within the Planning Team of the ICT will use the outputs from monitoring and evaluation to determine if a protection priority is likely to be impacted by oil. Mechanical dispersion activities may be directed to areas of oil that could potentially impact a receptor which is unable to be treated by other response strategies. Mechanical dispersion activities will only be conducted in water deeper than 20m.
Secure offshore work vessel	Logistics Chief to secure vessels through current contracts or vessels of opportunity to: • prop wash the spilled products (if permitted by vessel master and owner); and • agitate using the fire monitor or alternative spray system. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.
Secure spotter aircraft	Logistics Chief to secure helicopter or fixed wing aircraft to direct vessels into areas of the slick that require manual dispersion. Spotter aircraft pilot to be able to communicate with marine vessel. Operations Chief to brief pilot on what parts of the slick should be targeted.
Deploy vessels	Vessels will be deployed from Dampier. Masters of vessels being used for this operation will have communication with aerial surveillance so that the leading edge of a slick can be targeted.
Develop waste management plan	Planning Chief to develop waste management plan that prevents translocation of oil from hot zones to warm and cold zones. The Planning Team will be cognisant of the potential for transferring oily waste when the vessel returns to Dampier, and will ensure that provisions have been made in the waste management plan to manage the risk of secondary contamination. It is possible that the resources for this response strategy may be combined with that of monitoring and evaluation or transportation for shoreline clean-up so that maximum resource efficiencies can be achieved.
Incident action planning	At the completion of mechanical dispersion operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future mechanical dispersion activities.

Task	Guidance
Effectiveness guidance for response strategy	OMP4 – Water quality. OMP3 – Effects on fisheries. Visual observation to determine whether oil is dispersing into the water column from the vessel and aerial observations: • Oil is mixing within the water column. • Surface oil is reduced.

Table 3-10: Mechanical dispersion minimum resource requirements

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Vessel	Prop wash the spilled hydrocarbons. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.	Opportunistic offshore support vessel.	Opportunistic offshore support vessel.	Opportunistic offshore support vessel.	N/A	Opportunistic offshore support vessel/s.	Opportunistic offshore support vessel/s.	Opportunistic offshore support vessel/s.
Fire hose	Agitate using the fire monitor or alternative spray system. Enhancement of weathering process such as natural dispersion and dilution of oil into the water column.	Working fire monitor/spray system. Crew to operate.	Working fire monitor/spray system. Crew to operate.	Working fire monitor/spray system. Crew to operate.	N/A.	Working fire monitor/spray system. Crew to operate.	Working fire monitor/spray system. Crew to operate.	Working fire monitor/spray system. Crew to operate.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.4 Containment and recovery strategy

Table 3-11: Containment and recovery operations

<table>
<tr><th>Task</th><th>Guidance</th></tr>
<tr><td>Planning Chief to undertake a SIMA of containment and recovery operations and consider the following:</td><td>Is the slick is moving toward a sensitive receptor - consider time to impact, volume and probability?
Is the sea-state and weather conditions amenable for effective boom and skimmer deployment?
Is the weathered oil able to be recovered with skimmers?
Is there a safe operating environment for responders?</td></tr>
<tr><td>Do weather conditions and sea state permit safe and effective deployment of booms and skimmers?</td><td>Metocean conditions required for safe and effective boom and skimmer deployment:<table><tr><th>Equipment</th><th>Maximum sea state (Beaufort scale)</th><th>Maximum current (knots)</th><th>Winds (knots)</th></tr><tr><td>Booms</td><td>3-4</td><td>1</td><td>14-22</td></tr><tr><td>Weir skimmer</td><td>1</td><td>1</td><td>7</td></tr><tr><td>Disc skimmer</td><td>2-3</td><td>1</td><td>11-14</td></tr><tr><td>Vacuum skimmer</td><td>1</td><td>1</td><td>7</td></tr></table></td></tr>
<tr><td>Does containment and recovery appear feasible?</td><td>BER is a limiting factor of effective containment and recovery operations. An estimation of the resources required and potential volume of oil able to be recovered for Category A and C spills is provided in the OSR Capability Review [VOG-7000-RH-0009].
Considerations to take into account:
Is the oil thick enough for effective recovery?
Will containment and recovery treat a notable portion of the spill volume?</td></tr>
<tr><td colspan="2">If the decision is made in the ICT to proceed with containment and recovery (based on Planning Chief’s recommendation) the following tasks are to be completed.</td></tr>
<tr><td>Mobilise vessels suitable for either offshore or near shore operations.</td><td>Work vessels that can carry and deploy offshore booms and skimmers are required for this strategy along with a mechanism for storing and transporting waste.
Logistics Chief to secure two offshore work vessels or a vessel from AMSNOR based in Dampier. Ideally vessels would have the ability to carry, deploy and retrieve booms and skimmers up to the size of ro-boom and the GT-185 weir skimmers (i.e. GT-185 and Desmi 250), as well as temporary waste storage.
Deployment of ro-boom, large skimmers and at-sea waste storage equipment requires vessels that can maintain the correct configuration of the towed booms at very low speeds through the water. The OSRL Containment and Recovery Field Guide provides some guidance on the ideal vessel specifications required for this type of operation.
The operational time of the vessels on the water conducting this response activity will be dictated by the available waste collection capacity; once waste tanks are full the vessels will demobilise from the oil site to unload collected waste. To maintain</td></tr>
</table>

Task	Guidance
	longer operational periods, the Planning Chief may consider an application to AMSA (Commonwealth waters) or DoT (State waters) to decant oily water from waste collection tanks back into the oil plume collected behind the boom. The total amount of oily waste water returned to shore may be reduced by at-sea decanting (allowing oil to settle on the surface of the waste storage container and decanting water from the bottom). The IPIECA Oil Spill JIP report 'The Use of Decanting during Offshore Oil Spill Recovery Operations', provides some guidance on this practice.
Mobilise booms and skimmers	Logistics Chief to mobilise booms, skimmers and temporary waste storage equipment from AMSNOR, the AMOSC stockpiles in Broome and Exmouth, as well as the AMSA National Plan stockpiles in Dampier and Fremantle. Ongoing response efforts may require the mobilisation of equipment from interstate stockpiles. Specifications regarding the type of booms, skimmers and waste storage required are described in the OSR Capability Review [VOG-7000-RH-0009].
Mobilise trained equipment operators	Logistics Chief to source people with experience and training operating equipment from marine vessels from: • AMSNOR; • AMOSC core group members; • AMSA NRT; and • WA DoT State Response Team. Logistics Chief to ensure that personnel forms and information is completed and forwarded to the Finance Chief for cost tracking. This equipment will only be deployed and retrieved by trained personnel such as those available through AMSNOR, the AMOSC Core Group, AMSA NRT, DoT State Response Team or OSRL. Standard Operating Procedures are available in the AMSA OSR OH&S Manual.
Spotter plane to direct operations	Logistics Chief to activate a helicopter or fixed wing aircraft to direct vessels to thickest part of slick to contain and recover oil. CHC or Karratha Flying Service Aircraft will need ability to communicate with marine vessels and a communication plan as well as observation logs to report back to the Operations Chief.
Establish a forward operating base for temporary storage of equipment and waste	Logistics Chief to activate a Forward Operating Post at Toll in Dampier where VOGA has personnel who can manage the receipt and deployment of equipment. It is in this yard where equipment can be stored and readied for deployment. Toll will manage the transport of equipment that VOGA requires in Dampier.
Secure trained personnel	This equipment will only be deployed and retrieved by trained personnel such as those available through AMSNOR, the AMOSC Core Group, AMSA NRT DoT State Response Team or OSRL. Standard Operating Procedures are available in the AMSA OSR OH&S Manual.
Deploy booms, skimmers and temporary waste storage	Deployment of ro-boom, large skimmers and at-sea waste storage equipment requires vessels that can maintain the correct configuration of the towed booms at very low speeds through the water. The OSRL Containment and Recovery Field Guide provides some guidance on the ideal vessel specifications required for this type of operation.

Task	Guidance
Develop waste storage and transport plan	Logistics Chief in consultation with Planning Chief activates temporary waste storage capacity held by Toll (IBCs through ToxFree); evaluate the feasibility of securing the Caltex 2 x 16KT tankers on charter and rotate between Dampier and Singapore; and activate towable storage barges such as lancer barges held by AMSA in Dampier and Fremantle. Consideration will be made in the waste management plan for how to best manage contaminated equipment when it returns from operations to Dampier. A hot, warm and cold zone will be established in the laydown area along with a decontamination station and plan to manage the risk of secondary contamination. The operational time of the vessels on the water conducting this response activity will be dictated by the available waste collection capacity; once waste tanks are full the vessels will demobilise from the oil site to unload collected waste. To maintain longer operational periods, an application will be made by the ICT to AMSA (Commonwealth waters) or DoT (State waters) to decant oily water from waste collection tanks back into the oil plume collected behind the boom. The total amount of oily waste water returned to shore may be reduced by at-sea decanting (allowing oil to settle on the surface of the waste storage container and decanting water from the bottom). The IPIECA Oil Spill JIP report 'The Use of Decanting during Offshore Oil Spill Recovery Operations' provides some guidance on this practice.
Incident action planning	At the completion of the containment and recovery operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future containment and recovery operations.
Effectiveness guidance for response strategy	OMP5 – oil encounter rate. Visual observation to determine whether booming operations are effective, more specifically is there no evidence of undercutting (losing hydrocarbon beneath the skirt of the boom), splash over (hydrocarbon splashing over the top of the boom due to wave energy) and entrainment issues (recovery is too slow resulting in too much hydrocarbon collecting in the apex of the boom). Boom type, towing speed, weather, containment configuration and currents can all affect the effectiveness of the above. Visual observation to determine whether recovery operations are effective, more specifically is hydrocarbon being recovered. Is the type of recovery system appropriate for the hydrocarbon product and its fate? What is the ratio of hydrocarbon to water? Are the temporary storage operations sufficient to maintain recovery? Recovery system type, recovery methodology (skimming while vessels are moving) and timing can be altered to increase effectiveness. The Planning Chief will consider: • The potential to contain oil contained booms. • The potential for oil recovery – weir skimmers recovering > 10% oil; oleophilic skimmers recovering > 50% oil. • Availability of waste storage of required capacity.

Table 3-12: Containment and recovery minimum resource requirements

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Two vessel booming tasking (U sweep or V sweep) and/or NOFI current buster								
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	24 hours.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.
Booming systems	A system that can effectively and efficiently corral oil offshore.	3 x 400m ro-booms (or similar). NOFI current buster	6 x 400m ro-booms (or similar). NOFI current buster	6 x 400m ro-booms (or similar). NOFI current buster	48 hours to marine operating base post-spill.	1,200m (Category D). 2,400m (Category E, F). NOFI current buster	1,200m (Category D, F[1]). 2,400m (Category E). NOFI current buster	2,400m (Category E). NOFI current buster
Recovery systems	High-capacity skimmers that can recover both fresh and weathered crudes.	3 x Active weir skimmer recovery systems or similar.	6 x Active weir recovery systems or similar.	6 x Active weir skimmer recovery systems or similar.	48 hours to marine operating base post-spill.	3 (Category D). 6 (Category E, F).	3 (Category D). 6 (Category E, F).	6 (Category E).
Waste storage	500m^3 of on-board or towable storage	Varying capacities of IBCs, totalling 500m^3, or other suitable combined storage, e.g.	Varying capacities of IBCs, totalling 500m^3, or other suitable combined storage, e.g.	Varying capacities of IBCs, totalling 500m^3, or other suitable combined storage, e.g.	48 hours to marine operating base post-spill.	2,500m^3 (Category D). 5,000m^3 (Category E, F).	5,000m^3 (Category D, F). 10,000m^3 (Category E).	20,000m^3 (Category E).

[1] Category D and F spills are not continuous and as such the ability to corral and recover oil at sea diminishes over time, it is unlikely that at sea containment and recovery operations will continue for 20 days however if it does, the capability for Category E spills covers this need.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
		towable storage barges.	towable storage barges.	towable storage barges.				
Spotter aircraft	A fixed wing or helo is able to accurately direct the vessel operator where the oil is.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	72 hours on site post-spill.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	2 x Trained spotters. 1 x Aerial platform. Pilots for the same.
Marine delivery	Vessels that can store up to 500m^3 of oil/water waste, skimmer system and 4 tonnes bollard pull. Vessel to lead the boom operation, 4 tonne bollard pull.	6 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	12 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	12 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	72 hours on site post-spill.	12 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	12 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.	12 x Work vessels suitable for the NWS. Crew (7 for boom deployment and recovery, oil storage and transfer management) and master for the same.
Single vessel side sweep operation and/or NOFI current buster								
Marine operating base	Marine operating base that can accommodate vessel and crews is close to the response site.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	24 hours.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.	Wharf space. Loading areas. Forward operating area.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Booming systems	A system that can effectively and efficiently corral oil offshore.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.	48 hours to marine operating base post-spill.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.	Side sweep boom such as Troilboom solid buoyancy sweeping boom with outrigger and collection point. NOFI current buster 5 x Crew to operate the system.
Recovery systems	High-capacity skimmers that can recover both fresh and weathered crudes.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	48 hours to marine operating base post-spill.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.	1 x Active weir skimmer recovery system or similar, e.g. GT1852 x Crew to operate the system.
Waste collection, storage and transport	500m^3 of on-board or towable storage	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.	48 hours to marine operating base post-spill.	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.	100m^3 IBCs, or on-board storage tanks, or towable storage barges. Total 500m^3.

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Spotter aircraft	A fixed wing or helo is able to accurately direct the vessel operator where the oil is.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	72 hours on site post-spill.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.	1 x Trained spotter. 1 x Aerial platform. Pilots for the same.
Marine delivery	Vessel that can carry 100m^3 of oil/water waste, skimmer system, and effectively 4 tonnes bollard pull.	1 x Large work vessel and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	1 x Large work vessel and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	1 x Large work vessel and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	72 hours on site post-spill.	2 x Large work vessels and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	2 x Large work vessels and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.	2 x Large work vessels and one tender or smaller work vessel to assist with recovery operations. Crew and master for same.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.5 Protection and deflection strategy

Table 3-13: Protection and deflection operations

Task	Guidance
Analysis of trajectory modelling and SIMA	Planning Chief and Environment Unit Leader analyse trajectory models (pre-event modelling and real-time modelling) to predict which shorelines may be impacted by oil, time to impact, probability and quantity of oil to shore. Priority resource protection areas are compared with the shorelines that are predicted to be oiled and operational/tactical plans are activated. Outputs from the monitoring and evaluation strategy will confirm protection priorities that require action to prevent oiling. Priority of the implementation of tasks to support this strategy will be focused on protecting the highest shoreline and near-shore environmental sensitivities. Oil that has not been successfully chemically or physically dispersed or contained and recovered at sea may come ashore and strand. Using deterministic modelling during a spill, combined with situational awareness gained through ongoing monitoring and evaluation, VOGA will implement this strategy in these areas to protect sensitive shorelines.
Analysis of aerial observation and current situational awareness (OMP1)	Planning Chief and Environment Unit Leader to use aerial surveillance data, information gathered by the Situation Unit and the protection priorities identified in pre-spill planning as a starting point for deployment of protection and deflection operations.
Understanding of real time currents and tides	Booming configuration will depend on the tidal movements and speed of currents in the location in which booms are to be deployed. Booms will fail when the forces of water movement push oil over or under the boom, or when there is failure of anchoring systems. This can be in currents of as little as 1 knot, however there are ways in which booms can be set up (e.g. chevron booming, staggered booming) so that oil is directed with the current onto another boom or into a collection area.
SIMA	Priority of the implementation protection and deflection is to oiling of shorelines with the highest environmental sensitivities. Planning Chief and Environment Unit leader in consultation with DoT to determine where the optimum mitigation outcomeswill be achieved through protection and deflection activities. Shoreline protection priorities are mangrove environments and identified turtle nesting beaches during nesting and hatching season. Where trajectory modelling indicates likely multiple stranding of oil, and a SIMA indicates no likely worse outcome, shores may be left to allow oil to collect utilising areas of natural containment.

Task	Guidance
Determine and source resources required and booming configuration	Planning Chief to liaise with Operations Chief to determine type of booms (including ancillaries such as anchors and power packs for land sea booms) required and a booming configuration that can effectively and efficiently direct oil away from a resource, or prevent contact by oil. Refer to OSRL handbook for Shoreline Operations for recommended booming configurations. Logistics Chief to source booms and skimmers (if being used to recover oil) from AMOSC stockpiles and the AMSA National Plan stockpiles. Logistics Chief to secure vessels (including crew) and equipment operators (AMOSC core group or AMSA NRT) to deploy booms and vessels to assist in shallow areas. Booms can be deployed in various configurations to either exclude oil from a sensitivity or deflect the oil away from it. Trained operators will be required for this task and are available from the AMOSC Core Group, AMSA NRT or the DoT State Response Team. Protection and deflection strike teams will establish exact equipment and resource requirements for specific shoreline protection and deflection according to the specific incident. However, each team will have a minimum resource make up according to the response quick guides in each spill category as detailed in Table 3-18, with further resources being brought in dependent on the scale and nature of the incident. Capability determination details are documented in the OSR Capability Review (VOG-7000-RH-0009). Daily inspection and maintenance of deployed booms to be undertaken by response personnel.
Induction	Operations Chief to ensure that teams are informed of how to minimise damage to flora and avoid encounters with fauna. Induction and training of onshore teams accessing to uninhabited islands to include that spill response teams should avoid disruption of environment and take practical tactical precautions to avoid contact with flora and fauna. The number of staff and teams required will vary according to the sensitivities being protected.
Marine vessel transport of people and equipment	Logistics Chief to secure marine vessel(s) capable of carrying crew and spill equipment to remote islands.
Aerial surveillance and/or transport	Logistics Chief to secure aircraft to enable ongoing aerial surveillance of shorelines and/or transport of people and equipment.
Consider constraints	The major constraint for protection and deflection, especially in areas of northwest WA is the tidal range of and current speed that may be experienced. It may not physically be possible to deploy protection and deflection booming systems if the tide and current are not favourable. Other constraints include: • access to remote islands and mainland beaches; • biosecurity issues associated with moving people and equipment between remote islands and the mainland; • access to sites (habitat, terrain, distance from the mainland, landing/mooring sites for vessels); • transport of equipment to remote sites; • weather and sea-state; and

Task	Guidance
	• hazardous wildlife.
Incident action planning	At the completion of the containment and recovery operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future protection and deflection operations.
Effectiveness guidance for response strategy	OMP5 – Oil encounter rate. • Visual observation to determine whether a booming operation is 'protecting' and/or 'deflecting' the impact of hydrocarbon towards sensitivity; and • Boom type, deployment angle, anchoring, quantity and variation in materials can all be altered to increase effectiveness.

Table 3-14: Protection and deflection minimum resource requirements

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Landside (based on one team, resources will need to be scaled up for additional teams)								
Marine vessels	Marine vessel(s) capable of carrying crew and spill equipment to remote islands. Capable of logistics support/accommodation for 10 POB, crew, accessing remote islands.	Aluminium catamarans and/or flat bottom boats.	Aluminium catamarans and/or flat bottom boats.	Aluminium catamarans and/or flat bottom boats.	48 hours on site post-spill.	4 x Aluminium catamarans and/or flat bottom boats.	8 x Aluminium catamarans and/or flat bottom boats.	16 x Aluminium catamarans and/or flat bottom boats.
Crew	Crew capable of securing booms.	1 x Trained operator/Team Leader. 4 x Labourers.	1 x Trained operator/Team Leader. 4 x Labourers.	1 x Trained operator/Team Leader. 4 x Labourers.	48 hours on site post-spill.	5 x Trained operators/ Team Leaders. 20 x Labourers.	10 x Trained operators/ Team Leaders. 40 x Labourers.	20 x Trained operators/ Team Leaders. 80 x Labourers.
Booming systems	A system that can effectively and efficiently direct or prevent the movement of oil.	Various lengths of land/sea boom, shoreline protection	Various lengths of land/sea boom, shoreline protection	Various lengths of land/sea boom, shoreline protection	48 hours on site post-spill.	Various lengths of land/sea boom, shoreline protection	Various lengths of land/sea boom, shoreline protection	Various lengths of land/sea boom, shoreline protection

Means/task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
		booms, sorbent booms.	booms, sorbent booms.	booms, sorbent booms.		booms, sorbent booms.	booms, sorbent booms.	booms, sorbent booms.
Marine side (based on one team, resources will need to be scaled up for additional teams)								
Vessel	Vessel capable of assisting land-side crews to secure booms in waterways and in the shallow seas.	1 x Shallow draft work boat. Operational crew for same.	1 x Shallow draft work boat. Operational crew for same.	1 x Shallow draft work boat. Operational crew for same.	48 hours on site post-spill.	4 x Shallow draft work boat. Operational crew for same.	8 x Shallow draft work boats. Operational crew for same.	16 x Shallow draft work boats. Operational crew for same.
Crew	Crew capable of securing booms.	1 x Trained Operator/Team Leader. 2 x Labourers on-board.	1 x Trained Operator/Team Leader. 2 x Labourers on-board.	1 x Trained Operator/Team Leader. 2 x Labourers on-board.	48 hours on site post-spill.	2 x Trained Operators/ Team Leaders. 4 x Labourers on-board.	16 x Trained Operators/ Team Leaders. 32 x Labourers on-board.	32 x Trained Operators/ Team Leaders. 64 x Labourers on-board.
Booming systems	A system that can effectively and efficiently direct or prevent the movement of oil.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	48 hours on site post-spill.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.6 Shoreline clean-up strategy

Table 3-15: Shoreline clean-up operations

Task	Guidance
Shoreline clean-up, subject to amenable weather conditions and access, is the use of a variety of clean-up methods on shorelines to remove stranded hydrocarbons, and to minimise the potential ongoing environmental damage caused by those hydrocarbons.	
Analysis of trajectory modelling (OMP1)	Planning Chief and Environment Unit Leader analyse trajectory models (pre-event modelling and real-time modelling) to predict which shorelines may be impacted by oil, time to impact, probability and quantity of oil to shore. Priority coastline sections are compared with the shorelines that are predicted to be oiled and available tactical plans are activated.
Analysis of aerial observation and current situational awareness (OMP1)	Planning Chief and Environment Unit Leader to use aerial surveillance data, information gathered by the Situation Unit and the protection priorities identified in pre-spill planning as a starting point for shoreline surveys and clean-up activities.
SIMA	Priority of the implementation of tasks to support this strategy will be focused on cleaning oil from shorelines with the highest environmental sensitivities. Planning Chief and Environment Unit leader to determine where the optimal mitigation outcomes will be achieved through shoreline clean-up activities. This analysis will require information gathered by shoreline assessment field teams, and consulting with WA DoT representatives to confirm protection priorities. SIMA Shorelines will be assessed for the extent of the oiling, with this information reported back to the VOGA ICT to determine which shoreline(s) is/are the priority for clean-up. This determination will be made based on the preparatory SIMA, and the SIMA that will be undertaken at the time by the Planning Unit within the ICT. Shoreline clean-up will follow a three-stage methodology (refer to ITOPF Technical Information Paper No. 7): 1. Emergency phase – collection of oil floating close to the shore and pooled bulk oil removal. 2. Project phase – removal of stranded oil and oiled shoreline material that cannot be cleaned in-situ. 3. Polishing phase – final clean-up of light oil contamination and removal of oil stains, where the incident SIMA demonstrates this is necessary. Actual clean-up tasks for each of the three stages will be selected based on an assessment of suitability for the clean-up task for the oil character and shoreline type. Where trajectory modelling indicates likely multiple strandings of oil, and a SIMA indicates no likely worse outcome, shores may be left to recover without intervention. In undertaking this three-step process, VOGA contractors, employees and support agencies will work to effectively and efficiently clean shorelines where possible.

Task	Guidance
	A number of technical guidance notes exist for shoreline assessment and clean-up operations. These include the Environment Canada SCAT Guidelines (2007), the POSOW Shoreline Clean-up Guidelines, the UK SCAT Manual (2004), and the WA DoT Oiled Shoreline Field Book.
Deploy shoreline clean-up teams	Deploy 8 shoreline clean up teams by Day 4 to priority coastline sections verified by the SCAT survey, SIMA and OSTM analyses. One trained shoreline team leader and ten shoreline clean up workers per team. By day 20 have a total of 100 shoreline clean-up teams ready for deployment.
Logistics	Logistics Chief activate resources in Logistics Management Plan [VOG-7000-RH-0008]. Finance Chief to ensure that personnel records are completed.
Induction and training	Operations Chief to ensure that shoreline teams are informed of how to minimise damage to flora and avoid encounters with fauna. Induction and training of onshore teams accessing to uninhabited islands to include that spill response teams should avoid disruption of environment and take practical tactical precautions to avoid contact with flora and fauna. The number of staff and teams required will vary according to the sensitivities being protected. Operations Chief to also ensure the waste management plan prepared by Planning and Logistics is implemented on site.
Marine vessel transport of people and equipment	Logistics Chief to secure marine vessel(s) capable of carrying crew and spill equipment to remote islands.
Aerial surveillance and/or transport	Logistics Chief to secure aircraft to enable ongoing aerial surveillance of shorelines and/or transport of people and equipment.
Equipment	Cleaning equipment, decontamination set. The type and amount of equipment required for shoreline clean-up will depend on the technique used) and operational constraints such as access to the shoreline and weather conditions. Equipment held in the State stockpiles (DoT) is suitable for shoreline clean-up activities as well as the equipment held in AMOSC and AMSA stockpiles. Additional resources can be accessed from OSRL.
Ongoing clean-up operations	Planning Chief and Operations Chief decide in each IAP cycle which shorelines are to be cleaned and the clean-up method to be used. The decision to use particular clean-up methods will be based on the information provided by the SCAT teams and operational teams working the shorelines. Shoreline clean-up, subject to amenable weather conditions and access, is the use of a variety of clean-up methods on shorelines to remove stranded hydrocarbons, and to minimise the potential ongoing environmental damage caused by those hydrocarbons. Priority of the implementation of tasks to support this strategy will be focused on cleaning oil from shorelines with the highest environmental sensitivities. Shoreline clean-up teams will be directed (as part of the IAP) to mount operations in areas where the optimum mitigation outcomes will be achieved. This analysis will be undertaken at the time by the Planning Team, using shoreline assessment field

Task	Guidance
	teams, and consulting with WA DoT representatives to confirm protection priorities. The WA DoT will be consulted in the SIMA process and response strategy selection for OSR that impacts State waters. Sorbents will not be used for shoreline clean-up on high energy shorelines. Mechanical removal and high pressure flushing will not be undertaken in mangrove areas. Water from high pressure flushing will not be directed in between rocks and onto sediment.
Waste collection and transport	Where shoreline clean-up is occurring, VOGA will implement the establishment of hot, warm and cold zones, to minimise secondary contamination. Local sites will be used for the temporary storage of soiled material, liquid waste and solid waste/oil mixes, to enable appropriate final waste solution to be effectively implemented. Shoreline waste generation can be reduced by identifying shorelines likely to be impacted and pre-cleaning the shore of debris and vegetation before oil strands, thus reducing the total amount of oily waste to dispose of. Shoreline waste generation can range from three to over 10 times the amount of oil stranded. Sorbent materials will be stored in a contained storage area prior to transport and disposal to prevent any further contamination of habitats.
Incident action planning	At the completion of shoreline clean-up operations, the Planning Chief will review the operations based on a briefing from the Operations Chief and provide a recommendation to the Incident Commander for future shoreline clean-up activities.
Effectiveness guidance for response strategy	OMP6 – Shoreline assessment. OMP7 – Sediment quality. OMP4 – Water quality. OMP5 – Oil encounter rate. • Shoreline surveys undertaken. • Information collected in surveys used to inform clean-up activities. • Shoreline clean-up activities don't do further damage than oil alone. • Waste stored and removed offsite. • Shoreline clean-up endpoints agreed to and closed out by stakeholder representatives.

Table 3-16: Shoreline clean-up minimum resource requirements

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Induction	Shoreline teams are informed of how to minimise	1 x Trainer.	1 x Trainer.	1 x Trainer.	72 hours on site post-spill.	1 x Trainer.		3 x Trainers.

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
	damage to flora and avoid encounters with fauna.							
Manual shoreline clean-up activities	Floating oil close to shore collected and pooled bulk oil removed. Stranded oil removed. Cleanup of light oil contamination (polishing phase).	8 team leaders and 80 clean-up workers (88 people) sourced and mobilised to forward operating base.	8 team leaders and 80 clean-up workers (88 people) sourced and mobilised to forward operating base.	8 team leaders and 80 clean-up workers (88 people) sourced and mobilised to forward operating base.	3 shoreline clean-up teams (30 workers and 3 team leaders) mobilised and on site for induction within 72 hours post spill.	8 shoreline clean-up teams on site (88 people – 1 trained team leader, 10 workers per team).		100 team leaders and 1,000 workers sourced and ready to deploy to forward operating base.
Logistics	Crews are safe, fed, in contact with other parts of the response and watered.	Mobilisation of PPE, food, water, shelter, communications network.	Mobilisation of PPE, food, water, shelter, communication s network.	Mobilisation of PPE, food, water, shelter, communications network.	72 hours on site post-spill.	PPE, food, water, shelter, communications network. Amenities for 88 pax.		PPE, food, water, shelter, communications network. Amenities for 1,100 pax.
Marine vessels	Marine vessel(s) capable of carrying crew and spill equipment to remote islands.	Marine vessels.	Marine vessels.	Marine vessels.	72 hours on site post-spill.	8 x Marine vessels to support transport of personnel, equipment and ammenities. 3 x marine vessels capable of accomodating shoreline. clean-up teams working at priority island locations.		20 x Marine vessels to support transport of personnel, equipment and ammenities. Marine vessels and/or floatel capable of accomodating

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
								shoreline clean-up team members working on islands.
Equipment	Cleaning equipment and decontamination set selected according to suitablity for clean-up task and shoreline type.	20 x shoreline clean-up kits made up of shovels, plastic bags, rakes, buckets, wheelbarrows. Decon kit.	20 x shoreline clean-up kits made up of shovels, plastic bags, rakes, buckets, wheelbarrows. Decon kit.	20 x shoreline clean-up kits made up of shovels, plastic bags, rakes, buckets, wheelbarrows. Decon kit.	72 hours on site post-spill.	80 x shoreline clean-up kits made up of shovels, plastic bags (20kg capacity), rakes, buckets, wheelbarrows and PPE. 2 x decontamination stations (1 per operational zone) Mechanical equipment: 2 x front end loaders for work on mainland locations. 2 x graders for work on mainland locations. 4 x skid steers. 8 x 4WD vehicles (1 per team leader).		1,000 x shoreline clean-up kits made up of shovels, plastic bags (20kg capacity), rakes, buckets, wheelbarrows and PPE. 20 x decontamination stations (based on 5 operational zones and to be determined with real time data). Mechanical equipment: 10 x front end loaders for work on mainland locations. 10 x graders for work on mainland locations. 20 x skid steers. 50 x 4WD vehicles (mainland only).

Means/ task	Outcomes	Minimum resources required for first 48 hours			Timeframe	5 days	10 days	20 days
		Category D	Category E	Category F				
Booming systems	A system that can effectively and efficiently direct or prevent the movement of oil.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.	48 hours on site post-spill.	Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.		Various lengths of land/sea boom, shoreline protection booms, sorbent booms. Crew to operate the system.
Waste collection, storage and transport	Short term waste collection. Long term oily waste collection based on total oil ashore for a single worst case single trajectory (Category E) 18,214m^3 with a bulking factor of 10.	Temporary waste storage capability activated.	Temporary waste storage capability activated.	Temporary waste storage capability activated.	48 hours to marine operating base post-spill.	Temporary waste storage on site to clean-up locations for 18,920m^3 oily waste.	Waste transferred to intermediate storage and potentially final waste disposal.	Temporary waste storage on site to clean-up locations for 182,140m^3 of waste collected over 182 days. Waste transferred to intermediate storage and potentially final waste disposal.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

3.2.7 Oiled Wildlife Response strategy

3.2.7.1 Wildlife First Strike Response

Table 3-17: Wildlife first strike response

Task	Guidance
Activate WAOWRP and POWRP	Call the DBCA State Duty Officer on telephone **(08) 9219 9108.** The DBCA State Duty Officer will notify an OWA. Appoint a Wildlife Division Coordinator. First strike response activities may be undertaken within the Environment Unit of the Planning section until a Wildlife Division Coordinator is actually in the ICC.
Rapidly assess the situation	Review OSTM – both the model used in response planning and the real time when available. SITREP – reports of wildlife both oiled and active within the response area.
Provide advice to the IMT in relation to the wildlife assets at risk	Wildlife Division Coordinator to undertake. Use POWRP to identify wildlife assets at risk, cross reference with wildlife information contained in SIMA.
Determine the response level	Will be OWR Level 6 for OPP2 (Category D, E, F spills) and a lower level for OPP1.
Liaise with Oiled Wildlife Advisor	Wildlife Division Coordinator to liaise with OWA.
Gather information from POWRP	Wildlife specific for POWRP Operational Sectors 7 - 12 initially then most appropriate Operational Sectors between days 10-20
Activate first strike response kits	Wildlife Division Coordinator and OWA discuss get approval from IC. First strike kits are portable and contain equipment to allow stabilisation of wildlife before triage and possible treatment at an oiled wildlife facility. Refer to Table 3 of the POWRP for kit location and access details.

3.2.7.2 Mobilisation of resources

Table 3-18: Mobilisation of resources

Task	Guidance
Personnel	Activate and mobilise a Wildlife Operations Coordinator to Dampier.
	Activate the AMOSC OWR Industry Team

Task	Guidance
	DBCA volunteer database – access through DBCA Duty Officer.
	Labour Hire – source personnel with the following skill sets/abilities: • Work away from home. • Work with animals. • Work in remote locations. • Medically fit. Source unskilled personnel (OWR skill level 1), mobilise to Dampier and conduct induction process and basic training developed by DBCA.
Equipment	Containers for OWR facilities –Dampier to be set up first to service POWRP Operational Sectors 7-12. Planning to be undertaken for staging sites in various locations in addition to holding centres and/or oiled wildlife facilities (small, medium or large) for Exmouth, Onslow or Port Hedland between days 10 and 20 and Broome beyond Day 20. To be confirmed by OSTM and the SIMA process at the time of the spill.
	Support mobilisation of first strike response kits to priority shoreline staging areas see Table 7-7.

3.2.7.3 Wildlife reconnaissance

Table 3-19: Wildlife reconnaissance

Task	Guidance
Reconnaissance across priority shorelines between Robe River Mouth and Dampier Archipelago prior to Day 10, with specific locations determined by OSTM and the initial SIMA at the time of the spill. Resources are required to identify and record location of oiled wildlife as well as determining the presence of wildlife in areas predicted to be impacted by oil. Real time wildlife reconnaissance is necessary to ground truth information contained in the POWRP due to seasonal and inter-annual variation in abundance and distribution of wildlife.	
Aerial reconnaissance	• Aerial reconnaissance will be highly beneficial to identify concentrations of wildlife that can then be targeted by foot or boat. • Where possible, combine the aerial surveillance activities undertaken in monitor and evaluate to gain situational awareness of wildlife that has been oiled or is likely to be oiled. • Need to emphasise data flows – make sure the information gathered is shared within the ICT for the IAP and OSMP activities. • Oiled wildlife specific reconnaissance of known habitats and of shoreline that is predicted to be impacted to identify potential for pre-emptive action.
Marine reconnaissance	• Vessel based reconnaissance will be required for islands and mangroves in POWRP Operational Sectors 7 to 12

Task	Guidance
Shoreline reconnaissance	• For stretches of sandy beach, reconnaissance can be conducted by ATV or 4WD. In areas where beach access is not possible via vehicle, (i.e. cliffs) reconnaissance by foot will be required. • All coastal access by vehicles on Barrow Island is forbidden unless approval is granted by DBCA. • See notes regarding access of personnel to Barrow Island – quarantine and induction requirements.

Table 3-20: OPP 3 OWR minimum resources

Means/task	Outcomes	Minimum resources required for first 48 hours	Timeframe	5 days	10 days	20 days
OPP3 activities – first strike response, mobilisation of resources and wildlife reconnaissance (OWR Stages 1-3)						
Wildlife first strike response	WAOWRP and the POWRP are activated.	N/A – activation task only	Once OPP1 or OPP2 is activated.	N/A – activation task only	N/A – activation task only	N/A – activation task only
	OWA and Wildlife Division Coordinator are activated and assigned to the ICT.	1 x OWA. 1 x OWR Division Coordinator.	Once WAOWRP is activated.	N/A – activation task only	N/A – activation task only	N/A – activation task only
Mobilisation of resources	First strike response kits are mobilised to staging areas within the POWRP Operational Sectors 7 -12.	Vehicles/small trucks to deliver 6 x first strike response kits to operational sectors. Vessels/aircraft to take kits to islands. 1 x OWA. 1 x OWR Division Coordinator.	Within 24 hours.	Mobilisation for Dampier 1 x OWA. 1 x OWR Division Coordinator.	Mobilisation for between North West Cape and Eighty Mile Beach 1 x OWA. 1 x OWR Division Coordinator.	Mobilisation for Eighty Mile Beach to Broome area if applicable - Activation of Kimberley OWRP if required (Sectors 1 & 2) 1 x OWA. 1 x OWR Division Coordinator.
	Two OWR containers are mobilised to an OWR facility location in Dampier.	2 x OWR containers from Dampier (AMSA) and Fremantle (AMOSC).	Within 24 hours.	2 x OWR containers deployed to Dampier OWR facility.	N/A – containers deployed	N/A – containers deployed

Means/task	Outcomes	Minimum resources required for first 48 hours	Timeframe	5 days	10 days	20 days
Wildlife reconnaissance across POWRP Operational Sectors 7 – 12.	Information contained in POWRP and SIMA is ground truthed. Situational awareness regarding wildlife that has been oiled and wildlife present within the path of the spill trajectory is gained.	1 x aerial observation over extent of spill combined with Monitor and Evaluate tasks. 1 x aerial observation over extent of predicted trajectory requires 1 x aircraft. Aerial survey: 1 x observer; 1 x aircraft; 1 x aerial support base for the task. Utilise aerial spill surveillance aircraft and personnel if none available specifically for oiled wildlife reconnaissance.	Concurrently with monitor and evaluate activities. Wildlife specific reconnaissance within 24 hours.	Aerial survey: 2 x observer; 1 x aircraft (fixed wing or helicopter); 1 x aerial support base for task. Boat based survey: 1 x small vessel (<12m length) 1 x boat driver; 2 x crew Shoreline survey: 2 x Quad motorbike or 4WD vehicle; 4 x survey crew. 8 x additional team members.	Aerial survey: 2 x observer; 1 x aircraft (fixed wing or helicopter); 1 x aerial support base for task. Boat based survey: 1 x small vessel (<12m length); 1 x boat driver; 2 x crew. Shoreline survey: 2 x Quad motorbike or 4WD vehicle; 4 x survey crew. 8 x additional team members.	Aerial survey: 2 x observer; 1 x aircraft (fixed wing or helicopter); 1 x aerial support base for task. Boat based survey: 1 x small vessel (<12m length); 1 x boat driver; 2 x crew. Shoreline survey: 2 x Quad motorbike or 4WD vehicle; 4 x survey crew. 8 x additional team members.
N						
IAP wildlife sub-plan development	Future OWR activities arrangement developed based on the spill scenario.	1 x OWR Advisor; 1 x OWR Planning officer; 1 x OWR Division Coordinator.	Within 48 hours.	12 x personnel.	12 x personnel.	12 x personnel.
Wildlife rescue and staging	OWR rescue operations should determine the best combination of pre-emptive capture, hazing and the collection and management of oiled wildlife based on resources available.	Boat based collection/hazing: 1 x small vessel (<12m length); 1 x boat driver; 2 x Crew; 2 x Capture nets; 10 x Cages (depending on vessel deck space & type of oiled wildlife encountered –	Within 72 hours.	Boat based collection/ hazing: 1 x vessel (<12m length); 1 x boat driver; 4 x crew; 4 x Capture nets; 50 x Cages	Boat based collection/ hazing: 1 x small vessel (<12m length); 1 x boat driver; 2 x crew; 2 x Capture nets; 10 x Cages	Boat based collection/ hazing: 1 x small vessel (<12m length); 1 x boat driver; 2 x crew; 2 x Capture nets; 10 x Cages

Means/task	Outcomes	Minimum resources required for first 48 hours	Timeframe	5 days	10 days	20 days
	Begin establishing staging site as a logistic base for search and capture teams. Staging areas to be set up in POWRP Operational Sectors 7-12. Then in most appropriate Operational Sectors between North West cape and Eighty Mile Beach in Day 10-15.	seabirds are most likely in this timeframe).		Staging site: 1 x OWR Kits (AMSA/ AMOSC). 25 x personnel.	Staging site(s): 2 x OWR kits (AMSA/ AMOSC) 25 x personnel.	Staging site(s): 2 x OWR kits (AMSA/ AMOSC). 25 x personnel.
Establishment of an oiled wildlife facility	Establish and manage OWR Facility in Dampier and Exmouth or Port Hedland.	1 x Suitable area for facility pre-identified/analysed for suitability i.e. Dampier Sharks Football Club (Pilbara OWRP) or Windy Ridge Oval and Facilities; 2 x OWR containers; existing built facilities or temporarily erected/installed structures i.e. marquees (at least 4m x 4m), mobile site offices; shower and toilet facilities; laundry facilities or contactor to outsource laundering; resources and equipment as listed in the WAOWRP.	Within 3-4 days for Dampier and between 10 -15 days for Exmouth, Onslow or Port Hedland.	Mobilise resources for oiled wildlife facility. 18 x personnel.	Oiled wildlife facility set up by Day 15. 18 x personnel.	Dampier and additional OWR facility operating resources. 18 x personnel.
Wildlife rehabilitation	OWA and OWR Planning officer to gather information on the spill to gauge potential wildlife impacts and therefore long-term rehabilitation requirements.	1 x OWR Planning officer; 1 x OWR Division Coordinator. Activation of OSMP oiled wildlife contractor.	By Day 5.	1 x OWR Planning officer; 1 x OWR Division Coordinator. 56 x personnel. Maintenance of OSMP oiled	1 x OWR Planning officer; 1 x OWR Division Coordinator. 56 x personnel.	1 x OWR Planning officer; 1 x OWR Division Coordinator. 56 x personnel. Maintenance of OSMP oiled

Means/task	Outcomes	Minimum resources required for first 48 hours	Timeframe	5 days	10 days	20 days
	Incorporates OSMP scientific monitoring tasks specific to oiled wildlife.			wildlife contractor.	Maintenance of OSMP oiled wildlife contractor.	wildlife contractor.
Oiled wildlife termination	Oiled wildlife rescue and rehabilitation of animals is completed. Establish a demob team to ensure all records are forwarded to the logistics section for processing, all facilities are decontaminated, stocks replenished, all waste is removed and all wildlife still in care is transferred to a suitable wildlife rehabilitation facility, i.e. Perth Zoo.	N/A	By Day 10.	N/A	4 x personnel for the demob team plus labour if required.	4 x personnel for the demob team plus labour if required.

LEGEND:	Resources required	Resources possibly required	Resources unlikely to be required

4 Termination and recovery

4.1 Response strategies termination criteria

Consistent with the National Plan, VOGA's priority in a response to an oil spill incident is human health and safety, meaning that response activities will cease if operations cannot be carried out in a manner that do not present unmanageable risks to human safety.

Termination criteria will aid the decision to terminate OSR activities for each strategy. Note that these termination criteria only apply if the strategy is able to be operationally implemented (e.g. the weather conditions allow marine/aerial operations to take place).

Response strategies are monitored throughout implementation and the following considerations are taken into account (in addition to safety issues) when determining if a response strategy is lowering impacts to ALARP:

- measures are no longer effective;
- further clean-up is likely to cause greater environmental damage (SIMA);
- the level of response is out of proportion to the amount of oil on the water; and
- when the costs of the response are exceeding the likely benefits, i.e. the point of diminishing returns is reached in terms of monetary costs.

As per the spill response planning process outlined in Figure 3-1, the operational SIMA provides guidance to the identification of termination criteria, by assessing if the:

- response strategy reduces the probability of impact of to the sensitive receptors;
- response strategy increases the number of days before impact to the sensitive receptors;
- response strategy reduces the average and/or total amount of oil to impact the sensitive receptors;
- response operation has more of a negative impact than untreated oil; and
- controls that are put in place to mitigate impacts associated with the proposed response strategy.

If risks associated with the response strategy are aligned with the Well Construction and Wandoo Field EP and this Wandoo Field OSCP, then KPIs (effectiveness measures which inform termination criteria) are developed, response strategies implemented and assessed. If termination criteria are met then the response strategy ceases. Table 4-1 presents termination criteria that can be used in the spill response planning process (IAP process). Shoreline clean-up termination criteria are explained in more detail separately because of the complexity that maybe present in a shoreline response (Table 4-2).

Table 4-1: Termination criteria

OSR strategy	Termination criteria for each OSR strategy
Monitor and evaluate	The spill is no longer visible to human observers. Specifically, a 'silvery/grey' sheen, as defined by the Bonn Agreement Oil Appearance Code (BAOAC), is no longer observable. Modelling will continue until response modelling predicts oil concentrations in the environment due to the spill are below contact threshold concentrations of $10g/m^2$ surface oil, 100ppb entrained oil and 50ppb dissolved aromatic hydrocarbons. When operational monitoring undertaken to evaluate effectiveness of response strategies is no longer required.
Chemical dispersion	Chemical dispersant activities will cease if the SIMA output demonstrates that the response strategy: • does not reduce the probability of oil impacting sensitive receptors; • does not increase the number of days to impact sensitive receptors; • does not decrease the volume of oil to impact sensitive receptors; • has more of a negative impact on sensitive receptors than the untreated oil (e.g. impact of entrained oil); or • hazard controls put in place are not achievable.
Containment and recover	Weir skimmers are recovering <10% hydrocarbon by volume, oleophilic skimmers are recovering <50% hydrocarbon by volume, entrapment in booms is no longer effective, or the observed trajectory of the oil indicates that it is heading away from sensitive receptors.
Mechanical dispersion	Oil is not observed to be effectively dispersed into the water column. The spill is no longer visible to human observers. Specifically, a 'silvery/grey' sheen, as defined by the BAOAC, is no longer observable.
Protect and deflect	Booms are unable to be deployed because of safety concerns or sea state and weather prevents effective deployment of equipment. The spill is no longer visible to human observers. Specifically, a 'silvery/grey' sheen, as defined by the BAOAC, is no longer observable.
Shoreline clean-up	Termination criteria for shoreline clean-up activities is site dependant and will be based on scientific advice that suggests further clean-up activities are unlikely to materially decrease lasting hydrocarbon impacts on environmental sensitivities. Termination points are likely to be selected based on the general clean-up objectives, which are to: • minimise exposure hazards for human health; • speed recovery of impacted areas if possible; and • reduce the threat of additional or prolonged natural resource impacts. Table 4-2 provides some examples of how shoreline clean-up termination points can be described. WA shorelines are within the jurisdiction of the WA State Government, the decision to cease shoreline clean-up will be made with advice from the WA DoT to take into account the State ESC position. Shoreline clean-up activities will cease if a safe working environment is not present for responders.
Oiled Wildlife	Termination criteria for oiled wildlfie response is dependent on the incident and will be based on the termination criteria described in Stage 8 of the WAOWRP.

4.1.1 Shoreline termination criteria

Due to the site and spill specific nature of shoreline clean-up, termination points are developed for the specific incident, however there are some guiding principles that VOGA will consider when working with the State ESC and stakeholders to identify termination points.

Termination points, also known as end points for shoreline clean-up are likely to be selected based on the general clean-up objectives, which are to:

- minimise exposure hazards for human health;
- speed recovery of impacted areas if possible; and
- reduce the threat of additional or prolonged natural resource impacts.

These objectives lead to developing clean-up strategies and end points that do not cause more harm to the environment than good (Oil Spill Response 2011).

Ideally, clean-up efforts will return the resource to its baseline condition without suffering further impact or affecting other resources. Aggressive and inappropriate clean-up techniques can make matters worse. Less intrusive methods or natural recovery are often preferable. The best clean-up strategy is often not the one that removes the most oil; rather, it is the strategy that removes oil that poses a greater risk of injury than would result from clean-up, and allows remaining oil to be removed by natural processes.

The Environment Unit within the Planning Section will provide the following in regards to shoreline clean-up:

- guide the Operations Section in conducting specific clean-up methods to minimise adverse environmental impact (best management practices);
- provide the Operations Section with environmental and safety constraints on conducting clean-up activities in specific habitats;
- develop spill-specific clean-up objectives, guidelines and termination points. This will require input from the State ESC because the DoT is the Controlling Agency and jurisdictional authority for OSR in State waters. Examples for shoreline clean-up that may be used as the basis for developing the spill-specific clean-up termination points with the State ESC are described in Table 4-2;
- identify time-critical and degree-of-use issues to be combined with clean-up priorities and end points; and
- identify sensitive resources that may be adversely affected by the proposed treatment methods (e.g. rich intertidal biota on rocky shores where low pressure ambient water flushing will be used).

Table 4-2: Shoreline clean-up termination points

No oil observed: not detectable by sight, smell, feel	• This end point is often used for sand beaches where oil removal can be effective without delaying resource recovery. • Visual inspections are preferred over chemical analysis of samples because of: difficulty of sampling areas with high variability; time and costs to complete sampling and analysis; and lack of guidelines on what levels are safe.

Visible oil but no more than background	• This termination point is often applied where there is a significant background rate of tar ball deposition on the shoreline.
No longer generates sheens that will affect sensitive areas, wildlife, or human health	• This termination point is used where sheening persists after clean-up efforts become ineffective, or on sensitive habitats where further clean-up efforts will cause more harm than natural removal. Residual sheening should persist over a relatively short time period. • Sheen is an oil film ranging from barely visible to dull colours. Sorbents effectiveness is usually limited in recovery of sheens. Consider the amount and duration of sheening, and the distance to sensitive resources, to determine if sheening poses a significant threat. • Consider the degree of exposure: high wave/tidal exposure speeds removal and breaks up sheens; sheltered areas will sheen longer and sheens will be more persistent. • Consider the degree and timing of use: sheening may be tolerated in areas or during periods of low use; even minor sheens may not be tolerated in areas of high use, such as swimming beaches.
No longer rubs off on contact	• This termination point is usually defined as oil removal to a stain or coat, or weathering to the point that it is no longer sticky. It is applied to hard substrates (rocky shores, seawalls, riprap, and gravel) and vegetation (marshes, mangroves). • The objective is to prevent oiling of fur, feathers, and feet of wildlife, and oiling of people and property during contact with oiled surfaces. • Consider the degree and timing of use: high-use areas often require higher cleanliness, whereas natural removal is allowed in low-use areas where further clean-up efforts will be disruptive.
Oil removal to allow recovery/re-colonisation without causing more harm than natural removal of oil residues	• This termination point is used where further oil removal will result in excessive habitat disruption (e.g. trampling of soft sediments and plant roots, mixing oil deeper, extensive sediment removal, vegetation cutting) or high biota mortality (e.g. from high-pressure, hot-water washing of intertidal communities). • It is also used for areas with difficult access, which limits the type of clean-up that can be conducted along that shoreline segment. • Consider the potential for erosion from excessive sediment removal, particularly where erosion/deposition patterns of the beach cycle will rework and clean sediments within an acceptable timeframe.

4.2 Stakeholder engagement in termination

Community and stakeholder understandings and expectations will play a role in both the decision to terminate a response and the acceptability of the decision. Consultation with these groups will be undertaken by VOGA prior to any termination decisions being implemented.

4.3 Post-response recovery

Following termination of the incident response, VOGA will undertake an investigation to identify any ongoing impacts to the environment or communities, and provide a coordinated plan for addressing these impacts.A debriefing and post-incident analysis will be undertaken with responders and stakeholders, to identify any improvements to this plan as appropriate.

PART 6: Support Plans

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5 Waste management

5.1 Waste management strategy

The purpose of the strategy is to ensure during an oil spill response, VOGA:

- Engage government agencies to obtain the appropriate waste management approvals necessary for the collection and transportation of waste;
- Cater for credible recovered waste during a response;
- Activate the key logistic contractors for the storage, transportation and disposal of collected waste;
- Ensure the collect segregation practices of waste are undertaken; and
- Terminate the waste management program on completion of the response.

Details of VOGA waste management practices are contained in VOGA's Emergency Response Logistics Management Plan [VOG-7000-RH-0008].

5.2 Waste management activation

Activation of the waste management plan assignments is an action step in the IAP and is the responsibility of the ICT Planning Chief for identification and ICT Logistic Chief for resource assessment and ICT Operations Chief for implementation.

Not all oil spill events will trigger a waste management activation. Once oily waste is planned to be contained or collected then the waste management plan would be activated.

Key aspects to be acted one are:

- assessment and decision making - determine the likely volume and types of waste likely to be collected;
- regulatory approvals - apply for DER licence to operate temporary waste storage facility and access DoT OSCP (2015) to commence the recording and waste management approval processes;
- collection/recovery/transportation/storage (intermediate and final) - activation of the Logistic Plan for activation of containment and transportation methods;
- final disposal - monitor the final disposal methods; and
- termination.

5.3 Waste management basis

To develop a feasible waste management strategy for implementation during a response, VOGA has considered:

- DoT's OSCP (2015) Waste Management Sub-Plan;
- VOGA waste contractors capability – assessed within the OSR Capability Review [VOG-7000-RH-0009];
- WA OSCP Marine Oil Pollution Waste Management Guidelines – provides information regarding the transportation of waste and temporary storages sites including an OSRA output of potential temporary storage sites;
- Decanting waste water at sea JIP;
- OSTM outputs for shoreline oiling greater than 100g/m^2;
- Environmental risks and the controls associated with waste management;
- Upper credible recovery rate for spill strategies (refer to Section 7.5);
- ITOPF technical papers to guide likely waste to hydrocarbon quantities ('bulking rates') associated with these strategies (refer to ITOPF Technical Information Paper 7 and 9); and
- AMSA management and disposal of oily waste and debris information.

5.4 Regulatory approvals

The waste management plan will require the support of logistics to source storage and transport options and to obtain the necessary approvals required for contaminated waste transportation and disposal.

As the temporary waste storage and treatment facilities will trigger the Category 61 thresholds within the *Environment Protection Act 1986*, a licence to operate will be required from the DER for any storage or treatment of wastes. As Works Approvals and licences can only be prescribed to specific premises, and suitable premises may not be determined until a spill has eventuated, obtaining these formal approvals is not possible in advance.

Specific regulatory approvals required or potentially required are listed in Table 5-1.

Table 5-1: Regulatory approvals for waste management activities

Approval required	Authority	Process
S75 Emergency approval for temporary waste storage	DER	1. Identification of suitable land for operations. 2. Preparation of indicative site plan and operational flowchart. 3. VOGA to request emergency approval for waste storage of DER CEO. 4. Approval granted for 14 days. 5. Further approval requested for extra 14 days if required.

Approval required	Authority	Process
Approval of temporary lay-down area	DER	1. Design of temporary lay-down area prepared for consultation with DER, DoT and DBCA. 2. VOGA apply for temporary license at time of incident. 3. Required works commence. 4. Application received, and advertised in prescribed manner. 5. DER issue operating license for lay-down area.

During offshore recovery operations, it may be beneficial as a waste reduction strategy, to discharge low concentrations of oily water recovered back into the boomed area to reduce the bulking factor volume of oily water recovered.

Offshore discharges of oil in WA State waters also fall under WA *Pollution of Waters by Oil and Noxious Substances Act 1987*. If discharge of oily water becomes necessary, approval from:

- AMSA (Commonwealth waters) or
- DoT (State waters) must be obtained through submission of the MARPOL Exception Form for discharges of oily water.

5.5 Waste practices

Waste will generally be associated from two clean-up locations:

- at sea response operations; and
- shorelines.

Table 6-2 presents a summary of the type of waste generated from these two activaties:

Table 5-2: Summary of waste generated

Clean Up Location	Type of Waste Generated
At sea response operations	Non contaminated organic materials (pre-impact) Recovered oil Contaminated water/oil in water Contaminated containment and recovery equipment Containment/storage equipment Vessel hull Contaminated PPE, sorbent Organic and Non-organic flotsam and jetsam Animal carcasses
Shorelines	Recovered oil Water in oil Contaminated substrata- sand, pebbles, rocks Organic and non-organic Flotsam and jetsam Contaminated organic material seaweed etc. Animal carcasses Contaminated recovery and storage equipment Containment - 20kg bags, drums, plastic sheeting etc.

Clean Up Location	Type of Waste Generated
	PPE Responders waste for habitation

Shoreline clean-up and containment and recovery are likely to develop significant volumes of waste. However, particularly for shoreline clean-up, the amount generated will be significantly less given prudent work practices to minimise the amount of hard waste generated, and the likely impact being only a portion of the slick stranding, rather than the mass of volume assumed in shoreline clean-up waste calculations.

VOGA will leverage the waste hierarchy principles of waste reduction, reuse, recycling and disposal to minimise the amount of ultimate waste produced, thus reducing environmental and economic costs.

To reduce and manage the waste volumes during an incident, VOGA will follow, where appropriate and feasible, the work practices contained in Table 5-3.

Table 5-3: Waste minimisation work practices

Oil spill strategy	Waste minimisation work practice
Minimisation	Responder Induction to raise awareness of minimising collection or low/ partial contaminated materials minimising collection or low/partial contaminated materials. At sea operations – Decant waste water at sea as per the OSR JIP-17 and the WA Marine Oil Spill Waste Management Guidelines. • http://oilspillresponseproject.org/sites/default/files/uploads/JIP-17-Decanting.pdf • http://www.transport.wa.gov.au/mediaFiles/marine/MAC-MOP-WasteMgmtGuide.pdf Offshore and onshore – where practical access pre-impact and remove all flatsom and jetsam, miscellaneous material from water and between low-high water mark. Sort and classify waste into appropriate waste streams ASAP at source. Ensure a control on operations to comply with minimisation strategy. Consideration or washable PPE in lieu of disposals where appropriate. Early establishment of Hot and Cold areas to avoid cross contamination. Temporary storage areas are adequately contained- plastic sheeting /bunds to avoid secondary contamination.
Segregation	Responders Induction on need for waste segregation on work sites to manage waste collection and temporary storage. Segregation to consider the final treatment and disposal options. Sorting waste at source. Use of multiple containers to aid segregation of waste aligned with disposal/treatment practices.
At sea containment and recovery	Waste reduction – oil/water decanted back into the pocket of the boom to be re-skimmed and concentrated on-board. Oil-in-water concentration increases from 10% to at least 50%, thus reducing the bulking factor.

Oil spill strategy	Waste minimisation work practice
	Waste reduction – skimmers will be changed out to maximise the amount oil vs. water captured during the process (i.e. brush/disk skimmers over weir skimmers). The use of brush/disk skimmers can provide 90% oil concentration. Waste storage on-vessel – vessels will use a combination of IBCs and tanks to store larger volumes of oil/water. Temporary waste storage at marine terminal – robust logistics chain to enable efficient vessel/terminal unloading of product with 24/7 operations moving waste to final waste solution. This practice can help even out surges in generation/collection of waste. Final waste movement – 24/7 operations from temporary storage waste to final waste solution.
Shoreline clean-up	Pre-clean shorelines (where appropriate) of debris before oil strands to reduce solid waste. Waste reduction – manual over mechanical recovery. By applying this practice the bulking factor can be halved. Waste reduction – single bulk clean-up of shorelines rather than multiple clean-ups. By applying this practice the bulking factor can be halved, however this practice can only be applied where SIMA process supports this. Waste storage on-site – utilising areas of natural containment. This practice can help even out surges in generation/collection of waste. Waste storage on-site – allowing product to be temporary stored in bunds and bins. Final waste movement – 24/7 operations from temporary storage waste to final waste solution.

5.6 DoT waste reporting forms and processes

Due to DoT's jurisdiction over marine oil pollution response activities in state waters, VOGA will align its process with the DoT OSCP (2015) to streamline the information gathering and recording keeping between VOGA and DoT and use these forms and processes for both Commonwealth and State water impacts. The following DoT templates and forms may be adopted:

- Appendix C –Temporary Storage Site Suitability Assessment.
- Appendix D – Site Waste Management Pro-Forma.
- Appendix E – Waste Tracking Form.
- Appendix G – Waste Management Sub Plan Template.

5.7 Key waste streams

VOGA's Emergency Response Logistics Management Plan [VOG-7000-RH-0008] appendices present a detailed list of waste streams and likely containment requirements for a typical remote shoreline impact and a vessel offshore booming and recovery operation.

5.7.1 Non-oiled waste

Prior to impact, recovery of flotsam and jetsam that may be impacted by a spill will greatly reduce the type and volume of oiled waste generated. Pre-impact removal of organic and non-organic waste will be undertaken where time and logistic support is available.

5.7.2 Offshore oily waters

Assuming favourable conditions, vessels operating offshore will collect floating oil via trawling booms and skimmers.

Offshore discharges of oily water are specified through MARPOL regulations, which are in turn regulated by AMSA for Commonwealth waters, and the DoT within State waters.

In the event that approval for discharge of the water phase is not obtained through AMSA and/or the DoT, the complete collected fluids will remain in the collection tanks and all will be treated as a collected waste. In this event, the duration of containment and recovery operations will be reduced due to restricted available ullage.

5.7.3 Onshore oily waters

It is intended that shoreline storage of liquids will be of short duration, with third party contractors removing waste as soon as is practicable. All temporary storage of liquids will be performed within bunded areas and as per regulatory requirements.

5.7.4 Solid wastes

While oil-contaminated sand, rocks and debris from mechanical and manual clean-up operations will have considerable oil-contents (2-10%), recovery of these oils and cleaning of absorbed debris is difficult. At present, there are no readily available treatment options for these materials to reduce waste volumes from the operations, and disposal via landfill or incineration are the only options available.

Oily sands will be collected along the affected coastlines, skip bins will be distributed by telehandlers and readily accessible by clean-up crews. Wastes will then be either collected by operating mobile plant such as excavators, or through manual waste removal (bagged waste), and deposited into these bins.

In areas that are inaccessible by vehicles, barges may be used for the initial transfer operations, and transported to the marine operational base for pick-up.

Oil-contaminated sands and soils recovered during the operations will be deemed requiring Class III or Class IV landfills for disposal. In the event that oils are collected in such a form as to be too contaminated for landfill disposal, yet not liquid enough to be incorporated into the waste oil stream, then these solids will be segregated and despatched for incineration.

5.7.5 Oily organics

In conjunction with oil-contaminated sand, rocks and debris from mechanical and manual clean-up operations, it is anticipated that approximately 5% of the total solids stream will be organic in nature, consisting predominantly of seaweed, seagrasses and animal carcasses. In line with the waste hierarchy, it is desired to segregate these wastes and dispose to a composting facility to be turned into compost suitable for reuse.

Animal carcasses may be collected in plastic bags and stored in refrigerated containers were appropriate for later pathology testing or as directed by DBCA.

Authorised third parties will transport the waste to a commercial composter.

5.7.6 Remote location/islands

Methods used for cleaning up shorelines on Islands or remote areas of coastline will be similar to those for mainland shorelines. However, unlike on the mainland, the options of large mechanical waste collectors (bulldozers), easily accessible accommodation and immediate waste transfer via trucks is not available. These logistical challenges are overcome through the use of vessels capable of shoreline landings, smaller machinery and helicopters to deliver equipment and personnel and remove collected waste.

Access and all clean-up activities will be conducted via vessels or helicopters and require the establishment of hot/cold/warn areas to mitigate contamination waste collection will generally be undertaken manually with waste collected in 20kg bags to mitigate manual handling risks. As the response develops, tactical plans will establish if small mechanical equipment can be delivered to remote locations.

5.7.7 Oil spill equipment clean-up

During and after response activities, all oil contaminated PPE and disposable equipment/ items will be placed in separate plastic bags and transported in skips to a waste facility for final disposal. Re-useable equipment will be placed in skips and transported to the boom maintenance area for cleaning.

5.8 Waste assessment

An assessment of waste estimates for containment and recovery and shoreline clean-up assumptions have guided VOGA to establish upper maximum waste volumes which have been planned for within this OSCP. Total volume of oil ashore from a single worst case spill trajectory is basis from which oil estimates are calculated using a bulking factor of 10. Capability determination details are documented in the OSR Capability Review [VOG-7000-RH-0009].

6 Stakeholder engagement

6.1 Stakeholders

Stakeholder engagement is an important part of emergency management response, whether assisting with coordination of control and mitigation measures, liaison with regulatory bodies or responding to potential impacts on surrounding communities and businesses.

This section outlines the strategy to engage stakeholders during an OSR. The process for engaging relevant stakeholders pre-environmental plan approval or pre-campaign is addressed in the EP.

The stakeholders covered under this section of the plan include:

- key stakeholders for regulatory approval purposes;
- influencers; and
- interested parties (including communities, indigenous land owners and businesses) who are or may potentially be impacted by the oil spill or the associated response activities.

Key response/resource agencies are engaged through other sections of the ICT.

6.2 Stakeholder engagement strategy

6.2.1 Overview

In the very unlikely event of a significant event occurring, VOGA's primary responsibility is to the health and safety of all personnel impacted by the spill or the spill response. The stakeholder engagement process will at all times reflect and support this responsibility.

The purpose of the strategy is to ensure during an OSR, VOGA:

- engage government agencies to obtain the appropriate approvals and address regulatory requirements during an OSR;
- manage/mitigate the impact to surrounding communities, commercial operations including fishing and other petroleum operators; and
- keep stakeholders informed as required.

The strategy to engage the stakeholders during an OSR is provided in the following section. The engagement can be broken down into five distinct phases:

1. Pre-activity.
2. Activity.
3. Post-spill/pre-exposure.
4. Post-spill/post-exposure.
5. Termination.

The nature and frequency of further and ongoing stakeholder engagement will depend on the scale, duration, impact and other specifics of each incident.

6.2.2 Pre-activity

During this stage of the project, the objective is to ensure that:

- stakeholders have been defined, classified and consulted as appropriate;
- regulatory requirements are being met;
- the socio-economic activities that may be impacted by a potential spill or the response are identified;
- stakeholder contacts list have been checked and updated if required; and
- capability to provide response has been confirmed and outlined in a plan to implement the strategy available.

6.2.3 Activity

During this stage of the project, the focus is to maintain contact details and ensure information on the project and associated EP is accessible. A dedicated email address will be available at all times to interested parties wishing to contact the company.

6.2.4 Post-spill/pre-exposure

The purpose during this stage is to manage the potential impact that spill and response activities may have on stakeholders. This process is initiated as soon as a spill has occurred and the ICT is activated. During this stage, VOGA manages/mitigates the impact to stakeholders by:

- continually identifying specific stakeholders who may potentially be impacted by the spill and response strategy;
- where possible making contact with relevant interested parties prior to impact and keeping these stakeholders regularly informed and engaged;
- provide regulatory notifications and updates;
- providing relevant safety information on the event and potential hazards and precautions associated with the spill and response activities;
- confirming the process to engage with stakeholders regarding potential socio-economic impacts the spill and associated response may have and recording stakeholder input and responses; and
- provide information to media and engage influencers as required.

6.2.5 Post-spill/post-exposure

The purpose of this stage is to manage the direct impact that the spill and response activities have on stakeholders. During this stage, VOGA manages and attempts to limit the impact to stakeholders by:

- continuing to identify specific stakeholders who are being impacted by the spill and response strategy;

- providing relevant safety information on the event and potential hazards and precautions associated with the spill and response activities;
- engaging with relevant interested parties and keeping them regularly informed;
- implementing a process to monitor, report and record socio-economic impacts (positive and negative) as a direct result of a spill and spill response;
- where possible implementing measures to manage or limit the direct socio-economic impact of the spill and spill response, e.g. counselling, establishing community and recreational centres, providing financial support;
- providing regulatory notifications and updates; and
- providing information to media and engage influencers as required.

The OSMP includes an appropriate tool for reporting and communicating the state of the environment to relevant stakeholders via environmental report cards. Environmental report cards are designed to provide a readily interpretable summary of the state of a range of environmental variables. They summarise environmental and biodiversity monitoring information, allowing trends in condition (states of the environment) to be easily identified. They inform incident response decisions based on changes to trend and condition and provide a clear consensus for management decisions.

Environmental report cards provide several positive reporting outcomes:

- provide a template or structure for summarising and communicating trends in biodiversity and environmental values;
- communicate trends in values to managers and regulators in a simple, easy to interpret format;
- indicate the effectiveness of incident responses;
- allow a consensus interpretation of the data; and
- provide an indication of the quality or reliability of the data.

The environmental report card process is detailed within the OSMP (Appendix D).

6.2.6 Termination of oil spill response

Community and stakeholder understandings and expectations will play a role in both the decision to terminate a response and the acceptability of that decision. Consultation with these groups would be undertaken by VOGA prior to any termination decisions being implemented.

It should be noted that although the OSR may be terminated, there will be a continued and ongoing consultation with stakeholders impacted by the oil spill until a resolution is achieved.

6.2.7 Roles and responsibilities

The initial high-level division of engagement responsibilities can be summarised as follows:

- Stakeholder Liaison Officer – regulators, VOGA employees and VOGA contractors (not spill responders), VOGA Head Office;

- Logistics Officer – combat agencies; industry, including adjacent operators and contractors (spill responders); and
- Public Information Officer:
  - Community Liaison – local communities and interested parties, business, NGOs;
  - Media Liaison – local, national and international media; and
  - Public Information Controller – manage and coordinate all external communications.

The above three positions are located with the ICT and are involved in the regular debriefs and issuing of the IAP. These positions all report to the Corporate Command Operations Chief either directly or through the Stakeholder Liaison Officer.

6.2.8 Documentation and record keeping

All external communications occurring through the ICT, including with government, industry and community stakeholders, are documented in the ICT spill log or each officer's personal log. The Public Information Officer also records and manages all media inquiries and responses.

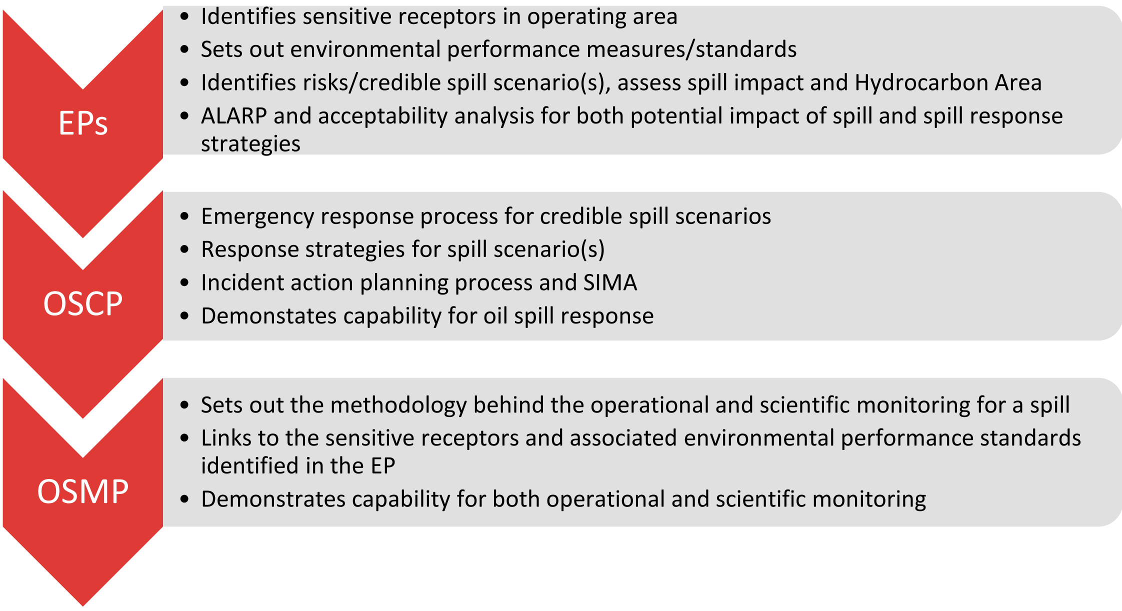
VOGA maintains comprehensive information on all identified stakeholders, including telephone, email and personnel details, and has access to an external email communications system in the event of impact to its own system.

7 Operational and scientific monitoring

The Wandoo Field OSMP [WAN-2000-RD-0001.03] (Appendix D) has been designed as part of an integrated package of the environmental management documentation including the EP and the OSCP. The OSMP is informed by the EP through the identification of the sensitive receptors in the Wandoo Field operating environment that could be impacted during an oil spill. The monitoring activities detailed in the OSMP may also provide a basis for:

- determining if (and/or when) the goals set for environmental protection are achieved;
- 'testing' the efficacy of predictions of impact presented in the EP; and
- 'testing' the effectiveness of the OSR within the OSCP.

Figure 7-1: Relationship between OSMP, OSCP and EP



The Wandoo Field OSMP [WAN-2000-RD-0001.03] (Appendix D) will be activated at the same time as the OSCP. The following details regarding the activation and undertaking of the OSMP include:

- values and receptors to be monitored;
- integration of operational and scientific monitoring;
- operational monitoring plans;
- scientific monitoring plans;
- data governance;
- roles and responsibilities; and
- resourcing and capabilities.

8 Health and safety

VOGA is committed to the health and safety of all personnel involved in OSR. VOGA's company policies and procedures in regards to safe working practices will be maintained during all OSRs.

Key resources providing OSR support are provided with OH&S information (including SDSs) as part of the briefing pack.

AMSA has a specific health and safety guideline for marine oil spill operations which includes a risk assessment for OSR operations as well as Standard Operating Procedures for National Plan equipment. This information will be considered in the development of task-specific instructions.

All operational activities will include a process such as a JHA to identify hazards, the risk rating associated with hazards and mitigation measures to ensure a safe work environment.

9 Logistics management

The VOGA Emergency Response Logistics Management Plan [VOG-7000-RH-0008] contains outputs from the identification of resources required and the scope of works/services required to deliver those resources. It is maintained as live document based on the resources identified and the Contractor Scope of Works in the OSR Capability Review [VOG-7000-RH-0009]. The plan provides details of the logistics support available to support the implementation of this OSCP for the largest spill categories (Category E and F). Logistics requirements for smaller spills can be scaled down from this.

On activation of the ICT for OSR, incident specific logistic plans will be developed to support effective logistics management and deployment. Depending on the size of logistics activities, SIMOPS plans may be developed to manage the hazards associated with multiple logistics interfaces within a confined area. The Logistics Officer is responsible for creating the logistics and SIMOPS plans.

Figure 9-1: Structure of VOGA logistics planning

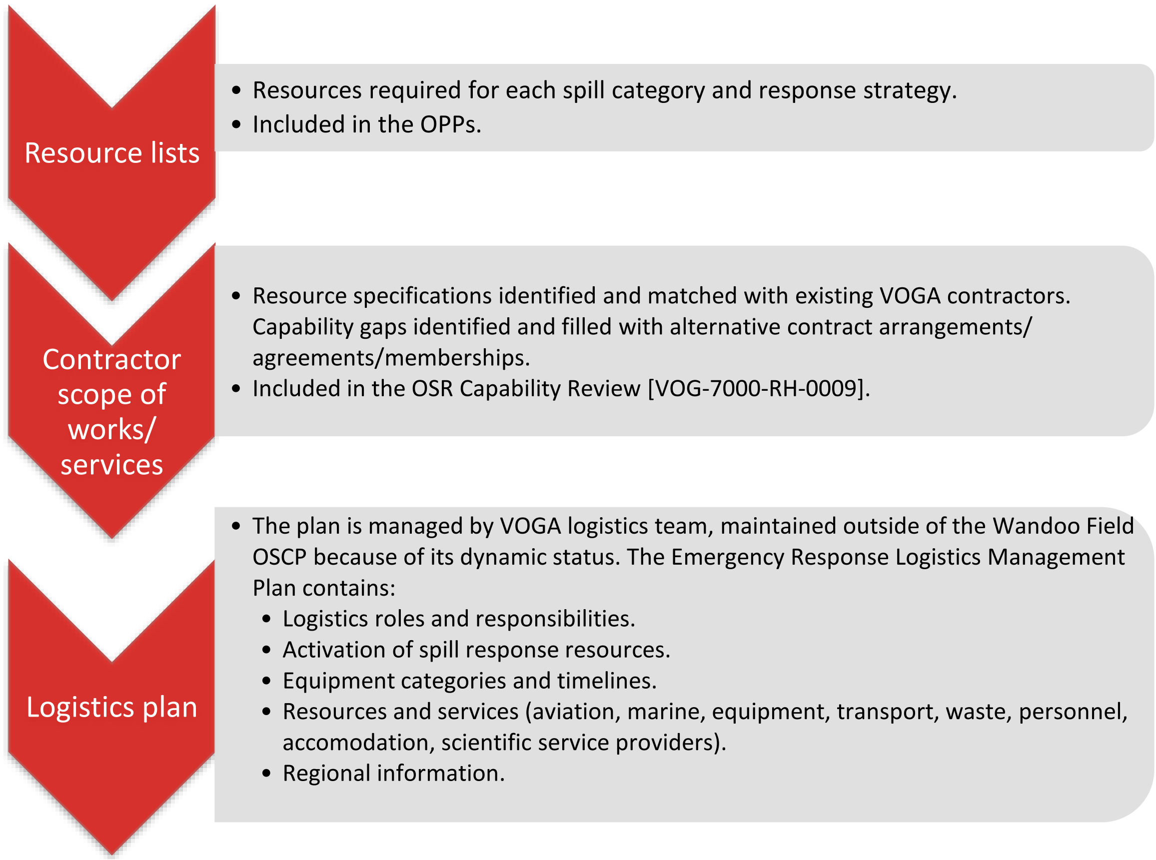


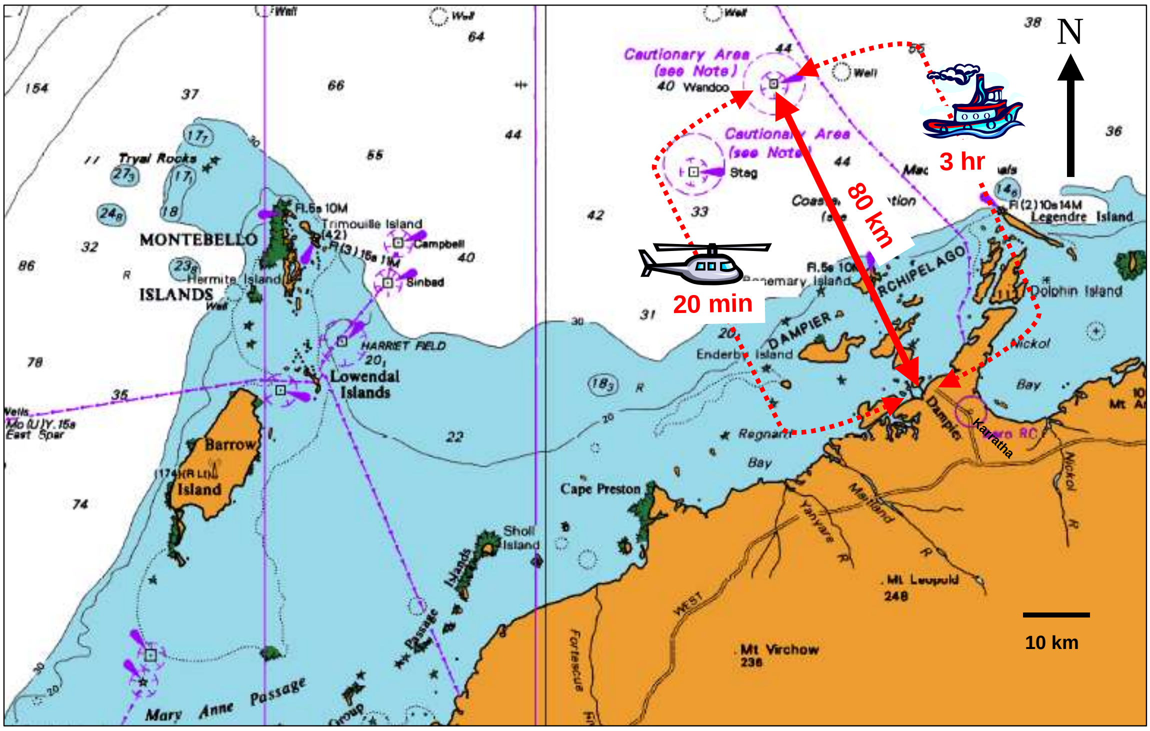
Table 9-1 provides approximate travel times by air and sea as well as distance in nautical miles between the Wandoo facilities and neighbouring locations. This information can be used to inform the aerial surveillance and aerial dispersant operations of travel times, distances and be used to estimate endurance out on site. Figure 9-2 depicts these travel times and distance on an image of a navigation chart.

Table 9-1: Travelling time between Wandoo facilities and neighbouring locations

Location	Approximate flying time to	Approximate sailing time	Distance (nm)
Wandoo Tanker/CALM Buoy	5 minutes	10 minutes	1.5
Karratha	20 minutes	n/a	48
Dampier	n/a	3.5 hours	35
North Rankin A	15 minutes	3.5 hours	38
Barrow Island	35 minutes	6.5 hours	65
Port Hedland	1 hour 15 minutes	12.5 hours	125
Onslow	1 hour 10 minutes	11.5 hours	115
Perth	2 hours 20 minutes	n/a	n/a

Flying time based on S76 helicopter (@ 140 knots)

Figure 9-2: Distance and travel time to Wandoo facilities from Dampier



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APPENDICES

Appendix A: SDS and assay sheets

Product Name **WANDOO CRUDE OIL**

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Supplier Name	**VERMILION OIL & GAS AUSTRALIA PTY LTD**
Address	Level 5, 30 The Esplenade, Perth, WA, AUSTRALIA, 6000
Telephone	(08) 9215 0300
Fax	
Emergency	(08) 9215 0300
Synonym(s)	AMPOLEX WANDOO CRUDE OIL (FORMERLY) • VERMILION WANDOO CRUDE OIL
Use(s)	CRUDE OIL

2. HAZARDS IDENTIFICATION

CLASSIFIED AS HAZARDOUS ACCORDING TO SAFE WORK AUSTRALIA CRITERIA

RISK PHRASES

R45	May cause cancer.
R46	May cause heritable genetic damage.

SAFETY PHRASES

S45	In case of accident or if you feel unwell seek medical advice immediately (show the label where possible).
S53	Avoid exposure - obtain special instructions before use.

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

3. COMPOSITION/ INFORMATION ON INGREDIENTS

Ingredient	Formula	CAS No.	Content
MINERAL OIL	Not Available	Not Available	>60%
OLEFINIC HYDROCARBONS	Not Available	Not Available	<10%
NAPHTHENIC HYDROCARBONS	Not Available	Not Available	<1%

4. FIRST AID MEASURES

Eye If in eyes, hold eyelids apart and flush continuously with running water. Continue flushing until advised to stop by a Poisons Information Centre, a doctor, or for at least 15 minutes.

Inhalation If inhaled, remove from contaminated area. To protect rescuer, use a Type A (Organic vapour) respirator or an Air-line respirator (in poorly ventilated areas). Apply artificial respiration if not breathing.

Skin If skin or hair contact occurs, remove contaminated clothing and flush skin and hair with running water. Continue flushing with water until advised to stop by a Poisons Information Centre or a doctor.

Ingestion For advice, contact a Poison Information Centre on 13 11 26 (Australia Wide) or a doctor (at once). If swallowed, do not induce vomiting.

Advice to Doctor Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flammability Combustible. May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

Fire and Explosion Evacuate area and contact emergency services. Toxic gases may be evolved in a fire situation. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers and nearby storage areas.

Extinguishing Dry agent, carbon dioxide or foam. Prevent contamination of drains or waterways.

Hazchem Code None Allocated

6. ACCIDENTAL RELEASE MEASURES

Spillage Use personal protective equipment. Clear area of all unprotected personnel. Ventilate area where possible. Contain spillage, then cover / absorb spill with non-combustible absorbent material (vermiculite, sand, or similar), collect and place in suitable containers for disposal.

7. STORAGE AND HANDLING

Storage Store in a cool, dry, well ventilated area, removed from oxidising agents, acids, alkalis, heat or ignition sources and foodstuffs. Ensure containers are adequately labelled, protected from physical damage and sealed when not in use. Check regularly for leaks or spills. Large storage areas should have appropriate fire protection systems. Store as a Class C1 Combustible Liquid (AS1940).

Handling Before use carefully read the product label. Use of safe work practices are recommended to avoid eye or skin contact and inhalation. Observe good personal hygiene, including washing hands before eating. Prohibit eating, drinking and smoking in contaminated areas.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Stds

Ingredient	Reference	TWA		STEL	
Oil mist, refined mineral	ASCC (AUS)	--	5 mg/m^3	--	--

Biological Limits No biological limit allocated.

Engineering Controls Avoid inhalation. Use in well ventilated areas. Where an inhalation risk exists, mechanical extraction ventilation is recommended. Maintain vapour levels below the recommended exposure standard.

PPE Wear splash-proof goggles and rubber or PVC gloves. Where an inhalation risk exists, wear: a Type A (Organic vapour) respirator. With prolonged use, wear: nitrile or viton (R) gloves and coveralls.


9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	DARK OILY VISCOUS LIQUID	**Solubility (water)**	INSOLUBLE
Odour	MINERAL OIL ODOUR	**Specific Gravity**	NOT AVAILABLE
pH	NOT AVAILABLE	**% Volatiles**	NOT AVAILABLE
Vapour Pressure	25 kPa @ 37.8°C	**Flammability**	CLASS C1 COMBUSTIBLE
Vapour Density	NOT AVAILABLE	**Flash Point**	144°C
Boiling Point	NOT AVAILABLE	**Upper Explosion Limit**	NOT AVAILABLE
Melting Point	NOT AVAILABLE	**Lower Explosion Limit**	NOT AVAILABLE
Evaporation Rate	NOT AVAILABLE		
Density	0.9368 kg/L @ 15°C	**Pour Point**	-30°C

10. STABILITY AND REACTIVITY

Chemical Stability Stable under recommended conditions of storage.

Conditions to Avoid Avoid heat, sparks, open flames and other ignition sources.

Material to Avoid Incompatible with oxidising agents (eg. hypochlorites), acids (eg. nitric acid), alkalis (eg. hydroxides), heat and ignition sources.

Hazardous Decomposition Products May evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition.

Hazardous Reactions Polymerization is not expected to occur.

11. TOXICOLOGICAL INFORMATION

Health Hazard Summary Moderate toxicity - irritant. This product has the potential to cause adverse health effects with over exposure. Use safe work practices to avoid eye or skin contact and inhalation. Over exposure to crude petroleum products has been associated with higher rates of cancer, however there is insufficient data to classify petroleum crude oil as to its carcinogenicity in humans (IARC Group 3). Maintain good personal hygiene standards.

Eye Irritant. Contact may result in irritation, lacrimation, pain, redness and conjunctivitis. May result in burns with prolonged contact.

Inhalation Irritant. Over exposure may result in irritation of the nose and throat, coughing, weakness, loss of appetite, nausea, vomiting and headache. High level exposure may result in dizziness, drowsiness, breathing difficulties, pulmonary oedema and unconsciousness.

Skin Irritant. Contact may result in drying and defatting of the skin, rash and dermatitis. May be absorbed through skin with harmful effects.

Ingestion Moderate toxicity. Ingestion may result in nausea, vomiting, abdominal pain, laxative effect, diarrhoea, and drowsiness with large quantities. Aspiration may result in chemical pneumonitis and pulmonary oedema.

Toxicity Data MINERAL OIL (Not Available)
Carcinogenicity: Confirmed human carcinogen (IARC Group 1)

12. ECOLOGICAL INFORMATION

Environment Limited ecotoxicity data was available for this product at the time this report was prepared. Ensure appropriate measures are taken to prevent this product from entering the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal For small amounts absorb with sand, vermiculite or similar and dispose of to an approved landfill site. Contact the manufacturer for additional information if larger amounts are involved. Prevent contamination of drains and waterways as aquatic life may be threatened and environmental damage may result.

Legislation Dispose of in accordance with relevant local legislation.

14. TRANSPORT INFORMATION

NOT CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE

Shipping Name	None Allocated				
UN No.	None Allocated	**DG Class**	None Allocated	**Subsidiary Risk(s)**	None Allocated
Packing Group	None Allocated	**Hazchem Code**	None Allocated		

15. REGULATORY INFORMATION

Poison Schedule A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

AICS All chemicals listed on the Australian Inventory of Chemical Substances (AICS).

16. OTHER INFORMATION

Additional Information MINERAL OILS - NON REFINED: Animal experiments and human experience have shown cancer risks when handling mineral oils. Such cases are reported to have occurred in conditions where poor occupational hygiene practices resulted in prolonged skin contact. CLEANING MINERAL OIL CONTAMINATED CLOTHING: Cleaners are advised that when cleaning oil contaminated clothing it is essential that freshly distilled solvent is used for each batch, including final rinse, as even filtered solvent will leave oil residues.

EXPOSURE STANDARDS - TIME WEIGHTED AVERAGES: Exposure standards are established on the premise of an 8 hour work period of normal intensity, under normal climatic conditions and where a 16 hour break between shifts exists to enable the body to eliminate absorbed contaminants. In the following circumstances, exposure standards must be reduced: strenuous work conditions; hot, humid climates; high altitude conditions; extended shifts (which increase the exposure period and shorten the period of recuperation).

ABBREVIATIONS:
ADB - Air-Dry Basis.
BEI - Biological Exposure Indice(s)

Product Name **WANDOO CRUDE OIL**

CAS# - Chemical Abstract Service number - used to uniquely identify chemical compounds.
CNS - Central Nervous System.
EC No - European Community Number.
IARC - International Agency for Research on Cancer.
M - moles per litre, a unit of concentration.
mg/m3 - Milligrams per cubic metre.
NOS - Not Otherwise Specified.
NTP - National Toxicology Program.
OSHA - Occupational Safety and Health Administration.
pH - relates to hydrogen ion concentration using a scale of 0 (high acidic) to 14 (highly alkaline).
ppm - Parts Per Million.
RTECS - Registry of Toxic Effects of Chemical Substances.
TWA/ES - Time Weighted Average or Exposure Standard.

HEALTH EFFECTS FROM EXPOSURE:
It should be noted that the effects from exposure to this product will depend on several factors including: frequency and duration of use; quantity used; effectiveness of control measures; protective equipment used and method of application. Given that it is impractical to prepare a Chem Alert report which would encompass all possible scenarios, it is anticipated that users will assess the risks and apply control methods where appropriate.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES:
The recommendation for protective equipment contained within this Chem Alert report is provided as a guide only. Factors such as method of application, working environment, quantity used, product concentration and the availability of engineering controls should be considered before final selection of personal protective equipment is made.

COLOUR RATING SYSTEM: RMT has assigned all Chem Alert reports a colour rating of Green, Amber or Red for the sole purpose of providing users with a quick and easy means of determining the hazardous nature of a product. Safe handling recommendations are provided in all Chem Alert reports so as to clearly identify how users can control the hazards and thereby reduce the risk (or likelihood) of adverse effects. As a general guideline, a Green colour rating indicates a low hazard, an Amber colour rating indicates a moderate hazard and a Red colour rating indicates a high hazard.

While all due care has been taken by RMT in the preparation of the Colour Rating System, it is intended as a guide only and RMT does not provide any warranty in relation to the accuracy of the Colour Rating System. As far as is lawfully possible, RMT accepts no liability or responsibility whatsoever for the actions or omissions of any person in reliance on the Colour Rating System.

Report Status

This Chem Alert report has been independently compiled by RMT's scientific department utilising the original Safety Data Sheet ('SDS') for the product provided to RMT by the manufacturer. The information is based on the latest chemical and toxicological research and is believed to represent the current state of knowledge as to the appropriate safety and handling precautions for the product at the time of issue. It is an independent collation by RMT of information obtained from the original SDS for this product. Its content has not been authorised or verified by the manufacturer / distributor of the chemical to which it relates.

This Chem Alert report does not constitute the manufacturer's original SDS and is not intended to be a replacement for same. It is provided to subscribers of Chem Alert as a reference tool only, is not all-inclusive and does not represent any guarantee as to the properties of the product. Further clarification regarding any aspect of the product should be obtained directly from the manufacturer.

While RMT has taken all due care to include accurate and up-to-date information in this Chem Alert report, it does not provide any warranty as to accuracy or completeness. As far as lawfully possible, RMT accepts no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this Chem Alert report.

Prepared By

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Last Reviewed: 28 Oct 2010

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End of Report

Western Atlas International

ARC560033-RT-14429

CORE LABORATORIES

AMPOL EXPLORATION LIMITED

WANDOO #1

RESERVOIR FLUID STUDY

Western Atlas International
A Litton/Dresser Company

CORE LABORATORIES

26 September 1991

Ampol Exploration Limited
40 The Esplanade
Perth WA 6000

ATTENTION: Mr. Ernie Delfos

Subject:	**Reservoir Fluid Study**
Well:	**Wandoo #1**
Location:	**Western Australia**
File:	**AFL 91017**

Gentlemen,

Surface and subsurface samples were collected during Production Testing on the Wandoo #1 well. These samples were submitted to our Perth laboratory for use in a reservoir fluid study. Presented in the following report are the results of this study.

Core Laboratories appreciates this opportunity to be of service to the Ampol Exploration Limited. Should you have any questions regarding this report, or if we may be of any further assistance, please feel free to contact us at your convenience.

Yours Faithfully,
For **CORE LABORATORIES**

Kevin Daken
Supervisor - Reservoir Fluids

Ampol Exploration Limited
Wandoo #1
AFL 91017

TABLE OF CONTENTS

Appendix

LABORATORY PROCEDURES

Sample

Two subsurface liquid samples, and six separator gas and four separator liquid samples were taken during Production Testing on the Wandoo #1 well. These samples were forwarded to our Perth laboratory for use in a reservoir fluid study.

Quality Checks

The saturation pressures of the bottom hole samples were measured at the reported reservoir temperature of 50°C. A small volume of each sample was charged, in single phase, to a high pressure visual cell and equilibrated at 50°C. The resultant bubble point pressures were then determined and found to be 882 psig for cylinder 9024-4 and 880 psig for cylinder 1116/75. These results are tabulated on page three.

Composition

The hydrocabon composition each of the gas samples, from Test 1 and Test 1A, was determined through heptanes plus by routine gas chromatography. These compositions are reported on pages three and five respectively.

The hydrocarbon composition of the bottom hole sample (in cylinder 1116/75) and each of the separator liquid samples from Test 1 and Test 1A, was determined through dodecanes plus using flash/chromatographic techniques. These compositions are reported on pages two, four and six respectively.

A high temperature distillation, through eicosanes plus, was conducted on the flashed tank oil, from cylinder 9214-102, and the resultant data are presented on page seven.

Basic Crude Tests

As requested by Mr A. Carrol, the viscosity and pour point of the stock tank oils from RFT 1180 and separator sample #10 were measured. These results are tabulated on page eight.

Ampol Exploration Limited
Wandoo #1
AFL 91017

PRELIMINARY QUALITY CHECKS PERFORMED ON SAMPLES
RECEIVED IN LABORATORY

Cylinder Number	Sampling Date	Sampling Conditions		Bubble Point Conditions		Approximate Sample Volume (cc)	Water Recovered (cc)
		psig	°C	psig	°C		
9024-4	24-June-91	#	#	882	50	-	-
1116/75 *	24-June-91	#	#	880	50	-	-

These values were not forwarded to Core Laboratories.

* Sample from this cylinder was used for analyses.

Ampol Exploration Limited
Wandoo #1
AFL 91017

Bottom Hole Sample from Cylinder 1116 / 75

Component	Mol %	Weight %
Hydrogen Sulfide	0.00	0.00
Carbon Dioxide	0.20	0.04
Nitrogen	0.08	0.01
Methane	18.94	1.22
Ethane	0.02	0.00
Propane	0.00	0.00
Iso-Butane	0.00	0.00
N-Butane	0.00	0.00
Iso-Pentane	0.00	0.00
N-Pentane	0.00	0.00
Hexanes	0.00	0.00
Heptanes	0.00	0.00
Octanes	0.00	0.00
Nonanes	0.02	0.01
Decanes	0.10	0.05
Undecanes	1.06	0.62
Dodecanes Plus	79.58	98.05
Total	100.00	100.00

Properties of Heptanes Plus

°API Gravity at 60 °F	19.4
Density, gm/cc at 60 °F	0.9371
Molecular Weight	304

Properties of Dodecanes Plus

°API Gravity at 60 °F	19.2
Density, gm/cc at 60 °F	0.9383
Molecular Weight	307

Average Total Molecular Weight of Sample = 249

Ampol Exploration Limited

Wandoo #1 (Test 1)

AFL 91017

Separator Gases

Sample Identification	Cylinder 15928		Cylinder 68769		Cylinder 68758		Cylinder 68856	
Component	Mol %	GPM	Mol %	GPM	Mol %	GPM	Mol %	GPM
Hydrogen Sulfide	0.00		0.00		0.00		0.00	
Carbon Dioxide	1.23		1.13		1.12		1.22	
Nitrogen	0.95		0.29		0.71		1.49	
Methane	97.74		98.45		98.05		97.21	
Ethane	0.08	0.021	0.13	0.035	0.12	0.032	0.08	0.021
Propane	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Iso-Butane	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
N-Butane	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Iso-Pentane	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
N-Pentane	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Hexanes	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Heptanes plus	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total	100.00	0.021	100.00	0.035	100.00	0.032	100.00	0.021

	Cylinder 15928	Cylinder 68769	Cylinder 68758	Cylinder 68856
Gas Gravity (air = 1.000)	.57	.567	.568	.572

	Cylinder 15928	Cylinder 68769	Cylinder 68758	Cylinder 68856
Gross Heating Value BTU / cubic foot of dry gas at 14.73 psia and 60 °F	989	997	992	983

Ampol Exploration Limited

Wandoo #1 (Test 1)

AFL 91017

Separator Liquids

Sample Identification	Cylinder 8008 N 367		Cylinder 15821 / 70	
Component	Mol %	Wt %	Mol %	Wt %
Hydrogen Sulfide	0.00	0.00	0.00	0.00
Carbon Dioxide	0.04	0.01	0.05	0.01
Nitrogen	0.04	0.00	0.01	0.00
Methane	2.50	0.13	2.50	0.13
Ethane	0.01	0.00	0.01	0.00
Propane	0.00	0.00	0.00	0.00
Iso-Butane	0.00	0.00	0.00	0.00
N-Butane	0.00	0.00	0.00	0.00
Iso-Pentane	0.00	0.00	0.00	0.00
N-Pentane	0.00	0.00	0.00	0.00
Hexanes	0.00	0.00	0.00	0.00
Heptanes	0.00	0.00	0.00	0.00
Octanes	0.00	0.00	0.00	0.00
Nonanes	0.00	0.00	0.00	0.00
Decanes	0.29	0.13	0.28	0.13
Undecanes	1.11	0.54	1.07	0.53
Dodecanes plus	96.01	99.19	96.08	99.20
Total	100.00	96.08	100.00	100.00

Properties of Heptanes plus	Cylinder 8008 N 367	Cylinder 15821 / 70
°API @ 60°F	19.3	19.2
Density, gm/cc @60°F	.9372	.9382
Molecular Weight	307	307

Properties of Dodecanes plus	Cylinder 8008 N 367	Cylinder 15821 / 70
°API @ 60°F	19.1	19.
Density, gm/cc @60°F	.9385	.9394
Molecular Weight	309	309

Ampol Exploration Limited
Wandoo #1 (Test 1A)
AFL 91017

Separator Gases

Sample Identification	Cylinder 15872		Cylinder 68814	
Component	Mol %	GPM	Mol %	GPM
Hydrogen Sulfide	0.00		0.00	
Carbon Dioxide	1.00		1.10	
Nitrogen	0.56		1.36	
Methane	98.34		97.45	
Ethane	0.10	0.027	0.09	0.024
Propane	0.00	0.000	0.00	0.000
Iso-Butane	0.00	0.000	0.00	0.000
N-Butane	0.00	0.000	0.00	0.000
Iso-Pentane	0.00	0.000	0.00	0.000
N-Pentane	0.00	0.000	0.00	0.000
Hexanes	0.00	0.000	0.00	0.000
Heptanes plus	0.00	0.000	0.00	0.000
Total	100.00	0.027	100.00	0.024

	Cylinder 15872	Cylinder 68814
Gas Gravity (air = 1.000)	.566	.57

	Cylinder 15872	Cylinder 68814
Gross Heating Value BTU / cubic foot of dry gas at 14.73 psia and 60 °F	995	986

Ampol Exploration Limited

Wandoo #1 (Test 1A)

AFL 91017

Separator Liquids

Sample Identification	Cylinder 9214 / 102		Cylinder 8488 N 513	
Component	Mol %	Wt %	Mol %	Wt %
Hydrogen Sulfide	0.00	0.00	0.00	0.00
Carbon Dioxide	0.07	0.01	0.07	0.01
Nitrogen	0.01	0.00	0.01	0.00
Methane	3.35	0.18	3.12	0.17
Ethane	0.01	0.00	0.01	0.00
Propane	0.00	0.00	0.00	0.00
Iso-Butane	0.00	0.00	0.00	0.00
N-Butane	0.00	0.00	0.00	0.00
Iso-Pentane	0.00	0.00	0.00	0.00
N-Pentane	0.00	0.00	0.00	0.00
Hexanes	0.00	0.00	0.00	0.00
Heptanes	0.00	0.00	0.00	0.00
Octanes	0.00	0.00	0.00	0.00
Nonanes	0.00	0.00	0.00	0.00
Decanes	0.28	0.13	0.29	0.13
Undecanes	1.74	0.87	1.69	0.84
Dodecanes plus	94.54	98.81	94.81	98.85
Total	100.00	0.00	100.00	100.00

Properties of Heptanes plus	Cylinder 9214 / 102	Cylinder 8488 N 513
°API @ 60°F	19.3	19.3
Density, gm/cc @60°F	.9373	.9373
Molecular Weight	305	304

Properties of Dodecanes plus	Cylinder 9214 / 102	Cylinder 8488 N 513
°API @ 60°F	19.	19.
Density, gm/cc @60°F	.9391	.939
Molecular Weight	308	308

Ampol Exploration Limited
Wandoo #1
AFL 91017

High Temperature Distillation of Heptanes plus Fraction

Component Cut Fraction		Cut Temp °C	Mol Percent	Weight Percent	Volume Percent	Density, gm/cc @ 60°F	°API @ 60°F	Molecular Weight
	IBP	69						
Heptanes		99	0.00	0.00	0.00	-	-	-
Octanes		126	0.00	0.00	0.00	-	-	-
Nonanes		152	0.00	0.00	0.00	-	-	-
Decanes		175	0.00	0.00	0.00	-	-	-
Undecanes		197	0.00	0.00	0.00	-	-	-
Dodecanes		216	0.54	0.29	0.31	0.8680	31.4	159
Tridecanes		237	3.89	2.18	2.34	0.8756	29.9	172
Tetradecanes		254	5.09	3.08	3.26	0.8842	28.4	185
Pentadecanes		273	6.99	4.54	4.78	0.8911	27.1	199
Hexadecanes		288	7.38	5.11	5.33	0.8986	25.8	212
Heptadecanes		304	7.17	5.24	5.43	0.9056	24.6	224
Octadecanes		318	6.51	5.06	5.20	0.9118	23.5	238
Nonadecanes		332	5.60	4.57	4.68	0.9166	22.7	250
Eicosanes plus	FBP	332	56.83	69.93	68.67	0.9544	16.6	377
Total			100.00	100.00	100.00			

Ampol Exploration Limited
Wandoo #1
AFL 91017

BASIC CRUDE TESTS

Sample I.D.	Viscosity at 20°C cp (ASTM D 446)	Viscosity at 50°C cp (ASTM D 446)	Pour Point °C (ASTM D 97)
RFT 1180	178.4	28.24	- 24 *
Sample #10	174.3	27.09	- 24 *

Note (*) : Failure to flow at pour point is normally attributed to the separation of waxes from the oil and formation of "lattice" structures. In this case, the pour point appears to be due to the effect of temperature on the viscosity.

Appendix

FLOPETROL	Client : Ampol	Section : ANNEX 4.1
Base : AUF	Field : WANDOO Well : #1	Page : Report N°:

BOTTOM HOLE SAMPLING

Date of sampling : 24/6/91 Service order : Sampling No.: BHS #1
Sample nature : OIL Sampling depth : 586.5 m RKB

A – RESERVOIR AND WELL CHARACTERISTICS –

Producing zone : LOWER CRETACEOUS SAND Perforations : 602 - 611 m Sampling interval : 602 - 611 m
Depth origin : RKB Tubing Dia.: 5DP Casing Dia.: 9 5/8"
Surface elevation : Shoe : Shoe :

Bottom hole static conditions				
	Initial pressure :	at depth :	date :
	Latest pressure measured :	at depth :	date :
	Temperature :	at depth :	date :

B – SAMPLING AND TRANSFER CHARACTERISTICS –

Sampler : Type and No. 184 Capacity : 600 cc

Time at which sample was taken : 0115 Hour

Test duration: Running start : 0035 Hour; Pulling end : 0150 Hour

☐ Well shut in since : /
☐ Well flowing through choke : 1/4 ADJ.

Time elapsed since closing well : /
Production duration through this choke :

Production cond during sampling or before closing				
Bottom hole ... ft.	pressure: / temp. : /	Well head	pressure: 131/131 temp. : 23°c	Separator pressure: / temp. /
Flow rates : / SCFD / BOPD		W.L.R. : / Prod.G.O.R. : /		Specific gravity Gas (air:1): / Oil : /

Opening pressure of the first valve (if necessary) : 690 PSIG

Estimated bubble point under bottom hole conditions :
Temp. : 50°C Pressure : 925 psiG

Transfer conditions. ☐ By gravity ☑ By pumping
Temp. : 25°C Pressure : 1800 psiG

Hg volume: collected at transfering end : 600 cc; remaining in the shipping bottle : 15 cc

Final conditions of shipping bottle after decompression :
Temp. : 23°C Pressure : 1100 psiG

Hg volume withdrawn for bottle decompression : 10 cc

C – IDENTIFICATION OF THE SAMPLE –

Shipping bottle No.: 1116/75 sent on : by : Shipping order No.:
Addressee :

Coupled with	LIQUID		GAS	
Bottom hole samples No.	9024-4			
Surface samples No.				

D – REMARKS –

Visa Chief operator: E. GOH.

DOP 128

FLOPETROL	Client : Ampol	Section : ANNEX 4.1
Base : AnF	Field : WANDOO Well : #1	Page : Report N°:

BOTTOM HOLE SAMPLING

Date of sampling : 24/6/91 Service order : Sampling No.: BHS #2
Sample nature : OIL Sampling depth : 586.5m

A – RESERVOIR AND WELL CHARACTERISTICS

Producing zone : LOWE CRETACEOUS SAND. Perforations : Sampling interval :
Depth origin : RKB Tubing Dia. : 5" DP Casing Dia. : 9 5/8"
Surface elevation : Shoe : Shoe :

Bottom hole static conditions			
Initial pressure :	at depth :	date :
Latest pressure measured :	at depth :	date :
Temperature :	at depth :	date :

B – SAMPLING AND TRANSFER CHARACTERISTICS

Sampler : Type and No. : 149 Capacity : 600 cc

Time at which sample was taken : 0500 HRS

Test duration: Running start : 0400 HR; Pulling end : 0551 HR.

☐ Well shut in since :
☐ Well flowing through choke : 1/4 ADJ

Time elapsed since closing well :
Production duration through this choke :

Production conditions during or before sampling			
Bottom hole ... ft	pressure: ; temp. :	Well head pressure : 134 PSI; temp. : 23°C	Separator pressure : ; temp :
Flow rates : ... SCFD; ... BOPD		W.L.R. : ; Prod. G.O.R. :	Specific gravity Gas (air:1) : ; Oil :

Opening pressure of the first valve (if necessary) : 700 PSIG

Estimated bubble point under bottom hole conditions :
Temp. : 80°C Pressure : 925 PSIG

Transfer conditions. ☐ By gravity ☒ By pumping
Temp. : 25 C Pressure : 1100 PSIG

Hg volume: collected at transfering end : 600 CC; remaining in the shipping bottle : 15 CC

Final conditions of shipping bottle after decompression :
Temp. : 23°C Pressure : 1100 PSIG

Hg volume withdrawn for bottle decompression : 10 cc

C – IDENTIFICATION OF THE SAMPLE

Shipping bottle No. : 9024-4 sent on : by : Shipping order No. :
Addressee :

Coupled with

	LIQUID		GAS	
Bottom hole samples No	1116/75			
Surface samples No.				

D – REMARKS

Visa Chief operator

E. GOH

DOP 128

Schlumberger Wireline and Testing
Base : AUF

Client: Ampol
Field: Wandoo
Well: #1

Section: ANNEX 4.2
Page :
Report #:

- SURFACE SAMPLING -

Date of Sampling: 22-6-91 Service Order: Sampling No: PVT #1
Sampling Nature: PVT GAS Sampling Point: GAS OUTLET OF SEPARATOR

A - RESERVOIR AND WELL CHARACTERISTICS

Producing Zone: Lwr. Cretaceous Sandstone Perforations: 603 - 611m Sampling Interval: 15 min
Depth Origin: RKB Tubing Dia: 4½ Drill pipe Casing Dia: 9⅝"
Surface Elevation: Shoe: Shoe:

Bottom Hole Static Conditios
Initial Pressure at depth: Date:
Latest Pressure Measured at depth: Date:
Temperature at depth: Date:

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken: 1745 Time elapsed since stabilisation: 195 mins

Bottom Hole Dynamic Conditions
Choke Size ½" Fixed since: 1127 Wellhead Press: 190 psig Wellhead Temp: 84°F
Bottom Hole Pressure At Depth: Date:
Bottom Hole Temp At Depth: Date:

Flow Measurement of Sampled Gas - Gravity (Air: 1): 0.55 Factor Fpv = 1/√Z 1.0037
Values used for calculation:

Separator Pressure: 60 PSIG Temp: 114 °F
Rates - Gas : 124.664 MSCFD B
Oil (Separator Cond.): 1132.32 BOPD
GOR: 110.1 (Separator Cond.)

Stock Tank Atmosphere: mmHg °F
Tank Temperature: °F
Oil at 60°F: BOPD B a

BSW: 0 % WLR: 0 %

Transfering Fluid: Vacuum Transfer Duration: 15 mins

Final Conditions of tbe Shipping Bottle: 60 psig
Pressure: 60 psig Temp: 42°C

C - IDENTIFICATION OF THE SAMPLE

Shipping Bottle #: 15928 sent on: by: Shipping Order #
Addressee:

Coupled with:

	LIQUID	GAS
Bottom Hole Samples #		
Surface Samples #	8008 N 367	68769

Measurement Conditions:
A Tank
B Meter
C Dump
a Corrected with Shrinkage Tester
b Corrected with Tank

D - REMARKS

10 hr Gas Sample.

VISA CHIEF OPERATOR

Schlumberger Wireline and Testing Base : AUF	Client: Ampol Field: Wandoo Well: #1	Section: ANNEX 4.2 Page : Report #:

- SURFACE SAMPLING -

Date of Sampling: 22-6-91 Service Order: Sampling No: PVT #2
Sampling Nature: PVT Gas Sampling Point: Separator Gas Outlet

A - RESERVOIR AND WELL CHARACTERISTICS

Producing Zone: lwr. Cretaceous Sandstone Perforations: 603-611m Sampling Interval: 15 mins
Depth Origin: RKB Tubing Dia: 4½ Drill pipe Casing Dia: 9 5/8"
Surface Elevation: Shoe: Shoe:

Bottom Hole Static Conditios				
	Initial Pressure		at depth:	Date:
	Latest Pressure Measured		at depth:	Date:
	Temperature		at depth:	Date:

B - MEASUREMENT AND SAMPLING CONDITIONS

Time at which sample was taken: 1845 Time elapsed since stabilisation: 225 mins

Bottom Hole Dynamic Conditions		
Choke Size ½" Fixed since: 1127	Wellhead Press: 194psig	Wellhead Temp: 84°F
Bottom Hole Pressure	At Depth:	Date:
Bottom Hole Temp	At Depth:	Date:

Flow Measurement of Sampled Gas - Gravity (Air: 1): 0.55 Factor Fpv = 1/VZ 1.0036
Values used for calculation:

Separator	Pressure: 55 PSIG Temp: 109 °F	Rates - Gas: 120.971 m SCFD Oil (Separator Cond.): 1175.52 BOPD	B	GOR: 102.9 (Separator Cond.)
Stock Tank	Atmosphere: mmHg °F Tank Temperature: °F	Oil at 60°F: BOPD		B a

BSW: 0 % WLR: 0 %

Transfering Fluid: Vacuum Transfer Duration: 5 mins

Final Conditions of tbe Shipping Bottle:
Pressure: 5 psig Temp: 43°C

C - IDENTIFICATION OF THE SAMPLE

Shipping Bottle #: 68758 sent on: by: Shipping Order #
Addressee:

Coupled with:

	LIQUID		GAS	
Bottom Hole Samples #				
Surface Samples #	15821/70		68856	

Measurement Conditions:

A Tank B Meter C Dump
a Corrected with Shrinkage Tester b Corrected with Tank

D - REMARKS

VISA CHIEF OPERATOR

10 ltr. gas sample

FLOPETROL	Client : [illegible]	Section: ANNEX 42
Base : AUF	Field : WANDOO Well : [illegible]	Page : Report N°:

- SURFACE SAMPLING -

Date of sampling : 26-6-91 Service order : Sampling No. : PVT - 3
Sample nature : PVT OIL Sampling point : SEPARATOR OIL SIGHT GLASS

A - RESERVOIR AND WELL CHARACTERISTICS -

Producing zone : Lwr. Cretaceous Sandstone Perforations : [illegible]99 - 603, [illegible]3 - 611 Sampling interval : 30 min
Depth origin : RKB Tubing Dia. : [illegible]" Drillpipe Casing Dia. : 9 5/8"
Surface elevation : Shoe : Shoe :

Bottom hole static conditions			
Initial pressure :	at depth :	date :
Latest pressure measured :	at depth :	date :
Temperature :	at depth :	date :

B - MEASUREMENT AND SAMPLING CONDITIONS -

Time at which sample was taken : 1930 Time elapsed since stabilisation : 160 mins

Bottom hole dynamic conditions			
Choke size : 3/4" Fixed since : 1650	Well head pressure : 196 psig	Well head temp. : 93°F
Bottom hole pressure :	at depth :	date :
Bottom hole temp. :	at depth :	date :

Flow measurement of sampled gas - Gravity (air: 1) : 0.555 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0052
Values used for calculations :

Separator	Pressure : 90 PSIG Temp. : 111 °F	Rates - Gas : 234.573 MSCFD Oil (separator cond.) : 2587.20 BOPD [B]	GOR : 90 (separator cond.)
Stock tank	Atmosphere : mmHg - °F Tank temperature : °F	Oil at 60 °F : BOPD [A][B][C][a][b]	

BSW : 0 % WLR : 0 %

Transfering fluid : Mercury. Transfer duration : 30 mins.

Final conditions of the shipping bottle :
Pressure : 10 Temp. : 40°C

C - IDENTIFICATION OF THE SAMPLE -

Shipping bottle No. : 9214/102 sent on : by : Shipping order No. :
Addressee :

Coupled with	LIQUID		GAS	
Bottom hole samples No.				
Surface samples No.			15872	

Measurement conditions.
[A] - Tank. [B] - Meter. [C] - Dump.
[a] - Corrected with shrinkage tester. [b] - Corrected with tank.

D - REMARKS -

550cc Sample.
50cc - Gas cap
28cc - Mercury.
Oil gravity @ 60°F - 0.938

Visa Chief Operator

No.: DOP 127

FLOPETROL

Base : AUF

Client : Ampol

Field : Wandoo

Well : #1

Section: ANNEX 4.2

Page :

Report N°:

- SURFACE SAMPLING -

Date of sampling : 24-6-91 Service order : Sampling No. : PVT #4

Sample nature : PVT GAS Sampling point : SEPARATOR GAS OUTLET

A - RESERVOIR AND WELL CHARACTERISTICS -

Producing zone : LOWER CRETACEOUS SANDSTONE Perforations : 599-603, 603-611 Sampling interval : 30 mins

Depth origin : RKB Tubing Dia. : 4½" Drill pipe Casing Dia. : 9⅝"

Surface elevation : Shoe : Shoe :

Bottom hole static conditions			
Initial pressure :	at depth :	date :
Latest pressure measured :	at depth :	date :
Temperature :	at depth :	date :

B - MEASUREMENT AND SAMPLING CONDITIONS -

Time at which sample was taken : 2030 Time elapsed since stabilisation : 220 mins

Bottom hole dynamic conditions

Choke size : 3/4" Fixed since : 1650 Well head pressure : 202 psig Well head temp. : 100°F

Bottom hole pressure : at depth : date :

Bottom hole temp. : at depth : date :

Flow measurement of sampled gas - Gravity (air : 1) : 0.555 Factor Fpv = $\frac{1}{\sqrt{Z}}$: 1.0054

Values used for calculations :

Separator

Pressure : 90 PSIG Temp. : 111 °F

Rates - Gas : 237.535 M SCFD

Oil (separator cond.) : 2587.20 BOPD [B]

GOR : 91 (separator cond.)

Stock tank

Atmosphere : mmHg - °F

Tank temperature : °F

Oil at 60 °F : BOPD [A] [B] [b] [a] [C]

BSW : 0.1 % WLR : 0 %

Transfering fluid : Vacuum Transfer duration : 30 mins

Final conditions of the shipping bottle :

Pressure : 90 Temp : 40°C

C - IDENTIFICATION OF THE SAMPLE -

Shipping bottle No. : 6848/4 sent on : by : Shipping order No. :

Addressee :

Coupled with

	LIQUID		GAS	
Bottom hole samples No.				
Surface samples No.	8488 NSB			

Measurement conditions.

[A] - Tank. [B] - Meter. [C] - Dump.

[a] - Corrected with shrinkage tester. [b] - Corrected with tank.

D - REMARKS -

10 ltr Gas Sample

Oil SG @ 60°F 0.938.

Visa Chief Operator

No.: DOOP 127

Safety Data Sheet

Shell Tellus Oil 68

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Product Code	001B0670
Infosafe No.	ACKQ7 AU/eng/C
Issued Date	6/12/2005
Product Type/Use	Hydraulic oil.

Other Names	**Name**	**Code**
	Shell Tellus Oil 68	140001010641

Supplier

Shell Company of Australia Ltd.
Level 2, 8 Redfern Road,
Hawthorn East, Victoria 3123
(ABN 46 004 610 459)
AUSTRALIA

Telephone Numbers

Emergency Tel.
1800 651 818

Telephone/Fax Number
Tel: 03 9666 5444 Fax: 03 8823 4800

2. COMPOSITION/INFORMATION ON INGREDIENTS

Preparation Description
Highly refined mineral oils and additives. The highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP346.

3. HAZARDS IDENTIFICATION

Hazards Identification
NON-HAZARDOUS SUBSTANCE.
NON-DANGEROUS GOODS.
Hazard classification according to the criteria of NOHSC.
Dangerous goods classification according to the Australia Dangerous Goods Code.

Human Health Hazards
No specific hazards under normal use conditions. Prolonged or repeated exposure may give rise to dermatitis. Used oil may contain harmful impurities.

Safety Hazards
Not classified as flammable, but will burn.

Environmental Hazards
Not classified as dangerous for the environment.

4. FIRST AID MEASURES

Symptoms and Effects
Not expected to give rise to an acute hazard under normal conditions of use.

Inhalation
In the unlikely event of dizziness or nausea, remove casualty to fresh air. If symptoms persist, obtain medical attention.

Skin
Remove contaminated clothing and wash affected skin with soap and water. If persistent irritation occurs, obtain medical attention. When using high pressure equipment, injection of product under the skin can occur. If high pressure injuries occur, the casualty should be sent immediately to a hospital. Do not wait for symptoms to develop.

Eye
Flush eye with copious quantities of water. If persistent irritation occurs, obtain medical attention.

Ingestion
Wash out mouth with water and obtain medical attention. Do not induce vomiting.

Advice to Doctor
Treat symptomatically. Aspiration into the lungs may result in chemical pneumonitis. Dermatitis may result from prolonged or repeated exposure. High pressure injection injuries require prompt surgical intervention and possibly steroid therapy, to minimise tissue damage and loss of function.

5. FIRE FIGHTING MEASURES

Specific Hazards
Combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates and gases, including carbon monoxide, oxides of sulphur, and unidentified organic and inorganic compounds.

Extinguishing Media
Foam and dry chemical powder. Carbon dioxide, sand or earth may be used for small fires only.

Unsuitable Extinguishing Media
Water in jet. Use of halon extinguishers should be avoided for environmental reasons.

Protective Equipment
Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions
Avoid contact with skin and eyes. Wear PVC, Neoprene or nitrile rubber gloves. Wear rubber knee length safety boots and PVC Jacket and Trousers. Wear safety glasses or full face shield if splashes are likely to occur.

Environmental Precautions
Prevent from spreading or entering into drains, ditches or rivers by using sand, earth, or other appropriate barriers. Inform local authorities if this cannot be prevented.

Clean-up Methods - Small Spillages
Absorb liquid with sand or earth. Sweep up and remove to a suitable, clearly marked container for disposal in accordance with local regulations.

Clean-up Methods - Large Spillages
Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Dispose of as for small spills.

7. HANDLING AND STORAGE

Handling
Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Avoid prolonged or repeated contact with skin. When handling product in drums, safety footwear should be worn and proper handling equipment should be used. Prevent spillages. Cloth, paper and other materials that are used to absorb spills present a fire hazard. Avoid their accumulation by disposing of them safely and immediately. In addition to any specific recommendations given for controls of risks to health, safety and the environment, an assessment of risks must be made to help determine controls appropriate to local circumstances.

Storage
Keep in a cool, dry, well-ventilated place. Use properly labelled and closeable containers. Avoid direct sunlight, heat sources, and strong oxidizing agents.

Storage Temperatures
0°C Minimum. 50°C Maximum.

Recommended Materials
For containers or container linings, use mild steel or high density polyethylene.

Unsuitable Materials
For containers or container linings, avoid PVC.

Other Information
Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Exposure Limits

Substance	Regulations	Exposure Duration	Exposure Limit	Units	Notes
Oil mist, mineral	NOHSC:1003	TWA	5	mg/m3	
	NOHSC:1003	STEL	10	mg/m3	

NOHSC:1003 — Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003(1995)] - 3rd Edition

Exposure Controls
Use local exhaust ventilation if there is a risk of inhalation of vapours, mists or aerosols.

Respiratory Protection
Not normally required. If oil mist cannot be controlled, a respirator fitted with an organic vapour cartridge combined with a particulate pre-filter should be used.

Hand Protection
PVC or nitrile rubber gloves.

Eye Protection
Wear safety glasses or full face shield if splashes are likely to occur.

Body Protection
Minimise all forms of skin contact. Overalls and shoes with oil resistant soles should be worn. Launder overalls and undergarments regularly.

Environmental Exposure Controls

Minimise release to the environment. An environmental assessment must be made to ensure compliance with local environmental legislation.

9. PHYSICAL AND CHEMICAL PROPERTIES

Colour	Light brown.
Physical State	Liquid at ambient temperature.
Odour	Characteristic mineral oil.
pH Value	Not applicable.
Vapour Pressure	Expected to be less than 0.5 Pa at 20°C.
Initial Boiling Point	Expected to be above 280°C.
Solubility in Water	Negligible.
Density	886 kg/m3 at 15ºC.
Flash Point	223ºC. (PMCC).
Flammable Limits - Upper	10%(V/V) (typical).
Flammable Limits - Lower	1%(V/V) (typical).
Auto-Ignition Temperature	Expected to be above 320ºC.
Kinematic Viscosity	68 mm2/s at 40°C.
Vapour Density (Air=1)	Greater than 1.
Partition co-efficient, n-octanol/water	Log Pow expected to be greater than 6.
Pour Point	-24ºC.

10. STABILITY AND REACTIVITY

Stability

Stable.

Conditions to Avoid

Extremes of temperature and direct sunlight.

Materials to Avoid

Strong oxidizing agents.

Hazardous Decomposition Products

Hazardous decomposition products are not expected to form during normal storage.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment

Toxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the toxicology of similar products.

Acute Toxicity - Oral

LD50 expected to be > 2000 mg/kg.

Acute Toxicity - Dermal

LD50 expected to be > 2000 mg/kg.

Acute Toxicity - Inhalation

Not considered to be an inhalation hazard under normal conditions of use.

Eye Irritation

Expected to be slightly irritating.

Skin Irritation
Expected to be slightly irritating.

Respiratory Irritation
If mists are inhaled, slight irritation of the respiratory tract may occur.

Skin Sensitisation
Not expected to be a skin sensitizer.

Carcinogenicity
Product is based on mineral oils of types shown to be non-carcinogenic in animal skin-painting studies. Other components are not known to be associated with carcinogenic effects.

Mutagenicity
Not considered to be a mutagenic hazard.

Reproductive Toxicity
Not considered to be toxic to reproduction.

Other Information
Prolonged and/or repeated contact with this product can result in defatting of the skin, particularly at elevated temperatures. This can lead to irritation and possibly dermatitis, especially under conditions of poor personal hygiene. Skin contact should be minimised. High pressure injection of product into the skin may lead to local necrosis if the product is not surgically removed. Used oils may contain harmful impurities that have accumulated during use. The concentration of such impurities will depend on use and they may present risks to health and the environment on disposal. ALL used oil should be handled with caution and skin contact avoided as far as possible.

12. ECOLOGICAL INFORMATION

Basis for Assessment
Ecotoxicological data have not been determined specifically for this product. Information given is based on a knowledge of the components and the ecotoxicology of similar products.

Mobility
Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to soil particles and will not be mobile.

Persistence / Degradability
Not expected to be readily biodegradable. Major constituents are expected to be inherently biodegradable, but the product contains components that may persist in the environment.

Bioaccumulation
Contains components with the potential to bioaccumulate.

Ecotoxicity
Poorly soluble mixture. May cause physical fouling of aquatic organisms. Product is expected to be practically non-toxic to aquatic organisms, LL/EL50 >100 mg/l. (LL/EL50 expressed as the nominal amount of product required to prepare aqueous test extract). Mineral oil is not expected to cause any chronic effects to aquatic organisms at concentrations less than 1 mg/l.

Other Adverse Effects
Not expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.
Product is a mixture of non-volatile components, which are not expected to be released to air in any significant quantities.

13. DISPOSAL CONSIDERATIONS

Waste Disposal
Recycle or dispose of in accordance with prevailing regulations, by a recognised collector or contractor. The competence of the contractor to deal satisfactorily with this type of product should be established beforehand. Do not pollute the soil, water or environment with the waste product.

Product Disposal
As for waste disposal.

Container Disposal
Recycle or dispose of in accordance with the legislation in force with a recognised collector or contractor.

14. TRANSPORT INFORMATION

Transport Information
Not dangerous for transport under ADG, IMO and IATA/ICAO regulations.

ADG UN Class
None Allocated

ADG Packing Group
None Allocated

ADG Hazchem Code
None Allocated

IMDG Hazard Class
None Allocated

IMDG Packing Group
None Allocated

15. REGULATORY INFORMATION

EC Symbols	None.
EC Risk Phrase	Not classified.
EC Safety Phrase	Not classified.
EINECS	All components listed or polymer exempt.

AICS (Australia)
All components listed.

National Legislation
National Code of Practice for the Preparation of Material Safety Data Sheets [NOHSC:2011]
List of Designated Hazardous Substances [NOHSC:10005].
Approved Criteria for Classifying Hazardous Substances [NOHSC:1008].
Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:1003].
Australian Dangerous Goods Code.
Standard Uniform Scheduling of Drugs and Poisons.

Packaging & Labelling
Safety data sheet available for professional user on request.

16. OTHER INFORMATION

References
For detailed advice on Personal Protective equipment, refer to the following Australian Standards :-
HB 9 (Handbook 9) Manual of industrial personal protection.
AS/NZS 1337 Eye protectors for industrial applications.
AS/NZS 1715 Selection, use and maintenance of respiratory protective devices.
AS/NZS 1716 Respiratory protective devices.

Poisons Schedule
NS.

Restrictions
This product must not be used in applications other than recommended without first seeking the advice of the SHELL technical department.

Technical Contact Numbers
(03) 9666 5444.

Further Information
This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It does not constitute a guarantee for any specific property of the product.
... End Of SDS ...

Crude Assay Report Number 2007-FED-032680
WANDOO B CRUDE OIL

VERMILION ENERGY

08 September 2007

Our Accreditation are as follows:
SAC Singlas: Chemical and Biological Testing (Cert No: LA-1997-0115-A)
SAC Singlas: Environmental Testing (Cert No: LA-2000-0176-F)
LRQA   ISO 9001:2000 Certification (Cert No: 945092)

Sample ID	2007-FED-032680		1	Fraction							
Crude ID	WANDOO B CRUDE OIL			2	3	4	5	6	7	8	9
Client ID	VERMILION ENERGY		Whole	IBP - 218 °C	218 - 260 °C	260 - 343 °C	343 - 399 °C	399 - 482 °C	482 - 550 °C	343+ °C	550+ °C
Date	08 September 2007										
Test	Method	Unit									
Mass Yield	D2892 / D5236	%mass		1.97	7.76	27.31	10.12	29.31	11.30	62.95	12.23
Volume Yield		%volume		2.12	8.21	28.14	10.09	28.89	11.01	61.53	11.55
Density @15°C	D5002 / D4052	kg/L	0.9369	0.8710	0.8868	0.9102	0.9406	0.9512	0.9632	0.9592	0.9926
Specific Gravity @60/60°F		-	0.9374	0.8715	0.8873	0.9107	0.9411	0.9518	0.9638	0.9598	0.9932
API Gravity		API	19.4	30.9	28.0	23.9	18.9	17.2	15.3	15.9	11.0
Aniline Point	D611	°C	66.85	50.60	56.70	57.60	58.40				
Asphaltenes	D6560	%mass									<0.5
Bromine Number	D1159	-				0.9	3.1	3.4			
Carbon Residue - Micro	D4530	%mass	1.4			<0.1	<0.1	<0.1	1.0		11.8
Cetane Index	D4737	-				35.6					
Characterization Factor	UOP 375	-				11.1	11.2	11.3	11.6		
Cloud Point	D2500-02	°C			undetect	undetect	undetect				
FIA - Aromatics	D1319	%volume		3.4	7.6						
Flash Point	D93	°C	120		91	135					
Freeze Point	D5972	°C			undetect						
Heat of Combustion - Gross	D240	MJ/kg	44.41								
Heat of Combustion - Nett	D240	MJ/kg	41.98								
Kinematic Viscosity @20°C	D445	cSt	171.6								
Kinematic Viscosity @40°C	D445	cSt	48.69		2.914	7.567	41.77	143.7	1413		
Kinematic Viscosity @50°C	D445	cSt	29.94			5.653	25.20	74.59	585.3	203.4	
Kinematic Viscosity @100°C	D445	cSt				2.677	4.938	9.425	33.81	18.15	466.8
Kinematic Viscosity @135°C	D445	cSt									84.01
Mercury Content	UOP938	wt ppb	2								
Metal - Iron	IP501	wt ppm	11						<1	11	96
Metal - Nickel	IP501	wt ppm	4						<1	8	37
Metal - Sodium	IP501	wt ppm	8						<1	13	86
Metal - Vanadium	IP501	wt ppm	<1						<1	4	4
Metal - Potassium	IP501	wt ppm	2								
Nitrogen - Basic	UOP269	%mass	388	<1	2	32	184	328	680		
Nitrogen - Total	D4629	wt ppm	1039	<1	3	40	362	810	2124	1639	4386
Pour Point - Upper	D5853	°C	-24								
Pour Point	D97	°C			<-60	-54	-30	-12	6	-3	48
Refractive Index @70°C	D1747	-				1.4764	1.5011	1.5084	1.5194		
Smoke Point	D1322	mm		16.5	15.0	11.0					
Sulphur - Total	D4294	%mass	0.142	<0.0150	0.0198	0.0615	0.140	0.165	0.217	0.192	0.289
Total Acid Number	D664	mg KOH/g	1.77		<0.05	0.48	1.76	2.68	3.35	2.40	
Strong Acid Number	D664	mg KOH/g	zero								
Viscosity Index	D2270	%volume				235	-23				

Note:

Undetect - The samples set solid before a cloud/freeze point could be detected.

Appendix B: Incident Action Plan

Appendix B: Incident Action Plan

The IAP will be written at the time of a spill and be appropriate to the nature, size and scale of the activity. It will change according to weather and conditions at the time so will be rewritten or altered frequently. The first draft of the IAP should be ready within the first four hours of the incident occurring.

Should oil spill response strategies be considered by the VOGA ICT that are NOT part of the Wandoo Field OSCP, they may be communicated for acceptance to NOPSEMA through a draft IAP.

The IAP should include the date, time and signatures of both the person who prepared it and the Incident Commander who has signed off on it prior to strategy implementation. It should clearly state the overall aim of the response and be specific to the spill. It should also clearly state the objectives, which:

- are appropriate to the nature, size and scale of the activity;
- are specific, measurable, achievable, realistic and time-framed;
- may change according to weather and conditions at the time; and
- act to meet the aim.

The IAP should define a termination point for each strategy and one for the entire strategy.

The IAP should include the selected strategies relevant to this particular spill, which will be informed by a SIMA conducted at the time, and situational awareness. The SIMA will outline each strategy and assess the environmental gain/reduction from implementing each strategy by considering the potential impacts of strategy implementation on each identified protection priority. This should guide the decision on which strategy is most appropriate to the particular spill.

Situational awareness should be regularly updated and include a description of the oil type, volume, where it is, where it is going (modelling and weather conditions), when will it get there (modelling and weather conditions), what resources are at risk (priorities for protection), what is happening to it (weathering etc.), what is the worst-case credible scenario, and what can be done about it (strategies).

The IAP should also include specific tasks for each work team: Logistics, Administration, HSE, Human Resources, Communications, and Operations.

IAP SIMA

The SIMA will outline each strategy and assess the environmental gain/reduction from implementing each strategy by considering the potential impacts of strategy implementation on each identified protection priority. This should guide the decision on which strategy is most appropriate to the particular spill. Refer to Appendix E for the template and guide.

Compiled by:

Name ______________________ Position ______________________

Signature ______________________

Approved by:

Incident Controller Name ______________________

Incident Controller Signature ______________________

	Spill Assessment Checklist	
❑	Gather information and evaluate the incident: 1. Spill location. 2. Type of hydrocarbon. 3. Weather condition and sea state: o The phase of tidal cycle (neap or spring). o Current / tidal streams speed, direction and period. o Wind speed, direction and period.	
❑	Determine the boundary and trajectory of the spill.	
❑	Determine the spill volume by using the 'AMSA Oil Spill Calculator', engineering estimate and visual estimate.	
❑	Develop IAP: • Develop and rank response objectives, based on protection priorities. • Develop strategies for each objective. • Develop tactics for each strategy.	

	Actions	Strategies	To be Actioned By
❑	**Source Control**	Implement immediate source control.	
❑	**Notification**	Gather/send initial incident information/notification.	
❑	**Response Strategies**	Identify response strategies required to be implemented.	
❑	**Environmental Summary/SIMA**	Protection priorities identified.	
❑	**Operations – Marine Unit Assignment**	Resources to be assigned. i.e. vessels on hire, support vessels.	
❑	**Operations – Aviation Unit Assignment**	Resources to be assigned. i.e. Bristows, Karratha Flying Services.	
❑	**Operations – Shoreline Unit Assignment**	Equipment and personnel to be assigned.	
❑	**Operations – Wildlife Unit Assignment**	AMOSC notified. Equipment and personnel to be assigned.	
❑	**Operations – Waste Unit Assignment**	Equipment and personnel to be assigned.	

Incident Objectives and Strategies

INCIDENT OBJECTIVE/S:	

PROTECTION PRIORITIES (Locations based on EP)	OIL SPILL RESPONSE STRATEGIES (Means of accomplishing objectives – sourced from Quick Guides in OSCP)

STRATEGIES (What is planned to be done, in priority order)		TACTICS (Means of accomplishing objectives)	UNIT (Op. Unit to effect strategies)
1			
2			
3			
4			
5			

PREPARED BY:	

Response Personnel

RESOURCE	NAME	CONTACT DETAILS	LOCATION/ASSIGNMENT
Incident Commander			
Stakeholder Liaison Officer			
Safety Officer			
Planning Chief			
Situation Unit			
Environment Unit			
Resource Unit			
Consultation Unit			
Logistics Chief			
Procurement Unit			
Communications Unit			
Services Unit			
Transport Unit			
Medical Support Unit			
Operations Chief			
Staging Area Manager			
Aviation Unit			
Marine Unit			
Shoreline Unit			
Wildlife Unit			
OH&S			
Waste Management Unit			
Finance Chief			
Administration Unit			
Finance Unit			
Records Unit/Scribe			
Incident Management Centre Unit			
Industry Liaison Officer			
Quadrant Energy			
Chevron			
Dampier Port Authority			

Add extra rows to account for field team members

PREPARED BY:	

Environmental Summary

STRATEGIES	TACTICS

OPERATIONAL MONITORING		SCIENTIFIC MONITORING			
☑	OMP1 – Spill surveillance and tracking	❑	SMP1 – Sediment quality	❑	SMP9 – Turtles
❑	OMP2 – Determination of oil character	❑	SMP2 – Water quality	❑	SMP10 – Marine mammals
❑	OMP3 – Fish tainting	❑	SMP3 – Coral reef communities	❑	SMP11 – Seabirds and shorebirds
❑	OMP4 – Oil in the water column	❑	SMP4 – Mangrove communities	❑	SMP12 – Invertebrates
❑	OMP5 – Oil encounter rate	❑	SMP5 – Macro algae and seagrasses	❑	SMP13 – Finfish
❑	OMP6 – Shoreline assessment	❑	SMP6 – Subtidal soft-bottom communities	❑	SMP14 – Fisheries and aquaculture
❑	OMP7 – Oil in sediments	❑	SMP7 – Intertidal sand and mudflat communities	❑	SMP15 – Heritage
❑	OMP8 – Wildlife	❑	SMP8 – Rocky shore/intertidal reef platform communities		

Planning Unit Personnel assigned this period

PLANNING CHIEF:	ENVIRONMENTAL UNIT COORDINATOR:

PROTECTION PRIORITIES (Based on EP)	LIKELIHOOD OF IMPACT BY OIL (Based on outputs from forecast modelling)

PROTECTION PRIORITIES (Based on EP)	OUTCOME OF SIMA OF RESPONSE STRATEGIES (Links to SIMA in EP and OSCP)

Documents/links used in SIMA

PREPARED BY:	

Operations – Marine Unit Assignment

STRATEGIES	TACTICS

Marine Response Teams assigned this period

TEAM IDENTIFIER	SECTOR	ASSIGNMENT	TEAM LEADER	CONTACT NO.
M1				
M2				
M3				
M4				

Resources assigned to Marine Response Teams this period

TEAM IDENTIFIER	EQUIPMENT REQUIRED	PERSONNEL REQUIRED	TRANSPORTATION REQUIRED		DROP-OFF TIME	PICK-UP TIME
			Yes	No		
M1						
M2						
M3						
M4						

Special instructions/general safety message

PREPARED BY:	

Operations – Aviation Unit Assignment

STRATEGIES	TACTICS

Operation Management Personnel assigned this period

OPERATIONS CHIEF:	AVIATION COORDINATOR:

Fixed wing aircraft

ASSIGNMENT	SECTOR	TIME START	TIME FINISH	CONTACT NAME	CONTACT NO.

Helicopters

ASSIGNMENT	SECTOR	TIME START	TIME FINISH	CONTACT NAME	CONTACT NO.

Special instructions/general safety message

PREPARED BY:	

Operations – Shoreline Unit Assignment

STRATEGIES	TACTICS

Operation Management Personnel assigned this period

OPERATIONS CHIEF:	SHORELINE COORDINATOR:

Shoreline Response Teams assigned this period

TEAM IDENTIFIER	SECTOR	ASSIGNMENT	SUPERVISOR NAME	CONTACT NO.
SLC 1				
SLC 2				
SLC 3				
SLC 4				
SLC 5				
SLC 6				

Resources assigned to Shoreline Response Teams this period

TEAM IDENTIFIER	MAJOR EQUIPMENT	NO. OF PERSONNEL	TRANSPORTATION REQUIRED		DROP-OFF TIME	PICK-UP TIME
			Yes	No		
SLC 1						
SLC 2						
SLC 3						
SLC 4						
SLC 5						
SLC 6						

Special instructions/general safety message

PREPARED BY:	

Operations – Wildlife Unit Assignment

STRATEGIES	TACTICS

Operation Management Personnel assigned this period

OPERATIONS CHIEF:	WILDLIFE COORDINATOR:

Wildlife Response Teams assigned this period

TEAM IDENTIFIER	SECTOR	ASSIGNMENT	SUPERVISOR NAME	CONTACT NO.
WILD 1				
WILD 2				
WILD 3				
WILD 4				
WILD 5				
WILD 6				

Resources assigned to Wildlife Response Teams this period

TEAM IDENTIFIER	MAJOR EQUIPMENT	NO. OF PERSONNEL	TRANSPORTATION REQUIRED		DROP-OFF TIME	PICK-UP TIME
			Yes	No		
WILD 1						
WILD 2						
WILD 3						
WILD 4						
WILD 5						
WILD 6						

Special instructions/general safety message

PREPARED BY:	

Operations – Waste Unit Assignment

STRATEGIES	TACTICS

Operation Management Personnel assigned this period

OPERATIONS CHIEF:	WASTE COORDINATOR:

Waste Response Teams assigned this period

TEAM IDENTIFIER	SECTOR	ASSIGNMENT	SUPERVISOR NAME	CONTACT NO.
W1				
W2				
W3				
W4				

Resources assigned to Waste Response Teams this period

TEAM IDENTIFIER	MAJOR EQUIPMENT	NO. OF PERSONNEL	TRANSPORTATION REQUIRED		DROP-OFF TIME	PICK-UP TIME
			Yes	No		
W1						
W2						
W3						
W4						

Special instructions/general safety message

PREPARED BY:	

Appendix C: Spill Impact and Mitigation Analysis

1. The SIMA process

The Spill Impact Mitigation Assessment (SIMA) process provides a means to determine the environmental gain/reduction from implementing each response strategy by considering the potential impacts on each identified protection priority, and will enable informed decisions to be made.

2. Responsibility to complete the SIMA

A SIMA is most likely to be undertaken by the Environment Unit team leader with assistance from the Planning Chief. Advice from the Operations Chief regarding the execution of response strategies (i.e. limitations, constraints, advantages of strategy); and the Resource Unit team leader or Logistics Chief regarding resource availability will also be sought.

3. Information requirements for the SIMA process

- A copy of the OPP for the spill category.
- Current situation report (SITREP from) that includes details about the spill, weather, currents and tides, action taken to date, forecast situation.
- Outputs from Operational Monitoring such as:
    - oil spill trajectory model outputs from previous studies;
    - forecast oil spill trajectory model outputs based on real time spill and metocean conditions;
    - preferred response options from the OSCP;
    - sensitive resources at risk from oiling;
    - laboratory data such as dispersant efficacy, oil weathering characteristics; and
    - outputs from response strategy monitoring and evaluation (e.g. aerial surveillance).
- Knowledge of response strategy impacts, advantages, constraints and limitations as outlined in the EPs, for example details regarding:
    - Wandoo Field EP Hazards: EP-OP-R01, EP-OP-R02, EP-OP-R03, EP-OP-R05, EP-OP-R18, EP-OP-R23; and
    - Well Construction EP Hazards: EP-WC-R01, EP-WC-R02, EP-WC-R03.

4. How data is used in the SIMA process

Once oil type, quantity, real-time weather information and a trajectory pathway are known, the sensitivities within the EMBA and Hydrocarbon Area need to be identified. Review the protection priority ranking that has been provided in the OPPs and consider:

- Outputs from OSTM analysis:
  - the probability of impact – will the response strategy reduce the probability of impact sensitive receptor?
  - minimum time to impact (days) – will the response strategy increase the number of days before impact sensitive receptor?
  - severity of impact (quantity of oil) – will the response strategy reduce the average and/or total amount of oil to impact sensitive receptor?
- Impacts associated with the proposed response strategy – will the response operation have more of a negative impact than untreated oil?; and
- The recovery time of the sensitive receptor after exposure to hydrocarbons – is recovery time likely to be short or long term?

5. Recommended response strategies and controls

Response strategy recommendations are made at the conclusion of the SIMA process and controls identified to minimise the impacts associated with response operations. Development of response strategy controls is the last step of the SIMA process to ensure that the operation does not have an more of a negative impact than the spill alone. Controls are defined according to:

- risk, impacts and benefits associated with each strategy and whether it is consistent with the EP;
- environmental sensitivities and their priority (environmental significance, severity of impact and recovery time) as per Table C-1 and Table C-2;
- seasonal and migratory patterns as per Table C-2;
- fish and coral spawning times whale aggregation periods; and
- State (WA) jurisdictional requirements and approvals.

Consideration of the environmental benefit for each strategy has also been considered when preparing the Oil Pollution Plans in the OSCP and are represented in Table C-2. This information is used in the SIMA when assessing proposed response strategies and attention should be paid to the notes that accompany the headings in this table.

For each sensitive receptor, independently assess each response strategy for suitability by determining whether its use will result in an increase or decrease in environmental benefit. If there are conflicting outcomes for a particular response option then the sensitive receptor with the higher priority becomes the preferred response option.

A check of the decision then needs to be made to ensure that the risks and impacts associated with the response options are consistent with those identified in the EPs. If the risks and impacts are not consistent with those identified in the EPs then the following will occur:

- response strategy controls are identified and assessed;
- an alternative response strategy is assessed; or
- an application for approval to implement the response strategy will be made.

6. Protection priorities

A decision must be made as to which sensitive receptors have the highest protection and/or clean-up priority and which response strategy/strategies will result in an overall net environmental benefit. Priority shorelines and habitats are mangroves, turtle nesting beaches during nesting and hatching season and significant bird breeding/nesting sites. Table C-1 is a graphic representation of protection priorities for habitats or shoreline considering the recovery time and potential impact from oil.

Table C-1: Protection priority matrix (obtained from AMOSC training material)

		RECOVERY TIME ←→ RAPID			SLOW
		<1 year	2-5 years	5-10 years	>10 years
Potential Impact Rank	Slight	Low	Low	Low	Medium
	Minor	Low	Medium	Medium	High
	Major	Low	Medium	High	High
	Severe	Medium	High	High	High

7. SIMA frequency

The SIMA will be completed on the following timeline:

- within 6 hours – a preliminary SIMA to identify indicative protection priorities and response options
- within 24 hours of the spill as part of the OPEP;
- every 24 hours as part of the IAP cycle;
- as required if the situation changes beyond what is planned for and response strategies require evaluation; and
- until termination criteria are met for response strategies and ultimately the incident.

8. Decision making toolbox

Overview

A number of tools exist that can aid the Environment Unit leader and Planning Chief in completing a SIMA for an oil spill response are available in the ICT Toolbox. Specific sections within the Wandoo Field OSCP and associated EPs are identified.

Table C-2 SIMA Matrix

Sensitivity	Protection Priority[1] **(based on likelihood of impact, severity of impact and recovery time)**	Seasonal presence in Zone of Potential Impact												Response Strategy (**↑ Increase in environmental benefit; ↓ Decrease in environmental benefit; X not applicable)**					
		J	F	M	A	M	J	J	A	S	O	N	D	Monitor and evaluate[2]	Chemical dispersant[3]	Mechanical dispersion[4]	Contain and recover[5]	Protect and deflect[6]	Shoreline clean-up[7]
Ecological																			
Whales (resting/calving)	High (T,M)							✓	✓	✓	✓			↑	↓	↑	↑	X	X
Dugongs (foraging)	High (M)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↑	↑	X	X
Dolphins	High (M)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↑	↑	X	X
Sharks	High (T,M)			✓	✓	✓	✓							↑	↓	↑	↑	X	X
Turtle nesting	High (T,M)	✓	✓	✓						✓	✓	✓	✓	↑	↑	↑	↑	↑	↑
Migratory birds	High (T,M)	✓	✓	✓	✓					✓	✓	✓	✓	↑	↑	↑	↑	↑	↑
Sea birds	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	X	X
Shore birds	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	↑
Coral spawning	Medium	✓	✓	✓	✓					✓	✓	✓	✓	↑	↓	↑	↑	X	X
Habitat/Ecosystem																			
Mangroves	High	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	↓
Intertidal rocky reef	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	X	X
Coral reef	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	X	X
Seagrasses	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	X	X
Marshland	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	↓
Mudflats	Medium	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	↓
Subtidal rocky reef	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	X	X
Sandy beaches	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	↑
Rocky shore	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	X
Open waters	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↑	↑	X	X

Sensitivity	Protection Priority[1] **(based on likelihood of impact, severity of impact and recovery time)**	Seasonal presence in Zone of Potential Impact												Response Strategy **(↑ Increase in environmental benefit; ↓ Decrease in environmental benefit; X not applicable)**					
		J	F	M	A	M	J	J	A	S	O	N	D	Monitor and evaluate[2]	Chemical dispersant [3]	Mechanical dispersion[4]	Contain and recover[5]	Protect and deflect[6]	Shoreline clean-up[7]
Socioeconomic																			
Protected shipwrecks	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	↑	X
Fisheries	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↓	↓	↑	↑	X
Petroleum activity	Low	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	↑	↑	↑	↑	↑	X

1 Protection priority: This ranking is based on a combination of factors including the likelihood of impact (time of year), severity of impact (type of exposure to the sensitivity, where the sensitivity is listed as Threatened (T) or Migratory (M) under the EPBC Act) and recovery time after exposure to hydrocarbons. Table 6 1 can be used to assess the risk of sensitivity).

2 Monitor and evaluate: This strategy is important for gathering and maintaining situational awareness throughout a response and will always have a positive benefit.

3 Chemical dispersant: Each sensitivity in the above table must be assessed independently and each strategy must also be assessed independently. Where chemical dispersant has been given a ↓, this indicates that when used alone chemical dispersant will reduce the overall environmental benefit.

The purpose of applying chemical dispersant is to break up the surface oil into small droplets of oil and to suspend the oil through the water column to accelerate the breakdown process through biodegradation. Effective dispersant application is capable of reducing the amount of oil that could potentially reach the shoreline as a surface slick.

For some species/habitats the use of chemical dispersants has been shown to reduce the severity of hydrocarbon impact. Dispersing oil into the water column reduces the quantity of oil on the surface, subsequently reducing the amount of oil that can strand and smother any resource in which it comes into contact with, i.e. mangrove pneumatophores (rhizomes that grow upwards vertically out of the mud – used for respiration and salt balance). Mangroves support a vast ecosystem of organisms below the water surface, as do seagrass beds. Dispersed oil in the water column is likely to have an adverse impact compared with oil remaining on the sea surface.

4 Mechanical dispersion: This strategy will have a positive benefit where it is beneficial to assist with the natural dispersion process, encouraging an oil slick to evaporate and mix becoming suspended within the water column where it can be more easily biodegraded. Mechanical dispersion will be more effective on smaller spills where the expected fate of the hydrocarbon is to evaporate and disperse within 24-72 hours or where it is used to assist with chemical dispersion when sea conditions are calm.

5 Containment and recovery: The containment of an oil slick with boom and recovery using mechanical devices minimises the severity of impact to sensitivities by reducing the quantity of product that could come in to contact with sensitivity. Where it is operationally feasible to use this equipment the result will have a positive environmental benefit.

6 Protection and deflection: The deployment of protection and deflection boom can assist with minimising the potential impact and/or deflecting an oil slick away from a known sensitivity towards an area where collection can be more effective. This strategy is dependent on the right environmental conditions and habitat type, however it has the capacity to have a very positive environmental benefit.

7 Shoreline clean-up: Where shoreline clean-up has been given a ↓, this indicates that the use of equipment, machinery and personnel in that environment is likely to have negative effect, potentially causing more damage and reducing the recovery and environmental benefit to that sensitivity.

NOTE: A SIMA is a decision-making process and will ultimately result in a trade-off of priorities and response strategies. It is possible for a response strategy to be used for one sensitivity – even if it has been identified that this response option may not benefit one or several other sensitivities. The final outcome of the response however should result in an overall net environment benefit.

9. References in the OSCP and EP that can assist in completing the SIMA template

The following sections of the OSCP may assist the Environment Unit leader and Planning Chief to complete the SIMA template:

- Response strategies
- Oil Pollution Plans
- Termination criteria

The following sections of the EPs can assist the Planning Chief to complete the SIMA template:

- Description of the environment;
- Key sensitivities and potential impacts;
- Impact assessment of oil spill scenarios and response strategies (EP Hazard Report Tables)
- OSTM outputs.

10. External References for Environmental Sensitivity Identification

- DoT Regional Protection Priority Assessments (ie. for Zone 2: Pilbara – Final Report; 16 Oct 2017)
- WA Oiled Wildlife Response Plan (WAOWRP) and the Pilbara Region Oiled Wildlife Response Plan (POWRP).

Response strategy being assessed (one SIMA for each strategy):	
Operational period for which response strategy is being considered:	
Date and time response required: (specify to whom and their role)	
Names of persons contributing to the SIMA (environment unit):	

Factors for consideration when completing this SIMA:

Spill dependant factors – quantity spilled, aerial coverage, oil thickness and character, oil viscosity

Site dependant factors – water depth, wind speed, wave height, current speed

Equipment/operator dependent factors – mobilization time, typical oil treatment rate, availability of operators, logistical limitations, safety limitations.

Ecological resources at risk – sensitive and vulnerable resources at risk of oiling, expected and potential damage to resources, recovery potential of the resources, importance of resources, likelihood and extent to which oil will be persistent.

Spill specific information:

1. What is the oil type and how much has been spilled? Is it a continuous spill?

2. What are the conditions on site?

Weather – current temperature, wind speed, forecast weather conditions.

Currents and tides – real time and forecast.

3. How is the oil expected to weather?

Consider rate of spreading, evaporation, emulsification, natural dispersion, dilution etc.

4. What response measures have been used and how effective have they been?

Use visual observation of dispersant effectiveness guideline (OSRL handbook); and observations from aerial and vessel based observations.

5. Where is the oil expected to go?

Consider oil spill trajectory models, 3D modelling of sub surface oiling concentrations and changes in characteristics of oil over time. Use the outputs from trajectory models to inform this step (both pre-incident models and real time models).

6. What is the expected time to impact of sensitive receptors?

Use the outputs from trajectory models to inform this step (both pre-incident models and real time models).

7. How much oil is expected to strand on sensitive receptors?

Use the outputs from trajectory models to inform this step (both pre-incident models and real time models).

8. What is the probability (likelihood) of oil impacting sensitive receptors?

Use the outputs from trajectory models to inform this step (both pre-incident models and real time models).

Effectiveness of response strategies:

9. How effective is the response strategy likely to be?

Use pre incident modelling, laboratory efficacy testing and in-situ dispersant testing (if available) to inform this step.

Consider the likelihood of an effective at-sea recovery operation removing the bulk of the oil including equipment and personnel required. Will the Boom Encounter Rate will be sufficient to warrant the effort to respond with this method? Use BER calculations in OSCP.

Consider the effectiveness of booming operations for protection and deflection.

Consider effectiveness and appropriateness of shoreline clean-up methods.

10. What is the window of opportunity?

As oil weathers it becomes less amenable to chemical dispersants, are the required personnel available eg. aerial surveillance to support aerial spraying?

How fast is the oil spreading will it be of a sufficient thickness for effective containment and recovery?

Understanding the impacts associated with response strategies:

11. Is the environmental impact of the response strategy likely to be less than the impact of untreated oil?

How vulnerable and acutely sensitive to oil are the surface, sub-surface and coastal resources?

Consider seasonality, oil spill trajectory model and water depth. Acute sensitivity is resource specific and a function of their tolerance to the chemical toxicity and physical smothering of the oil.

12. What potential impacts could oil and/or the response strategy have on wildlife?

Consider seasonality of wildlife patterns, depth of water, distance from coastline. Refer to Table 3 SIMA matrix for seasonality information.

13. How persistent will the oil be?

Consider the wave exposure of the shoreline and the oil type. Dispersed oil is usually rapidly diluted and biodegraded, unless it becomes entrained in deep muddy seabed sediments where it could remain indefinitely.

14. How important is the resource?

Consider importance to community, adjacent ecosystems (productivity), biodiversity, rarity and commercial importance.

15. Can the response strategy be applied safely and effectively?

Consider standard operating procedures and risk assessment prepared by AMSA

16. Have necessary approvals been obtained?

Dispersant application (NOPSEMA accepted OSCP; State ESC approval)

17. What are the potential impacts of the response strategy ?

Refer to Hazard Assessment tables in EPs

18. What controls could mitigate these risks?

Refer to Hazard Assessment tables in EPs

What is the conclusion of the analysis?

Is the response strategy appropriate from the environment group's point of view?

What are the Environment Group's recommendations and advice for this response strategy in terms of response controls?

E.g. what should responders do to prevent unwanted impacts?

Position	**Agree with recommendation**	**Disagree with recommendation**
Environment Unit leader sign off:		
Planning Chief sign off:		
Incident Commander sign off:		

Strategic SIMA - Summary of likely response options and Environmental Impact considerations for each spill category

	Category A	Category B	Category C	Category D	Category E	Category F
Upper credible scenario	*Single release 300m^3 Wandoo Crude*	*Single release 700m^3 diesel spill*	*Single release 1,300m^3 HFO*	*Single release 10,000m^3 Wandoo Crude*	*Continuous up to 595m^3/day (for up to 60 days) Wandoo Crude spill*	*Single release 250,000bbl over 24 hours from CGS*
Predicted outcomes	*Based on modelling for other scenarios, oil is expected to remain offshore and not impact shorelines.*	*Is expected to evaporate and spread rapidly with no shoreline impact.*	*Based on modelling for other scenarios, oil is expected to remain offshore and not impact shorelines.*	*Shoreline impact varies with season, modelling suggests a 49% probability of contact to any shoreline during summer within about 3 days.*	*Modelling suggests a greater than 80% probability of contact to any shoreline throughout all seasons within about 3-4 days.*	*Modelling suggests a probability of 21% of shoreline impact during summer within about 4 days.*
Source control						
Identified as suitable?	Yes	Yes	Yes	Yes	Yes	Yes
SIMA considerations	Isolation of ruptured section of flow line, flow stopped or redirected. Subsea inspection and repair to follow. Preventative inspections and maintenance carried out periodically. This is an important mitigation measure once a spill has occurred, because it reduces the volume of oil reaching the marine environment.	Source control activities include, shutting off pumps and transferring fuel to another fuel tank. All strategies would be effective in minimising the amount of hydrocarbons lost to the environment and would reduce the area of potential exposure.	Transfer product to another tank to minimise the amount of hydrocarbons lost to the environment.	Transfer product to another tank to minimise the amount of hydrocarbons lost to the environment.	Regaining control of a well may require a relief well to achieve the desired result. The use of a sub-sea capping stack to regain the control of a well is not feasible for Wandoo wells.	Regaining control of a spill will be achieved through CGS repair options.
Monitor and evaluate						
Identified as suitable?	Yes	Yes	Yes	Yes	Yes	Yes
SIMA considerations	All spills will be monitored and evaluated to assess the natural biodegradation of the hydrocarbons and ensure situational awareness of the spill is maintained by VOGA emergency response teams.					
Chemical dispersion						
Identified as suitable?	Yes	No	Yes	Yes	Yes	Yes
SIMA considerations	Dispersants have the potential to increase the rate of biodegradation by entraining oil droplets within the water column. This can reduce the impact on sensitive resources such as seabirds. A dispersant test spray run will be undertaken prior to moving to full dispersant application operations to verify its effectiveness.	Marine diesel is not a persistent hydrocarbon; it has a high natural dispersion and evaporation rate due to the high percentage of volatile components within the oil. Approximately 70% of the diesel will have evaporated after 30 days and the majority of the remaining 30% will become entrained in the water column. A small increase in sea state (wave and wind action) can assist natural biodegradation through entraining diesel in the water column. Shoreline impact is not predicted.	HFO is likely to be persistent in the environment for some time. Even though modelling for this scenario doesn't indicate shoreline impact, dispersants have the potential to increase the rate of biodegradation by entraining oil droplets within the water column. This can reduce the impact on sensitive resources such as seabirds.	Dispersants will be assessed as a response option to increase the rate of biodegradation and minimise and the impacts of oil on the environmental sensitivities in the Hydrocarbon Area. Dispersant use could potentially result in an increase in environmental benefit for mangroves, mudflats, marshland, sandy beaches and rocky shores; as well as turtle nesting sites, migratory birds, seabirds and shorebirds. A dispersant test spray run will be undertaken prior to moving to full dispersant application operations to verify its effectiveness.	Dispersants will be assessed as a response option to increase the rate of biodegradation and minimise and the impacts of oil on the environmental sensitivities in the Hydrocarbon Area. Dispersant use could potentially result in an increase in environmental benefit for mangroves, mudflats, marshland, sandy beaches and rocky shores; as well as turtle nesting sites, migratory birds, seabirds and shorebirds. A dispersant test spray run will be undertaken prior to moving to full dispersant application operations to verify its effectiveness.	Dispersants will be assessed as a response option to increase the rate of biodegradation and minimise the impacts of oil on the environmental sensitivities in the Hydrocarbon Area. Dispersant use could potentially result an increase in environmental benefit for mangroves, mudflats, marshland, sandy beaches and rocky shores; as well as turtle nesting sites, migratory birds, seabirds and shorebirds. A dispersant test spray run will be undertaken prior to moving to full dispersant application operations to verify its effectiveness.

	Category A	Category B	Category C	Category D	Category E	Category F
Upper credible scenario	*Single release 300m^3 Wandoo Crude*	*Single release 700m^3 diesel spill*	*Single release 1,300m^3 HFO*	*Single release 10,000m^3 Wandoo Crude*	*Continuous up to 595m^3/day (for up to 60 days) Wandoo Crude spill*	*Single release 250,000bbl over 24 hours from CGS*
Mechanical dispersion						
Identified as suitable?	Yes	No	Yes	Yes	Yes	Yes
SIMA considerations	Mechanical dispersion will be assessed as a response option to enhance dispersion and dilution of oil into the water column which then leads to biodegradation of the oil. Mechanical dispersion can result in an increase in environmental benefit for all ecological sensitivities.	Diesel spreads and evaporates rapidly. Mechanical dispersion may inhibit the rate of evaporation and could cause the oil to emulsify.	Mechanical dispersion will be assessed as a response option to enhance dispersion and dilution of oil into the water column which then leads to biodegradation of the oil. Mechanical dispersion can result in an increase in environmental benefit for all ecological sensitivities and for mangroves, marshlands, mudflats, sandy beaches, rocky shores and open waters.	Mechanical dispersion will be assessed as a response option to enhance dispersion and dilution of oil into the water column which then leads to biodegradation of the oil. Mechanical dispersion can result in an increase in environmental benefit for all ecological sensitivities and for mangroves, marshlands, mudflats, sandy beaches, rocky shores and open waters.	Mechanical dispersion will be assessed as a response option to enhance dispersion and dilution of oil into the water column which then leads to biodegradation of the oil. Mechanical dispersion can result in an increase in environmental benefit for all ecological sensitivities and for mangroves, marshlands, mudflats, sandy beaches, rocky shores and open waters.	Mechanical dispersion will be assessed as a response option to enhance dispersion and dilution of oil into the water column which then leads to biodegradation of the oil. Mechanical dispersion can result in an increase in environmental benefit for all ecological sensitivities and for mangroves, marshlands, mudflats, sandy beaches, rocky shores and open waters.
Containment and recovery						
Identified as suitable?	Yes	No	Yes	Yes	Yes	Yes
SIMA considerations	Containment and recovery can be used to recover oil to prevent it impacting on environmental, social and cultural sensitivities. Containment and recovery may be effective on Wandoo Crude as it is a persistent crude oil with a high specific gravity and viscosity. Depending on metocean conditions, containment and recovery is expected to have a removal rate of 10% to 15% (ITOPF, 2013). Containment and recovery will be used if metocean conditions are suitable and if oil is of suitable thickness.	An instantaneous spill of diesel will spread and evaporate rapidly due to the high proportion of volatile components within the oil and will not be of a sufficient thickness to provide for effective containment and recovery operations.	Containment and recovery will be assessed as a response option because of the persistent nature of HFO. Containment and recovery can result in an increase in environmental benefit for all ecological and habitat/ecosystem sensitivities.	OSTM of this scenario suggests that up to 60% of the Wandoo Crude will remain on the surface of the water after 10 days. Containment and recovery can be used to recover oil to prevent it impacting on environmental, social and cultural sensitivities. Containment and recovery may be effective on Wandoo Crude as it is a persistent crude oil with a high specific gravity and viscosity. Depending on metocean conditions, containment and recovery is expected to have a removal rate of 10% to 15% (ITOPF, 2013). Containment and recovery will be used if metocean conditions are suitable and if oil is of suitable thickness.	Containment and recovery can be used to recover oil to prevent it impacting on environmental, social and cultural sensitivities. Containment and recovery may be effective on Wandoo Crude as it is a persistent crude oil with a high specific gravity and viscosity. Depending on metocean conditions, containment and recovery is expected to have a removal rate of 10% to 15% (ITOPF, 2013). Containment and recovery will be used if metocean conditions are suitable and if oil is of suitable thickness.	Containment and recovery can be used to recover oil to prevent it impacting on environmental, social and cultural sensitivities. Containment and recovery may be effective on Wandoo Crude as it is a persistent crude oil with a high specific gravity and viscosity. Depending on metocean conditions, containment and recovery is expected to have a removal rate of 10% to 15% (ITOPF, 2013). Containment and recovery will be used if metocean conditions are suitable and if oil is of suitable thickness.

	Category A	Category B	Category C	Category D	Category E	Category F
Upper credible scenario	*Single release 300m^3 Wandoo Crude*	*Single release 700m^3 diesel spill*	*Single release 1,300m^3 HFO*	*Single release 10,000m^3 Wandoo Crude*	*Continuous up to 595m^3/day (for up to 60 days) Wandoo Crude spill*	*Single release 250,000bbl over 24 hours from CGS*
Protection and deflection						
Identified as suitable?	No	No	No	Yes	Yes	Yes
SIMA considerations	The extent of a Wandoo Crude spill of this size is not expected to impact sensitive habitats/ ecosystems and as such the deployment of protection booms will not be required. It is unlikely that oil will be of a sufficient thickness to be effectively corralled or deflected by protection booms.	Diesel spreads and evaporates rapidly; it is unlikely that a spill in this category will be of a sufficient thickness to be effectively corralled or deflected by booms. A diesel spill of this scale is not expected to impact sensitive resources and as such the deployment of protection booms will not be required.	The extent of a HFO spill of this size is not expected to impact sensitive resources and as such the deployment of protection booms will not be required.	Where the Hydrocarbon Area indicates impact to shoreline sensitivities, protection and deflection will be assessed as a response strategy. OSTM for this scenario suggests some shoreline impact and as such protection and deflection may result in an environmental benefit for turtle nesting sites, migratory birds, shorebirds, mangroves, marshland, mudflats, sandy beaches and rocky shores.	Where the Hydrocarbon Area indicates impact to shoreline sensitivities, protection and deflection will be assessed as a response strategy. OSTM for this scenario show that there is a probability sensitive marine resources will be impacted by oil at a thickness greater than 10g/m^2, hence protection and deflection may result in an environmental benefit for turtle nesting sites, migratory birds, shorebirds, mangroves, marshland, mudflats, sandy beaches and rocky shores.	Where the Hydrocarbon Area indicates impact to shoreline sensitivities, protection and deflection will be assessed as a response strategy. OSTM for this scenario show that there is a probability sensitive marine resources will be impacted by oil at a thickness greater than 10g/m^2, hence protection and deflection may result in an environmental benefit for turtle nesting sites, migratory birds, shorebirds, mangroves, marshland, mudflats, sandy beaches and rocky shores.
Shoreline clean-up						
Identified as suitable?	No	No	No	Yes	Yes	Yes
SIMA considerations	Shoreline impacts are not anticipated for spills in this category and as such shoreline clean-up is not required.	Shoreline impacts are not anticipated for spills in this category and as such shoreline clean-up is not required.	Based on the current Hydrocarbon Area, shoreline impacts are not anticipated for spills in this category and as such shoreline clean-up is not required.	Shoreline clean-up activities will be assessed as a response where impact is predicted to occur in areas of highest sensitivity. Modelling suggests minimum time to shore is 11 days. Shoreline clean-up activities have the potential to cause more harm than good and as such require careful planning and execution. An increase in environmental benefit can generally be achieved when clean-up activities are undertaken on sandy beaches and areas where there are turtle nesting sites, migratory birds and shorebirds.	Shoreline clean-up activities will be assessed as a response where impact is predicted to occur in areas of highest sensitivity. Modelling suggests minimum time to shore of approximately 3 days. Shoreline clean-up activities have the potential to cause more harm than good and as such require careful planning and execution. An increase in environmental benefit can generally be achieved when clean-up activities are undertaken on sandy beaches and areas where there are turtle nesting sites, migratory birds and shorebirds.	Shoreline clean-up activities will be assessed as a response where impact is predicted to occur in areas of highest sensitivity. Modelling suggests minimum time to shore of approximately 3 days. Shoreline clean-up activities have the potential to cause more harm than good and as such require careful planning and execution. An increase in environmental benefit can generally be achieved when clean-up activities are undertaken on sandy beaches and areas where there are turtle nesting sites, migratory birds and shorebirds.
Oiled wildlife response						
Identified as suitable?	Yes	Yes	Yes	Yes	Yes	Yes
SIMA considerations	Surveillance for oiled wildlife will be conducted as per the VOGA Operational and Scientific Monitoring Plan (OSMP). Oiled wildlife response (OWR) will be undertaken for all categories if required.					

	Category A	Category B	Category C	Category D	Category E	Category F
Upper credible scenario	*Single release 300m³ Wandoo Crude*	*Single release 700m³ diesel spill*	*Single release 1,300m³ HFO*	*Single release 10,000m³ Wandoo Crude*	*Continuous up to 595m³/day (for up to 60 days) Wandoo Crude spill*	*Single release 250,000bbl over 24 hours from CGS*
In-situ burning						
Identified as suitable?	No	No	No	No	No	No
SIMA considerations	Wandoo Crude is not amenable to in-situ burning (flash point of 144°C), and the required equipment, technology, approved accelerant, and training is not readily available in Australia.	Diesel evaporates rapidly and is not suitable for in-situ burning.	The characteristics of HFO are variable and as such it is not known if the oil will be amenable to in-situ burning (i.e. flashpoint). The required equipment, technology, approved accelerant, and training is not readily available in Australia.	Wandoo Crude is not amenable to in-situ burning (flash point of 144°C), and the required equipment, technology, approved accelerant, and training is not readily available in Australia.	Wandoo Crude is not amenable to in-situ burning (flash point of 144°C), and the required equipment, technology, approved accelerant, and training is not readily available in Australia.	Wandoo Crude is not amenable to in-situ burning (flash point of 144°C), and the required equipment, technology, approved accelerant, and training is not readily available in Australia.
Scientific monitoring						
Identified as suitable?	No	No	Yes	Yes	Yes	Yes
SIMA considerations	All spills will be monitored and evaluated to assess the natural biodegradation of the hydrocarbons and ensure situational awareness of the spill is maintained by VOGA emergency response teams. However, only longer term scientific monitoring plans are likely to be triggered for Category C, D, E and F spills due the unlikely impact on sensitive receptors during a Category A or B spill.					

Appendix D: WAN-2000-RD-0001.03 Wandoo Field Operational Scientific and Monitoring Plan

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WANDOO FIELD OPERATIONAL AND SCIENTIFIC MONITORING PLAN

WAN-2000-RD-0001.03

Revision	Date	Originator	Checker	Approver
4	03/01/2020	Environmental Advisor	HSE Manager	Operations Manager

Revision history

Revision	Date	Description
1	16 October 2014	Issued for NOPSEMA Acceptance
2	07 October 2016	Issued for Use
3	27 September 2018	Issued for Use – Updated Baseline Data, potential providers and included Assurance activities section
4	03 January 2020	Issued for NOPSEMA Acceptance

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Abbreviations and acronyms

ALARP	As Low As Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
ANZECC	Australia and New Zealand Environment and Conservation Council
AODN	Australian Oceans Data Network
APASA	Asia-Pacific Applied Science Associates
Astron	Astron Environmental Services
BACI	Before-After-Control-Impact
BPPH	Benthic Primary Producer Habitat
BRUV	Baited Remote Underwater Video
CALM	Department of Conservation and Land Management
CoC	Chain of Custody
DEC	Department of Environment and Conservation
DoF	Department of Fisheries
DoT	Department of Transport
DBCA	Department of Biodiversity, Conservation and Attractions (formerly DPaW)
EMBA	Environment that may be affected
EP	Environment Plan
EPA	Environmental Protection Authority
EPIRB	Emergency Position-Indicating Radio Beacon
FWADC	Fixed Wing Aerial Dispersant Capability
GIS	Geographical Information System
GPS	Global Positioning System
HSE	Health, Safety and Environment
IAP	Incident Action Plan
IBA	Important Bird Areas
ICT	Incident Command Team
I-GEMS	Industry-Government Environmental Metadata System
IMOS	Integrated Marine Observing System
IUCN	International Union for the Conservation of Nature
MBACI	Multiple Before-After, Control-Impact
MC	Monitoring Coordinator

MMO	marine mammal observer
NATA	National Association of Testing Authorities
NEBA	Net Environmental Benefit Analysis
NDVI	Normalised Difference Vegetation Index
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NWS	North-West Shelf
OM	Operational Monitoring
OMP	Operational Monitoring Plan
OSCP	Oil Spill Contingency Plan
OSMP	Operational and Scientific Monitoring Plan
OSRA	Oil Spill Response Atlas
OSTM	Oil Spill Trajectory Modelling
OWRP	Oiled Wildlife Response Plan
PAH	Polycyclic Aromatic Hydrocarbons
PTTEP	PTT Exploration and Production Public Company Limited
QA/QC	Quality Assurance/Quality Control
ROV	Remotely Operated Vehicle
SAR	Synthetic Aperture Radar
SM	Scientific Monitoring
SMP	Scientific Monitoring Plan
SOP	Standard Operating Procedure
SPR	State-Pressure-Response
TPH	Total Petroleum Hydrocarbons
UHF	Ultra High Frequency
VHF	Very High Frequency
VOGA	Vermilion Oil & Gas Australia Pty Ltd
WA	Western Australia
WAMSI	Western Australia Marine Science Institute
WMA	Web Map Application

1 Overview

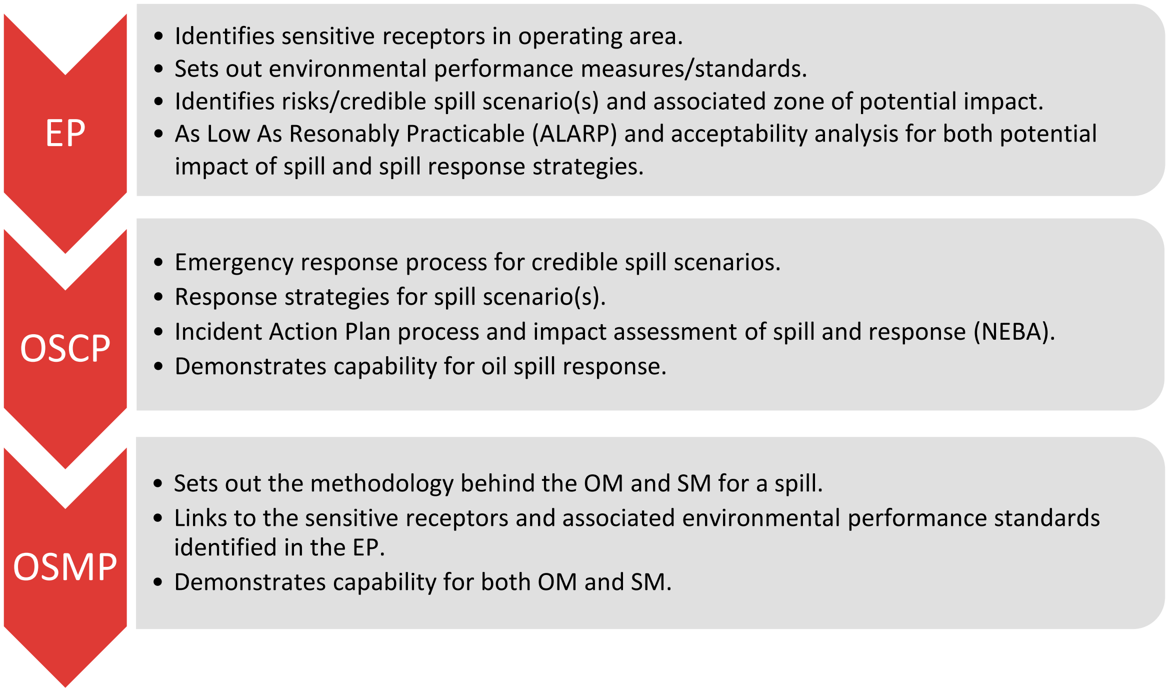
1.1 Introduction

This Operational and Scientific Monitoring Plan (OSMP) has been designed as part of an integrated package of the environmental management documentation that includes the Vermilion Oil & Gas Australia Pty Ltd (VOGA) Operational and Well Construction Environment Plans (EPs) and the Wandoo Field Oil Spill Contingency Plan (OSCP) [WAN-2000-RD-0001]. The OSMP is informed by the EPs through the identification of the sensitive receptors in the Wandoo Field operating environment that could be impacted during an oil spill. The monitoring activities detailed in this OSMP may also provide a basis for:

- determining if (and/or when) the goals set for environmental protection are achieved;
- 'testing' the efficacy of predictions of impact presented in the EPs; and
- 'testing' the effectiveness of the oil spill response within the OSCP.

The Operational Monitoring (OM) components of this OSMP have been designed around the specific response strategies described in the OSCP. The sensitive receptors outlined in the EPs for the Wandoo Field operating area directly informs the Scientific Monitoring (SM) components of this OSMP. It is important to recognise that although each monitoring strategy has been informed through different information pathways, they are inextricably linked through the EP ⇨ OSCP ⇨ OSMP development process (Figure 1-1), as well as through initiation and termination criteria that VOGA has identified for this plan.

Figure 1-1: The VOGA environmental management package and the process that links the documentation



1.2 Aims

The aims of this OSMP are to provide details that inform relevant responders during an oil spill and protect the environment via effective operational and scientific monitoring. This is achieved via:

- Arrangements for in field OM to inform oil spill response;
- How OM initiates and informs SM;
- The values and receptors that will be monitored and the objectives for monitoring them;
- The parameters to be measured and the timeframes for initiating monitoring to ensure that data is appropriate for measuring impacts in the event of a spill;
- Appropriate initiation and termination criteria;
- How the termination criteria for response strategies is informed by OM outputs; and
- The necessary resources that will be available and their associated competencies, to ensure that the SM program can be implemented and the objectives and performance outcomes can be met.

1.3 OSMP implementation

This OSMP is designed to be used by the VOGA Incident Command Team (ICT) Planning Chief to:

- Identify the response strategies being implemented and the relevant Operational Monitoring Plans (OMPs) that may be triggered (Table 3-1);
- Initiate appropriate OMPs that may be triggered via specific criteria (Table 5-2 to Table 5-9);
- Use the guidance in the respective OMPs to implement tactics;
- Initiate appropriate Scientific Monitoring Plans (SMPs) that may be triggered via specific criteria (Table 6-2 to Table 6-15);
- Identify providers and resources required to implement SMPs triggered;
- Stage implementation of oil spill monitoring response teams:
    - Standby – this period is used to validate preparedness to monitor prior to an incident occurring. The oil spill monitoring response team is also on standby during high risk periods (i.e. well construction);
    - Pre-exposure – a narrow time window that allows the oil spill monitoring response team to mobilise and confirm by rapid assessment the current state of identified values at the high-priority sites before impact. This is used to support the baseline data already held and addresses the issue of naturally high inter-annual variability in some of the identified biodiversity values, such as seabirds; and
    - Post-exposure and recovery – in this period repeat-measures monitoring is undertaken, reported and reviewed.
- Terminate OMPs and SMPs if associated termination criteria has been met.

1.4 Assumptions

This OSMP assumes that in the event of an oil spill incident, VOGA:

- Activates and implements its emergency response;
- Directs the ICT to provide sufficient support to deliver operational, planning and logistical resources required for the standby emergency monitoring team to mobilise, access key sites and capture pre-exposure data listed;
- Implements emergency management that aims to protect specific high-value biodiversity assets from oil exposure; and
- Provides sufficient resources that will be required to collate, collect, analyse and report on the complete OSMP dataset to satisfy oil spill monitoring.

2 Values and receptors to be monitored

2.1 Environment that may be affected

Environmental, sociological and economic sensitivities within the identified EMBA have been assessed in the activity-specific EPs which describe key marine habitats, associated flora and fauna, social and economic values, and areas of environmental significance. For planning purposes, priority locations for protection are based on OSTM and identified environmental sensitivities.

OSTM analysis indicates the Pilbara coast and offshore islands between North West Cape and Eighty Mile Beach contain several sensitive locations that are most likely to be impacted first and most significantly. This includes the following locations identified as a 'Very High' protection priority ranking in the DoT Regional Protection Priority Assessment for Zone 2: Pilbara Report:

- Barrow Island;
- Montebello Islands;
- Lowendal Islands; and
- Dampier Archipelago

2.2 Baseline data

VOGA undertakes regular reviews of the status, availability and suitability of environmental baseline/monitoring data for key receptors of the EMBA to ensure the data is effective in determining the impacts on the environment from an oil pollution event. This information is available as part of the ICT Toolbox for use by the Planning Coordinator and Environment Unit.

Appendix A summarises the current and target states and available baseline/monitoring data for high protection priority locations within the EMBA from sources including the following on-line resources, which may also be used in real-time during a spill response.

2.2.1 Industry-Government Environmental Metadata System

I-GEMS was established by a number of APPEA member companies, marine research institutes and Western Australian government agencies. I-GEMS is geo-spatial metadata representing the key baseline environmental datasets relevant to impact assessment and monitoring in the event of an oil spill. The datasets include the Western Australian coastline area between the Abrolhos Islands and the Timor Sea.

The marine environmental metadata includes instant online access to the list of available data sets on key receptor sensitivities in the event of major oil spill. Furthermore, the online centralised system allows VOGA to search available data sets and understand the baseline (pre-spill) condition of key environmental sensitivities and consider priority gaps in baseline data collection.

2.2.2 Western Australian Oil Spill Response Atlas

The Western Australian Oil Spill Response Atlas (OSRA) is a spatial database of environmental, logistical and oil spill response data. Using a geographical information system (GIS) platform, OSRA displays datasets collated from a range of custodians allowing decision makers to visualise environmental sensitivities and response considerations in a selected location. Oil spill trajectory modelling (OSTM) can be overlaid to assist in determining protection priorities, establishing suitable response strategies and identifying available resources for both contingency and incident planning.

2.2.3 Australian Ocean Data Network

The Australian Oceans Data Network (AODN) is the primary access point for search, discovery, access and download of data for Western Australia collected by the Australian marine community. These data are presented as a regional view of all the data available from the Australian Ocean Data Network. Primary datasets are contributed by Commonwealth Government agencies, State Government agencies, Universities, the Integrated Marine Observing System (IMOS) an Australian Government Research Infrastructure project, and the Western Australia Marine Science Institute (WAMSI).

2.2.4 The Atlas of Living Australia

The Atlas of Living Australia is also an on-line resource that contains information on all the known species in Australia aggregated from a wide range of data providers. It provides a searchable database when considering species within the EMBA.

3 Operational and scientific monitoring

3.1 Methodology background

A two-class monitoring nomenclature has been developed in Australia, and is defined according to the primary objectives of the monitoring program:

- OM provides information of direct relevance to spill response operations through the implementation of OMPs; and
- SM relates to non-response objectives and includes short term environmental damage assessments, longer-term damage assessments (including recovery), purely scientific studies and all post spill monitoring activities through SMPs.

The OMPs summarise accepted monitoring methods used to inform response operations and determine potential oil spill and response strategy impacts on habitats or species within the marine and shoreline environments. The monitoring methods have been sourced from the Australian Maritime Safety Authority (AMSA) *Oil Spill Monitoring Handbook* (AMSA, 2003a) and *Oil Spill Monitoring Background Paper* (AMSA, 2003b), already established monitoring programs, including PTT Exploration and Production Public Company Limited (PTTEPs) *Monitoring Plan for the Montara Well Release Timor Sea* (PTTEP, 2009) and Chevron's *Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report* (Chevron Australia Pty Ltd, 2011), as well as the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) *Operational and scientific monitoring programs Information Paper* (NOPSEMA, 2016).

Monitoring methods detailed in the OMPs in some cases are different to those detailed in the SMPs. Some methods are suitable for the OMPs, but they may not be suitable for the SMPs. For example, the more rapid assessments such as aerial surveys of shoreline habitats are appropriate tactics for an OMP but are less likely to fulfil the sampling requirements and measurements required for an SMP. Where appropriate, this OSMP has been designed so that any data generated from the OMPs is transferrable to the SMPs.

Given the low likelihood and unpredictable nature of an oil spill incident, it is very unlikely that one pre-established design for SM will be appropriate for all scenarios. Instead, monitoring will require an adaptive approach which employs previous baseline monitoring, new post-spill data, spatial control sites, and wherever possible, post-spill pre-impact data (DEC, 2009). A structured framework has been described in Section 3.2 in order to establish monitoring plans and apply methodologies which have the highest likelihood of identifying significant environmental impacts and consequent recovery.

Both OM and SM are required to best inform response activities and allow further decisions to be made in as near as real time as possible (AMSA, 2003b). With this aim, Section 3.3 highlights the most important approaches to statistical analysis, and importantly how this information is best summarised and communicated to guide further decision-making and management.

3.2 State-Pressure-Response framework

The OSMP requires the application of a logical framework to deliver an appropriate SM strategy. The SPR framework clearly fulfils this requirement and is used by the International Union for the Conservation of Nature (IUCN), DBCA, Parks Victoria and numerous other national and international marine and terrestrial environmental management agencies (Stem *et al.,* 2005; Hockings *et al.,* 2006; DEC, 2009).

The SPR framework is used to focus conservation efforts towards maintaining biodiversity to a desired condition often termed a target state (Hockings *et al.,* 2006; Varcoe, 2012). It guides management response by:

- clearly identifying what biodiversity exists (or is likely to exist) within an area of interest (seascape/landscape);
- measuring the condition of the biodiversity (can be referred to as baseline condition and should draw on already existing repeat-measures environmental monitoring data);
- identifying the target or desired state of the biodiversity in the future (typically no change in condition);
- listing the threats or pressures that degrade the condition of biodiversity within the area of interest and quantifying their level of threat (through direct monitoring or quantitative modelling – Ferrier, 2012);
- planning and implementing the response to manage the pressures degrading the biodiversity; and
- identifying whether the management response was effective in maintaining biodiversity to the target or desired state.

The management target is ‘no impact’, because the aim of the emergency response is to protect biodiversity from exposure, or facilitate recovery. Assessment of management effectiveness is achieved by compilation of existing and new monitoring information and analysis and interpretation of data gathered. The VOGA OSMP is framed to deliver monitoring data through an approach which combines a variety of analytical approaches and compilation of analytical results presented as Environmental Control Charts (Appendix B) which include numerical control limits. Information is then summarised in a series of Environmental Report Cards (Anderson and Thompson, 2004; Burgman *et al.,* 2012; Gove *et al.,* 2013).

3.3 Experimental monitoring designs

Current research and development on environmental monitoring and management effectiveness evaluation is a developing discipline in Australia (see numerous chapters in Lindenmayer and Gibbons, 2012). Contemporary SM publications alert managers to the significant risks of relying on pre-established Before-After-Control-Impact (BACI) designed monitoring programs. This is particularly pertinent in the case of oil spills which are unpredictable both in terms of timing and extent; making traditional statistical designs very difficult to establish pre-spill. Indeed, Burgman *et al.* (2012) caution against new monitoring campaigns that rely solely on experimental designs (e.g. BACI) to demonstrate environmental management effectives. This is because of the relative importance of Type I and Type II errors in statistical analyses in relation to high natural variability and the fact that traditional designs are focused on the rejection of the null hypothesis and Type I errors, whereas in impact monitoring the concerned is primarily with the risk of Type II errors (Burgman *et al.,* 2012).

Type I error is the risk of concluding an impact has occurred when in fact it has not (conventionally, this is most often set at 5%), while Type II is the risk of concluding there is no impact when in fact there has been an impact (i.e. the impact has gone undetected). Although less frequently explored, this is conventionally set at 20% (e.g. Chevron, 2014). Many environmental monitoring programs have no realistic chance of detecting significant impacts because they are prone to Type II errors because of the high natural variability in these values (Osenberg *et al.,* 1994; Underwood, 1994; Field *et al.,* 2006; Legg and Nagy, 2006).

Contemporary approaches consider both BACI designed data coupled with repeat-measures information presented as environmental control charts and summarised as report cards (Burgman *et al.,* 2012). Hence wherever possible, monitoring programs and consequent analysis should integrate both a spatial and long-term temporal component (Skalski, 1995).

Control charts have now been used as a key tool in the management of fisheries (Petitgas, 2009) and their summary into environmental report cards is applied to biodiversity management within forests (see WA State parliamentary question, September 2013), while contemporary statistical tools such as Generalised Additive Mixed Models, allow for the analysis of a diverse array of data. This is the approach adopted by VOGA in this OSMP.

In summary, the SPR framework for biodiversity management is encapsulated in management guidelines (DEC, 2009) and applied in marine conservation management plans and the Western Australian Marine Monitoring Program) and internationally (IUCN Monitoring and Evaluation Framework, Hockings *et al.,* 2006). It is logical that the SPR framework is applied to the planning and implementation of this OSMP.

3.4 Scientific monitoring methods

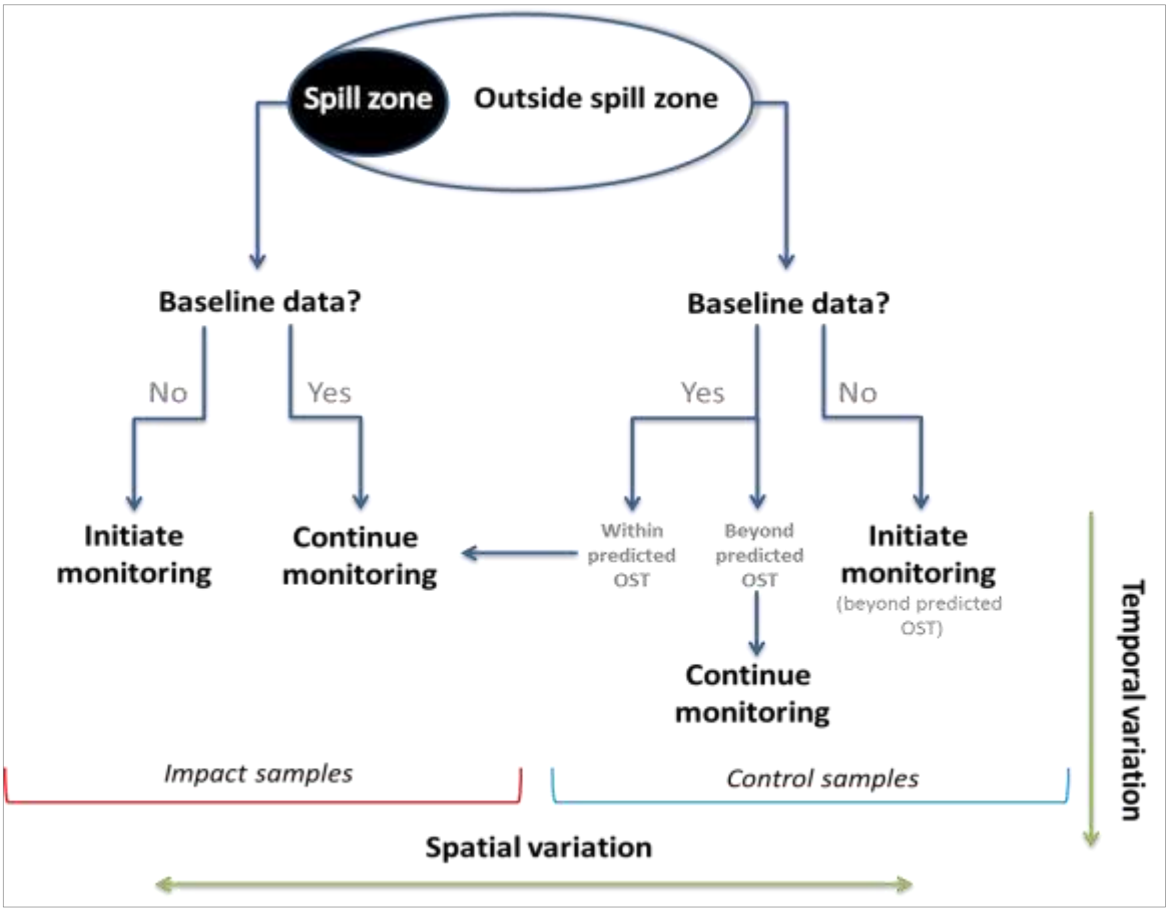
In the event of an oil spill, the monitoring design will depend upon the nature of the spill, the availability of baseline data in relation to the spill extent, and the expert opinion of those brought to the field. To ensure the application of robust designs and sampling approaches which have the highest likelihood of detecting an environmental impact while allowing suitable flexibility, this plan provides a set of Guiding Principles for monitoring design and sampling (Table 3-1). A structured decision-making framework for allocating monitoring effort in both time and space is described in Figure 3-1. In an ideal design, sampling would occur across a gradient of exposure rather than “impact” and “control” per say.

Table 3-1: Guiding principles for oil spill monitoring design and methodologies

Principle	Explanation	Key guiding references
Match baseline	Designs and methodologies should follow those used in appropriate baseline studies wherever possible.	N/A
Comprehensive sampling	Sampling methods should seek to sample the full range of taxa within each assemblage. This may require the use of several complimentary techniques. (The exception is if indicator taxa are employed; see below.)	N/A
Reliable indicator taxa	If indicator taxa are targeted then the choice of indicator should be defensible, and a link to the response of the broader assemblage demonstrated. Indicators of ecosystem function should also be considered.	Hilty and Merenlender, 2000

Principle	Explanation	Key guiding references
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 that 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 to reduce within-treatment variation.	N/A
Compositing of samples	Appropriate compositing to increase statistical power should be considered.	Carey and Keough, 2002
Account for environmental gradients and partition variations	Sources of variation are considered and compartmentalised to best reduce within-treatment variation, and thereby maximise power to detect an impact. This is managed through several means: 1. Environmental covariates are considered in sampling design recorded and incorporated statistically. 2. A hierarchical or stratified sampling design is used to address variation at multiple scales 3. Design is standardised, by sampling equivalent strata (e.g. level of exposure, depth etc.).	English *et al.,* 1997; Snedecor and Cochran, 1989
Assess statistical power	Where null-hypothesis tests are planned, statistical power of the design is assessed prior to execution.	Toft and Shea, 1982; Legg and Nagy, 2006; Gerrodette, 1987
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 1991, 1992, 1994
Appropriate temporal replication	Sampling should account for natural temporal variation.	Underwood 1991, 1992, 1994

Figure 3-1: Structured decision-making process based on Gregory *et al.* (2012) in reference to monitoring programs, the availability of baseline data, and oil spill trajectory



3.5 Quality Assurance and Quality Control (QA/QC)

In the event of an incident, reporting the results of the monitoring programs should be of a sufficient level to support the guiding principles for oil spill monitoring design and methodologies. The Quality Assurance and Quality Control (QA/QC) standards of the monitoring plans include:

- All personnel handling samples or sampling equipment wearing fresh nitrile gloves at each sample site to prevent cross contamination of samples;
- Establishing clear Chain of Custody (CoC), roles and lines of responsibility and processes for sampling, data collection, data entry/management, statistical analyses and interpretation;
- Ensure that those responsible for packages of work are appropriately qualified/accredited to do the work and are competent in the specific tasks;
- Maintenance of metadata;
- Processes for data backup, storage and archiving.

The CoC is used to keep track of individual samples to ensure that correct analysis and storage is undertaken, and that the recommended holding times are adhered to. The CoC forms include the following:

- Place of sampling;
- Sample identification, location and project reference number;
- Sampling date;
- Requested analysis;

- Sample storage request; and
- Sample transport details including date of dispatch.

All samples will be analysed at a National Association of Testing Authorities (NATA) accredited laboratory with suitable analytical limits of reporting for analysis against assessment criteria.

4 Integration of operational and scientific monitoring

4.1 Operational monitoring informing response strategies

Response strategies initiated in the OSCP require OM to inform effectiveness and ultimately termination. Table 4-1 is a matrix showing which OMPs are activated for each oil spill response strategy. Arrangements for in-field OM to inform spill response strategies rely on the effective use of the VOGA ICT structure.

The Planning Chief will, as part of the Incident Action Planning process, provide for the implementation of OMPs. Data collected through the implementation of the OMPs is communicated back to the Planning Chief via reporting forms, debriefs and reports (such as laboratory or OSTM reports). It is then the responsibility of the Planning Chief to evaluate the information collected to determine if the response strategies can be terminated, or if controls need to be put in place to manage impacts of the response activities.

Table 4-1: Matrix of OMPs activated for each OSCP response strategy

Response strategy	OMP1	OMP2	OMP3	OMP4	OMP5	OMP6	OMP7	OMP8
Monitor and evaluate	✓	✓	✓	✓				
Chemical dispersion			✓	✓	✓			
Containment and recovery					✓			
Mechanical dispersion			✓	✓				
Protection and deflection					✓			
Shoreline clean-up				✓	✓	✓	✓	
Wildlife response (support plan)								✓

OMP1 – Spill surveillance and tracking
OMP2 – Determination of oil character
OMP3 – Fish tainting
OMP4 – Oil in the water column
OMP5 – Oil encounter rate
OMP6 – Shoreline assessment
OMP7 – Oil in sediments
OMP8 – Wildlife

4.2 Operational monitoring initiating and informing scientific monitoring

Direction of information flow is primarily from OM to SM. OM inform the SM receptor studies in terms of their initiation criteria, and through provision of essential information to guide their mobilisation and establishment. Key information is the location and extent of hydrocarbons, and location and extent of impacted receptors.

OM will also provide the location of non-impacted receptors, where spill impact is imminent to establish post-spill pre-impact control samples and location of sites and receptors predicted to remain un-impacted which would form spatial controls. SM is used to quantify the impact of associated response strategies, such as the use of chemical dispersants and shoreline clean-up. This information will also be provided by the oil spill monitoring response Monitoring Coordinator (MC) to the Planning Chief.

Figure 4-1 shows how the information from OM that is used for operational decision-making, can trigger the termination of response strategies and also integrates into SM. The tables throughout this plan reference the specific triggers for each response strategy, OM and SM values in more detail, highlighting how they are informed by one another.

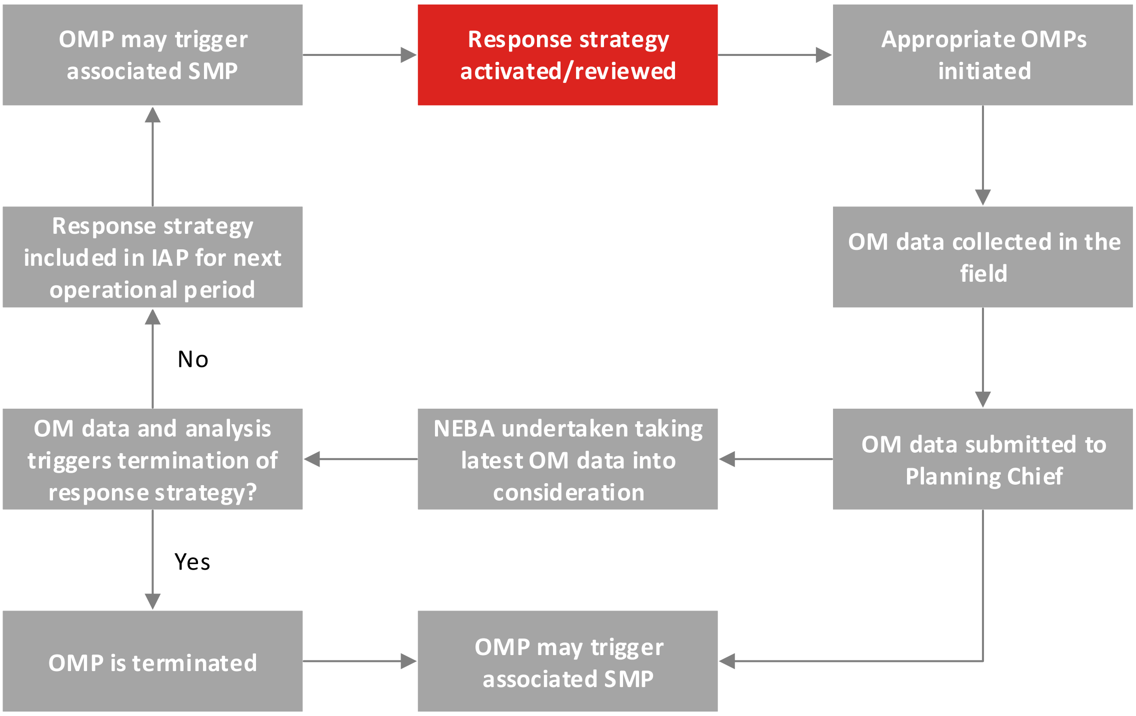


Figure 4-1: Information flow for OM and SM in the planning process

4.3 Monitoring Coordination Team structure

Both OM and SM are completely integrated into the VOGA ICT to ensure data generated is used either in the response decision-making process for OM or to gauge the impact of the spill/response strategies for SM. The organisational structure that will oversee the monitoring response, from pre-planning to recovery phases are described in Section 8.

5 Operational monitoring plans

5.1 OMP template

There are eight OMPs that have been described to inform operational decisions and potentially initiate SMPs. The initiation of these plans depends on the activation of specific response strategies (Table 4-1). The Planning Chief will provide for the implementation of the OMPs through the incident action planning process. The tables in this section describe each OMP, and Table 5-1 is a reference tool to describe the components of the OMPs.

Table 5-1: Reference tool to describe the components of the OMPs

Table headings	Description
Rationale	The rationale is a description of the basis and reasoning for the OMP.
Objectives	The objectives set the intention for the OMP. Depending on the nature of the OMP, the objectives can be quite broad to allow for the flexibility, adaptability and scalability required during a spill scenario.
Baseline	The pre-existing information used to inform the OMP. Baseline used for the OMPs is generally information gathered in the development of the OSCP and response tools such as the OSRA Web Map Application (WMA).
Initiation criteria	The trigger/s for activating the OMP.
Termination criteria	The trigger/s for the OMP to end.
Tactics	The tasks to be conducted to achieve the objectives of the OMP. Each OMP will be implemented through tactical plans which will contain tools/guidance for responders carrying out these tactics. These plans are currently under development.
Indication of resources required	The resources (personnel and equipment) that could be required to undertake the OMP (depending on the provider).
Possible provider(s) and competencies	The contractors/agencies VOGA have identified that have the capability to undertake tasks in the OMPs and the relevant competencies.
SMP(s) triggered and associated trigger	This shows the link between the OMP and the SMP. Each OMP can trigger initiation of particular SMP receptors. The trigger provides a clear indication of when the SMP study for the particular receptor(s) should commence. SMP receptors are triggered for spill categories C, D, E and/or F only.
Scope of works	The scope of works must be adapted to the spill scenario that may occur. An indication of timing of development is provided to allow the flexibility and scalability required for development of the OMP once a spill occurs.
Design elements	The design elements set out the main components of the OMP. Often the appropriate design with vary between spill scenarios and the associated real-time spill trajectory.
Implementation	The application of the OMP is outlined in terms of predicted timings and integration with the response strategy implementation.
Analysis and reporting	The analysis and reporting of the OMP information is a vital step in the decision-making/incident action planning development process. This section details how the OMP data is analysed and reported through the ICT structure.

5.2 OMP1 – Spill surveillance and tracking

Table 5-2: OMP1 – Spill surveillance and tracking

OMP1 – Spill Surveillance and tracking	
Rationale	**Surveillance to locate and track oil in order to plan and direct response activities:** • Guides planning of clean-up activities; • Indicates time and physical constraints to mounting a response (e.g. weather conditions, site access, habitat type etc.); • Provides information on the size, type, location and movement of oil to identify whether sensitive areas may be impacted; and • Allows identification of appropriate monitoring sites for SM. **Surveillance to assist in the development of response priorities:** • Sensitive areas must be identified to assess potential impact and effects; and • Potential impact to sensitive areas determines priorities for protection, response or clean-up.
Objectives	To identify and quantify spill in order to respond effectively, including; • Determining the extent and character of the spill; • Tracking slick movement; • Determining and forecasting sea and weather conditions; • Identifying sensitivities/receptors at risk; and • Establishing presence of SM receptors if applicable.
Baseline	• Pre-spill trajectory modelling and analysis materials; • OSCP/sensitivities identified at risk; and • Metocean data.
Initiation criteria	There has been an oil spill. NOTE: The Category of the spill will determine the appropriate tactics and overall OMP design elements e.g. Category D, E and F spills will trigger all tactics, whereas Category A, B and C spills may only trigger some tactics as applicable.
Termination criteria	• The relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and • The OMP is no longer contributing to or influencing spill response decision making.
Tactics	• Visual observation from vessel or facility; • Aerial observation; • Deploy satellite tracking buoy; • Real-time OSTM; • Satellite imagery (Synthetic Aperture Radar [SAR]); and • Analysis of all surveillance data. Assessment tactics are detailed within Guidelines M.3, M.4 and M.5 (Characterising oil slicks at sea, Video/photo surveying of slicks at sea and Visual monitoring of dispersant operations) (AMSA 2003a).

<table>
<tr><th colspan="3">OMP1 – Spill Surveillance and tracking</th></tr>
<tr><td>Indication of resources required</td><td colspan="2">Suitable aircraft for aerial observation;
Aerial observers (4-5 for rotation work);
Satellite tracking buoy (2 minimum);
OSTM contractor; and
Satellite imagery (and SAR if possible) contractor.</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>Internal or external trained aerial observers;
RPS Asia-Pacific Applied Sciences Associates (RPS APASA); and
Landgate (Satellite imagery – SAR).</td><td>Individuals trained or with experience in relevant tactics they are tasked with.
Aerial observation training or experience: 4-5 for rotation work.
Satellite imagery and/or SAR must be analysed by a trained and experienced person/team.</td></tr>
<tr><td>SMP(s) triggered and associated trigger</td><td>May trigger all SMPs.</td><td>Spill surveillance and tracking identifies oil contact or real-time predicted contact (for pre-impact monitoring) to SMP(s).</td></tr>
<tr><td>Scope of works</td><td colspan="2">Monitor and evaluate response activities detailed in Sections 9 and 10 of the OSCP.
Scope of works prepared within 24 hours of spill having been reported.</td></tr>
<tr><td>Design elements</td><td colspan="2">The appropriate design of this monitoring activity will vary between situations depending on:
size of the spill;
weathering rate of the oil;
potential environmental and economic consequences of the spill;
requirements to test specific response methods that may affect oil or be sensitive to the oil properties;
requirements to inform the public or other stakeholders;
the availability of human resources, suitable vessels and other logistics;
capacity for transporting samples from the site (e.g. by helicopter or vessel); and/or
safety considerations.</td></tr>
<tr><td>Implementation</td><td colspan="2">See Sections 9.5.1 and 10.5.1 in the OSCP: Monitoring and evaluation.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">All data collected for spill surveillance and tracking to be analysed within the situation unit to achieve OMP objectives;
All data collected for spill surveillance and tracking to be displayed in the ICT on either status boards or electronic projections;
All data collected to be collated for the Planning Chief for integration into the Incident Action Plan (IAP); and
All data collected to be made available to the MC for initiation of the SMP(s) (if applicable).</td></tr>
</table>

5.3 OMP2 – Hydrocarbon characterisation and weathering

Table 5-3: OMP2 – Hydrocarbon characterisation and weathering

OMP2 – Hydrocarbon characterisation and weathering	
Rationale	Physical and/or chemical analysis undertaken in order to better predict oil behaviour or potential effects. • Guides planning of clean-up activities; • Indicates time and physical constraints to mounting a response (e.g. weathering characteristic of oil in real-time conditions); • Confirm source of spill; • Characterise the oil by chemical fingerprinting; • Collect legally defensible samples to link source to spill or to eliminate possible alternative sources; • To characterise oil and/or receiving area to link spill with effects; and • Document/confirm weathering of oil.
Objectives	• Determine physical character to better predict behaviour; • To predict efficiency of response methods; • Determine the likely fate of the oil; and • To confirm the source of the oil (if applicable).
Baseline	Characterisation of the physical and chemical hydrocarbon properties for all spill categories. Refer to OSCP.
Initiation criteria	• There has been an oil spill; and • Chemical dispersant is being used as a response strategy. NOTE: The Category of the spill will determine the appropriate tactics and overall OMP design elements, e.g. Category D, E and F spills will trigger all tactics.
Termination criteria	This OMP will be terminated when the: • relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and • OMP is no longer contributing to or influencing spill response decision making.
Tactics	• Water sampling; • Laboratory analysis; and • Visual observations. Sampling tactics are detailed within Guideline M.6 (Sampling surface oil slicks) (AMSA 2003a).

<table>
<tr><th colspan="3">OMP2 – Hydrocarbon characterisation and weathering</th></tr>
<tr><td>Indication of resources required</td><td colspan="2">Field assessment team x minimum 3 people per team;
Sampling vessel;
Oleophilic sampling device;
Glass sampling jars with Teflon lined caps or other type of sampling jars compliant with chain of custody requirements for analysis (number will be informed by scope of works);
Sample jar rings, nylon or other type of sampling jar rings compliant with chain of custody requirements for analysis (number will be informed by scope of works);
Nitrile gloves; and
Chain of custody forms/labels/software/barcoding system.</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>BMT Oceanica with Astron support; and
ChemCentre.</td><td>Sampling planned by technical advisor experienced in water and sediment sampling. Sampling can be performed by unsupervised technicians. Samples analysed by a NATA accredited laboratory.</td></tr>
<tr><td>SMP(s) triggered and associated trigger</td><td>May trigger all SMP(s).</td><td>Oil character confirms extent of spill and determines locations for impact/control sites and un-impacted (for pre-impact monitoring) to SMP(s).</td></tr>
<tr><td>Scope of works</td><td colspan="2">Prepared within 24 hours of spill having been reported. It will provide information on sampling of oil on the sea surface and in the water column at sufficient locations and replication to guide the response. Sufficiency will be guided by evidence for the spatial extent and variability (i.e. patchiness) of the spill and sensitivity of the response decisions to this variability.</td></tr>
<tr><td>Design elements</td><td colspan="2">The appropriate design of this monitoring activity will vary between situations depending on:
size of the spill;
weathering rate of the oil;
potential environmental and economic consequences of the spill;
requirements to test specific response methods that may affect oil or be sensitive to the oil properties;
requirements to inform the public or other stakeholders;
the availability of human resources, suitable vessels and other logistics;
capacity for transporting samples from the site (e.g. by helicopter or boat); and
safety considerations.</td></tr>
<tr><td>Implementation</td><td colspan="2">See Tables 9.5.1 and 10.5.1 in the OSCP: Monitoring and evaluation.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">All data collected for spill surveillance and tracking to be analysed within the Situation Unit to achieve OMP objectives;
All data collected to be collated for the Planning Chief for integration into the IAP; and
All data collected to be made available to the MC for initiation of the SMP(s) (if applicable).</td></tr>
</table>

5.4 OMP3 – Fish tainting

Table 5-4: OMP3 – Fish tainting

OMP3 – Fish tainting	
Rationale	Monitoring undertaken to better manage fisheries, public or media concerns relating to potential effects of the spill or response activities. The results of this activity could reduce the timeframe that a particular fishery is impacted, e.g. OMP1 may have shown the oil trajectory moving over a particular fishing area, however fish samples taken from that area shows no tainting. Therefore, the fishery can continue to operate in that area (Gagnon, 2009). • Oil can cause a tainting of fish species; and • Dispersed oil can cause a tainting of fish species.
Objectives	• Collect samples of target fish species; • Determine whether oil has tainted fish species; and • Determine whether dispersed/entrained oil has tainted fish species (only applicable when chemical dispersants and/or mechanical dispersion are being used as a response strategy).
Baseline	• Commercially important fish species in area (pelagic and benthic). Refer to Appendix A (finfishes) and ICT Toolbox for current available baseline.
Initiation criteria	• There has been an oil spill; • Fisheries present in real-time zone of (potential/actual) impact; and/or • Chemical dispersant is being used as a response strategy (triggers dispersant relevant objectives and tactics).
Termination criteria	This OMP will be terminated when the: • SMPs 13 and/or 14 have been triggered for initiation and results transferred as appropriate; and • OMP is no longer contributing to or influencing spill response decision making.
Tactics	• Obtain any necessary permits for sampling; • Identify commercial important fish species in the potentially affected area (pelagic and benthic); • Sampling of identified target species for Total Petroleum Hydrocarbons (TPHs) and Polycyclic Aromatic Hydrocarbons (PAHs); • Analyse tissues for hydrocarbons and chemical dispersants (chemical dispersants – only applicable when chemical dispersants are being used as a response strategy); and • Confirm source of oil through fingerprinting analysis of any hydrocarbons detected. Monitoring and sampling tactics are detailed within Guidelines M.10 (Monitoring damage to commercial or recreational species) and M.14 (Sampling organisms for taint testing) (AMSA 2003a).
Indication of resources required	• Field assessment team x minimum 2-3 people per team; and • Sampling vessel; • Sampling equipment (provided and specified by provider, i.e. fish traps).

OMP3 – Fish tainting		
Possible provider(s) and competencies	• BMT Oceanica • Chemcentre	Team experienced in targeted pelagic and demersal fish sampling, and experience in tissue sampling and processing. Qualified laboratory to analyses tissue samples.
SMPs triggered and associated trigger	• SMP13 – Finfishes; and • SMP14 – Fisheries and aquaculture.	Hydrocarbons (and/or dispersant) detected in tissue samples and confirmed to be the oil spilled (and/or dispersant used).
Scope of works	Prepared within 36 hours of spill having been reported. Inputs include the estimated rate of flow, metocean conditions and predicted spill trajectory (real-time reports at least daily). Prepared once an understanding of the spill extent and potential impact to fisheries is understood and prior to completion of response activities.	
Design elements	The key components of this monitoring program are collection of data on the effects of the spill and response strategies on pelagic and benthic fish species. The assessment will include the following: • An adequate and reasonable sample size for both pelagic and benthic species (where applicable to response strategies) for rapid response sampling; • Those areas of known importance for commercial fisheries; • Requirements to inform recreational and commercial fisheries; • The availability of human resources, suitable vessels and other logistics; • Capacity for transporting samples from the site (e.g. by helicopter or vessel); and • Safety considerations.	
Implementation	As per Guideline M.14 (Guideline for sampling organisms for taint testing) (AMSA, 2003a) and wildlife impact monitoring during the Montara oil spill (Gagnon, 2009) samples can be collected from commercial fishers that have landed fish in areas known to have been impacted by oil (refer to OMP1 results to determine). If no commercial fishers have landed catch for areas within the real-time zone of (potential/actual) impact, other OM tasked vessels and teams can be used for this task; however, if the response is relying on the results of this program for decision-making for the next operational period/IAP then a vessel and team dedicated to the task will be engaged as they become available. Implementation of this monitoring program will focus on rapid determination of fish tainting, given the specifics of the spill and the zone of actual impact, therefore allowing for response strategies to continue accordingly. The results of this OM could also reduce the time that commercial and recreational fisheries are impacted.	
Analysis and reporting	• Record and report results to Planning Chief for integration into IAP development; • Record and report results to Planning Chief for referral to the Public Information Section to disseminate to recreational and commercial fisheries; and • Record results and handover to MC for initiation of the SMPs, storing data within a spatially explicit database for environmental report cards (if applicable).	

5.5 OMP4 – Oil in the water column

Table 5-5: OMP4 – Oil in the water column

OMP4 – Oil in the water column	
Rationale	Monitoring undertaken to determine the efficiency of, or potential adverse effects from monitor and evaluate (natural recovery), chemical dispersant, mechanical dispersion and shoreline clean-up response strategies, e.g. if a coral spawning event is due to occur during spill response operations. A Net Environmental Benefit Analysis (NEBA) will be undertaken to assess the trade-offs between the monitor and evaluate and chemical dispersant response strategies. Whichever the outcome, this OMP will be triggered to monitor the effectiveness of the chosen strategy as well as any potential impacts which may influence decision-making and further IAP development. • Sensitivities such as plankton, krill and larvae are extremely important for ecosystem health; • May be affected by spill and/or response strategies; and • Provide real-time feedback on effectiveness of response operations.
Objectives	• Collect baseline to determine real-time condition (pre-impact rapid baseline collection and analysis of baseline collected during OSMP development) for the real-time zone of impact (including real-time predicted zone of impact); • Monitor effectiveness of response strategies – setting criteria for termination which are suitable given the real-time conditions and situation; • Identify contamination levels; • Assess biological exposure/bioavailability of dispersed oil; and • Monitor trajectory/effect of dispersed oil plume (where applicable).
Baseline	• Background hydrocarbon levels; • Water column organisms; and • Coral spawning timings for the EMBA. Refer to Appendix A (water quality and coral reef communities) and ICT Toolbox for current available baseline.
Initiation criteria	• There has been an oil spill; and • Chemical dispersant is being used as a response strategy.
Termination criteria	This OMP will be terminated when the: • relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and • OMP is no longer contributing to or influencing spill response decision making.
Tactics	Tactics will depend on the response strategies being undertaken and may include: • sampling; • fluorometry; • field dispersant effectiveness monitoring; • laboratory analysis; and • visual observations. Sampling tactics are detailed within Guideline M.7 (Sampling of subsurface water) (AMSA 2003a).

<table>
<tr><th colspan="3">OMP4 – Oil in the water column</th></tr>
<tr><td>Indication of resources required</td><td colspan="2">Field assessment team x minimum 3 people per team;
Sampling vessel; and
Sampling equipment (provided and specified by provider).</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>BMT Oceanica with Astron support
RPS APASA (3D plume trajectory modelling)
Chemcentre</td><td>Sampling planned by technical advisor experienced in water sampling. Sampling can be performed by unsupervised technicians. Samples analysed by NATA accredited laboratory. Water and sediment quality samples (Table 5-8) could be taken concurrently.</td></tr>
<tr><td>SMP(s) triggered and associated trigger</td><td>May trigger all SMPs.</td><td>Oil concentrations exceed natural background levels in the real-time zone of impact;
Oil concentrations exceed those identified in marine management plans and specific project Environmental Protection Authority (EPA) conditions for receptors in the real-time zone of impact; and/or
Oil concentrations exceed those identified in the ANZECC (2000) water quality guidelines for the protection of aquatic ecosystems and/or recreational water quality (where applicable).</td></tr>
<tr><td>Scope of works</td><td colspan="2">Prepared within 24 hours of spill having been reported. Inputs include the estimated rate of flow, metocean conditions and predicted spill trajectory (real-time reports at least daily). Prepared once an understanding of the spill extent and response strategies to be employed is understood.</td></tr>
<tr><td>Design elements</td><td colspan="2">The key components of this monitoring program are collection of data on the effects of the spill and response strategies on water quality. The assessment will include the following:
An adequate and reasonable sample size for water quality (where applicable to response strategies) for rapid and/or response sampling;
Those areas with identified management targets and EPA conditions;
Requirements to inform the public or other stakeholders;
The availability of human resources, suitable vessels and other logistics;
Capacity for transporting samples from the site (e.g. by helicopter or boat); and
Safety considerations.</td></tr>
<tr><td>Implementation</td><td colspan="2">Samples will be taken in shallow water along shorelines, and in deeper offshore sites. This will require a marine vessel and ability to approach shorelines. Sediment and water quality samples (Table 5-8) should be taken concurrently.

In the first instance, other operational monitoring tasked vessels and teams can be used for this task; however, if the response is relying on the results of this program for decision-making for the next operational period/IAP then a vessel and team dedicated to this task will be engaged as they become available. Implementation of this monitoring program will focus on rapid determination of water quality, given the specifics of the spill and the zone of actual impact, therefore allowing for response strategies to continue accordingly.</td></tr>
</table>

OMP4 – Oil in the water column	
Analysis and reporting	• Samples analysed by NATA accredited laboratory; • Record and report results to Planning Chief for integration into IAP development; • Record and report results to Planning Chief for referral to the Public Information Section to disseminate to relevant stakeholders accordingly; and • Record results and handover to MC for initiation of the SMP(s), storing data within a spatially explicit database for environmental report cards (if applicable).

5.6 OMP5 – Oil encounter rate

Table 5-6: OMP5 – Oil encounter rate

OMP5 – Oil encounter rate	
Rationale	Monitoring the amount of oil collected and/or chemical dispersant usage during daily chemical dispersants, containment and recovery, protection and deflection and/or shoreline clean-up operations allows for real-time resource planning and monitoring the effectiveness of containment and recovery operations. The results will inform the termination of the response strategies and also the waste projections/planning for the overall response.
Objectives	• Monitor daily amounts of oil collected (if applicable); • Monitor daily amounts of chemical dispersant usage; • Monitor and predict waste volumes from operations; and • Monitor effectiveness of operations.
Baseline	Oil encounter rates estimations and calculation methodology in the OSCP.
Initiation criteria	There has been an oil spill and chemical dispersant, containment and recovery, protection and deflection and/or shoreline clean-up response strategies are being undertaken.
Termination criteria	This OMP will be terminated when the: • OMP is no longer contributing to or influencing spill response decision making; and/or • response strategies have ceased and the source is under control.
Tactics	Tactics will depend on the response strategies being undertaken and may include: • Visual observations from operational teams; • Daily reports from Fixed Wing Aerial Dispersant Capability (FWADC) provider Aerotech; and • Record rates of recovery for each vessel/team daily (if applicable).
Indication of resources required	OMP5 to be undertaken utilising resources identified in the OSCP for the relevant response strategies.
Possible Provider(s) and competencies	Not applicable. OM activities to be undertaken utilising resources identified in the OSCP for the relevant response strategies.

OMP5 – Oil encounter rate		
SMP(s) triggered and associated trigger	Not applicable.	Not applicable.
Scope of works	Prepared within 24 hours of spill having been reported. Inputs include the estimated rate of flow, metocean conditions and predicted spill trajectory (real-time reports at least daily). Prepared once an understanding of the spill extent and response strategies to be employed is understood.	
Design elements	The appropriate design of this monitoring activity will vary between situations depending on: • size of the spill; • weathering rate of the oil; • potential environmental and economic consequences of the spill; • requirements to test specific response methods that may affect oil or be sensitive to the oil properties; • requirements to inform the public or other stakeholders; • the availability of human resources, suitable vessels and other logistics; • capacity for transporting samples from the site (e.g. by helicopter or vessel); and • safety considerations.	
Implementation	This OMP will be implemented by the resources identified in the OSCP for the associated response strategies. Implementation of this monitoring program will focus on monitoring effectiveness of the relevant response strategies, given the specifics of the spill and the real-time zone of impact, ensuring compliance with ALARP principles outlined in the EP.	
Analysis and reporting	• Record and report results to Planning Chief for integration into IAP development; • Analyse recovery/boom encounter rates by comparing to the predicted amounts in the OSCP to predict ongoing waste volumes; • Analyse recovery/boom encounter rates by comparing to the predicted amounts in the OSCP to measure effectiveness of response strategies; and/or • Results to be provided back to the Planning Chief for integration into IAP development and overall response effectiveness analysis and adjustment of the response strategies as required.	

5.7 OMP6 – Shoreline assessment

Table 5-7: OMP6 – Shoreline assessment

OMP6 – Shoreline assessment	
Rationale	Monitoring undertaken to better design shoreline clean-up methods, formulate priorities or to measure the effectiveness of clean-up. • Geographical distribution and persistence of oil influences response and monitoring design; • Determine the effectiveness and efficiency of offshore response actions; and • Detection of spill and response physical effects.
Objectives	• Collect baseline data on impacted or potentially impacted areas, e.g. physical/ ecological character/ human use etc.; • Verify aerial surveys and baseline data; • Assess the effectiveness and effects of response activities; and • Support decision-making for protection and deflection and/or shoreline clean-up operations.
Baseline	• Background hydrocarbon levels in sediments; and • WA OSRA WMA aerial imagery, satellite imagery and other relevant data collected to satisfy project specific criteria and management plans for receptors in the real-time zone of impact. Refer to Appendix A (mangrove, macro algal and seagrass, intertidal sand and mudflat and rocky shore communities) and ICT Toolbox for current available baseline.
Initiation criteria	An oil spill has occurred and oil is likely to or has impacted shorelines.
Termination criteria	This OMP will be terminated when the: • relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and • OMP is no longer contributing to or influencing spill response decision making.
Tactics	Shoreline assessments to be conducted through: • aerial surveys and/or ground surveys; • satellite imagery; and • shoreline assessment forms to be completed for areas likely to be or that are known to have been oiled. Assessment tactics are detailed within Guidelines S.1-S.9 (AMSA 2003a).
Indication of resources required	• Field assessment team x minimum 4 people per team (flora and fauna); • Aircraft suitable for aerial surveys of shoreline; • Satellite imagery contractor; • Vessel/vehicle (depending on location); and • Equipment (provided and specified by provider). OMP6 to be undertaken utilising resources identified in the OSCP for the relevant response strategies.

<table>
<tr><th colspan="3">OMP6 – Shoreline assessment</th></tr>
<tr><td>Possible provider(s) and competencies</td><td>Astron with BMT Oceanica support;
State Response Team (Department of Transport [DoT]);
AMOSC (Australian Marine Oil Spill Centre) Core Group; and
Chemcentre</td><td>Field team led by technical advisor with oiled shoreline assessment training and/or experience.</td></tr>
<tr><td>SMP(s) triggered and associated trigger</td><td>May trigger:
SMP4 – Mangrove communities;
SMP7 – Intertidal sand and mudflat communities;
SMP8 – Rocky shore/intertidal reef platform communities;
SMP9 – Turtles; and
SMP11 – Seabirds and shorebirds.</td><td>Oil has impacted receptors;
Oil has the potential to impact receptors (pre-impact/control sites);
Oil concentrations exceed natural background levels for the receptors impacted; and/or
Oil concentrations exceed those identified in marine management plans and specific project EPA conditions for receptors impacted.</td></tr>
<tr><td>Scope of works</td><td colspan="2">Prepared within 48-72 hours of spill having been reported.</td></tr>
<tr><td>Design elements</td><td colspan="2">The appropriate design of this monitoring activity will vary between situations depending on:
size of the spill;
weathering rate of the oil;
potential environmental and economic consequences of the spill;
requirements to test specific response methods that may affect oil or be sensitive to the oil properties;
requirements to inform the public or other stakeholders;
the availability of human resources, suitable vessels and other logistics;
capacity for transporting samples from the site (e.g. by helicopter or boat); and
safety considerations.
In general, a shoreline assessment will comprise:
Assessment of shoreline character:
Shoreline type and form;
Substrate type;
Shoreline energy and processes; and
Shoreline habitat type.
Assessment of shoreline oiling:
Oil distribution, thickness and percentage cover;
Sub-surface distribution;
Oil physical character.
Sampling with subsequent laboratory analysis of oil chemical and physical characteristics to determine extent of weathering, toxicity, mobility and confirm source.</td></tr>
</table>

OMP6 – Shoreline assessment	
Implementation	Shoreline assessment teams to be deployed through the ICT Operations Unit. Shoreline assessments to be conducted at low tide where possible to gain the most useful information regarding shoreline character. Information generated from the shoreline assessment teams then feeds back into the Environment Unit (Planning) for integration into the IAP and the SM studies for relevant receptors.
Analysis and reporting	• Shoreline clean-up activities to be recorded and assessed daily by all teams; • Results to be provided back to the Environment Unit for analysis and integration into the IAP development; • Results to be collated for use by MC to initiate SMPs storing data within a spatially explicit database for environmental report cards (if applicable) and overall response impact tracking by the Planning Chief; and • All raw data collected will be disseminated into geospatial format for subsequent use in GIS mapping software and/or OSRA WMA.

5.8 OMP7 – Oil in sediments

Table 5-8: OMP7 – Oil in sediments

<table>
<tr><th colspan="3">OMP7 – Oil in sediments</th></tr>
<tr><td>Rationale</td><td colspan="2">Monitoring undertaken to better design shoreline clean-up methods, determine adverse effects from clean-up, e.g. shoreline washing/mechanical clean-up on shorelines, to formulate priorities and/or to measure the effectiveness of clean-up.
• Oil may enter intertidal/sub-tidal sediment;
• Oiled sediment may release oil over time;
• Often contain sensitivities of high value (biological, human uses, cultural, commercial);
• Susceptible to oil impacts; and/or
• May be directly impacted by response actions (e.g. shoreline washing operations including sediment reworking, high pressure and/or low pressure washing).</td></tr>
<tr><td>Objectives</td><td colspan="2">• Determine and analyse baseline conditions;
• Determine the cause (source confirmation – fingerprinting analysis) and extent of spill-related effects, e.g. sinking, stranding and/or buried oil;
• Assess effectiveness and effects of response strategies; and
• Support decision-making for protection and deflection and/or shoreline clean-up operations.</td></tr>
<tr><td>Baseline</td><td colspan="2">• Background sediment quality levels at specific site locations.
Refer to Appendix A (sediment quality) and ICT Toolbox for current available baseline.</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">An oil spill has occurred and oil is likely to or has impacted sensitivities.</td></tr>
<tr><td>Termination criteria</td><td colspan="2">This OMP will be terminated when the:
• relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and
• OMP is no longer contributing to or influencing spill response decision-making.</td></tr>
<tr><td>Tactics</td><td colspan="2">• Sediment sampling; and
• Laboratory analysis.
Sampling tactics are detailed within Guidelines S.8 (Obtaining sediment samples) and/or M.9 (Sampling of seabed sediments) (AMSA 2003a).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Field assessment team x minimum 3 people per team
• Sampling vessel/vehicle; and
• Sediment sampling equipment (provided and specified by provider).</td></tr>
<tr><td>Possible Provider(s) and competencies</td><td>• Astron with BMT Oceanica support.
• Chemcentre</td><td>Sampling planned by technical advisor experienced in water and sediment sampling. Sampling can be performed by unsupervised technicians. Samples analysed by NATA accredited laboratory. Water and sediment quality samples (Table 5-5) could be taken concurrently.</td></tr>
</table>

<table>
<tr><th colspan="3">OMP7 – Oil in sediments</th></tr>
<tr><td>SMP(s) triggered and associated trigger</td><td>May trigger:
• SMP1 – Sediment quality;
• SMP4 – Mangrove communities;
• SMP5 – Macro algal and seagrass communities;
• SMP6 – Subtidal soft-bottom communities;
• SMP7 – Intertidal sand and mudflat communities; and
• SMP12 – Invertebrates.</td><td>• Oil has impacted receptors;
• Oil has the potential to impact receptors (pre-impact/control sites);
• Oil concentrations exceed natural background levels for the receptors impacted; and/or
• Oil concentrations exceed those identified in marine management plans and specific project EPA conditions for receptors impacted.</td></tr>
<tr><td>Scope of works</td><td colspan="2">Prepared within 48-72 hours of spill having been reported. Inputs include the estimated rate of flow, met ocean conditions and predicted spill trajectory (real-time reports at least daily). Prepared once an understanding of the spill extent, response strategies to be employed and therefore possible sediment impact areas/pathways are identified.</td></tr>
<tr><td>Design elements</td><td colspan="2">The appropriate design of this monitoring activity will vary between situations depending on:
• size of the spill;
• weathering rate of the oil;
• potential environmental and economic consequences of the spill;
• requirements to test specific response methods that may affect oil or be sensitive to the oil properties;
• requirements to inform the public or other stakeholders;
• the availability of human resources, suitable vessels and other logistics;
• capacity for transporting samples from the site (e.g. by helicopter or boat); and
• safety considerations.</td></tr>
<tr><td>Implementation</td><td colspan="2">Implementation of this monitoring program will focus on monitoring effectiveness of the relevant response strategies, given the specifics of the spill and the real-time zone of impact, therefore allowing for any potential impacts of those response strategies complying with ALARP justifications made in the EP.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">• Results to be provided back to the Environment Unit for analysis and integration into the IAP development; and
• Results to be collated for use by MC to initiate SMPs storing data within a spatially explicit database for environmental report cards (if applicable) and overall response impact tracking by the Planning Chief.</td></tr>
</table>

5.9 OMP8 – Wildlife

Table 5-9: OMP8 – Wildlife

OMP8 – Wildlife		
Rationale	Monitoring undertaken to better determine the adverse effects from response techniques and to plan for wildlife response activities. • High level of public interest; and • Shoreline fauna such as birds and turtles are susceptible to direct oil impacts.	
Objectives	• Identify populations and seasonal presence/susceptibility; • Determine appropriate wildlife response strategy; and • Monitor impact of oil and response activities.	
Baseline	• OSRA WMA; • WA Oiled Wildlife Response Plan (OWRP) (AMOSC 2014); and • Pilbara Region OWRP (AMOSC 2014). Refer to Appendix A (turtles, marine mammals and seabirds and shorebirds) and ICT Toolbox for current available baseline.	
Initiation criteria	An oil spill has occurred, oil is likely to impact fauna and/or oiled wildlife response will be undertaken during the response.	
Termination criteria	This OMP will be terminated when the: • relevant SMPs have been initiated (if triggered) and results transferred as appropriate; and • OMP is no longer contributing to or influencing spill response decision-making.	
Tactics	• Aerial fauna surveys; • Vessel fauna surveys; • Record all sightings of fauna (oiled and un-oiled) on fauna survey form; • Collate results for use by SM teams; • Record daily progress by wildlife facility (where applicable), e.g. number of animals cleaned/released etc.; and • Conduct necropsies on all deceased wildlife collected to determine whether cause of death is related to the spill. Fauna assessment tactics are detailed within Guideline M.11 (Monitoring damage to marine mega fauna) (AMSA 2003a).	
Indication of resources required	Refer to Sections 4.2, 4.3 and 5 of the WAOWRP. Refer to Sections 3 and 4 of Pilbara Region OWRP.	
Possible provider(s) and competencies	• Astron; • BMT Oceanica; and • DBCA Wildlife handlers.	Planned by technical advisor with at least one field team member experienced in each of the following: • turtle monitoring procedures; • aerial and/or marine surveys of marine fauna; • handling and tissue sampling of marine mammals; • sea and shore bird surveys; and • tissue samples assessed for toxicology at experienced laboratory.

<table>
<tr><th colspan="3">OMP8 – Wildlife</th></tr>
<tr><td>SMP receptor(s) triggered and associated trigger</td><td>May trigger:
• SMP9 – Turtles;
• SMP10 – Marine mammals; and
• SMP11 – Seabirds and shorebirds.</td><td>• Oil has impacted receptors; and/or
• Oil has the potential to impact receptors (pre-impact/control sites).</td></tr>
<tr><td>Scope of works</td><td colspan="2">Prepared within 48-72 hours of spill having been reported. Inputs include the estimated rate of flow, metocean conditions and predicted spill trajectory (real-time reports at least daily). Prepared once an understanding of the spill extent and possible shoreline impact areas are identified.</td></tr>
<tr><td>Design elements</td><td colspan="2">The appropriate design of this monitoring activity will vary between situations depending on:
• size of the spill;
• weathering rate of the oil;
• potential environmental and economic consequences of the spill;
• requirements to test specific response methods that may affect oil or be sensitive to the oil properties;
• requirements to inform the public or other stakeholders;
• the availability of human resources, suitable vessels and other logistics;
• capacity for transporting samples from the site (e.g. by helicopter or boat); and
• safety considerations.</td></tr>
<tr><td>Implementation</td><td colspan="2">Wildlife survey teams to be deployed through the ICT Operations Unit Wildlife Division. Information generated from the wildlife survey teams then feeds back into the Environment Unit (Planning) for integration into the IAP and the SM studies for relevant receptors.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">• Collate results for use by MC to initiate SMPs (if applicable);
• Record daily progress by wildlife facility (where applicable), e.g. number of animals cleaned/released etc.;
• Record all results and report to Wildlife Coordinator for integration into IAP (specifically wildlife sub-plan) development; and
• Record and report to the wildlife division instances where wildlife are disturbed by both onshore and offshore response operations, including surveillance.</td></tr>
</table>

6 Scientific monitoring plans

6.1 SMP template

There are 14 SMPs developed to inform non-response objectives, including short term environmental damage assessments, longer-term damage assessments (including recovery), purely scientific studies and all post-spill monitoring activities. The initiation of these plans depends on the activation of specific response strategies and the information collected through OMPs that may trigger a value to be monitored. Table 6-1 is a reference tool to describe the components of the SMPs.

Table 6-1: Reference tool to describe the components of the SMPs

Table headings	Description
Rationale	The rationale is a description of the basis and reasoning for the SMP.
Objectives	The objectives set the intention for the SMP. Depending on the nature of the SMP, the objectives can be quite broad to allow for the flexibility, adaptability and scalability required during a spill scenario.
Baseline	The pre-existing information used to inform the SMP. Current baseline information available is available in Appendix A and ICT Toolbox.
Initiation criteria	The trigger/s for activating the SMP.
Termination criteria	The trigger/s for the SMP to end.
Tactics	The tasks to be conducted to achieve the objectives of the SMP. Each SMP will be implemented through tactical plans which will vary between the chosen provider(s).
Indication of resources required	The resources (personnel and equipment) that could be required to undertake the SMP (depending on the provider).
Possible provider(s) and competencies	The contractors/agencies VOGA have identified that have the capability to undertake tasks in the SMPs and the relevant competencies.
Spatial extent	The focus areas for the SMP.
Design elements	The design elements set out the main components of the SMP. Often the appropriate design with vary between spill scenarios and the associated real-time spill trajectory.
During and post-spill activities	Outlines the SMP tactics that will take place during and after the spill.
Implementation	A brief overview of how the SMP will be applied.
Analysis and reporting	This section details how the SMP data is analysed, reported and stored to get the most reliable data and results.

6.2 SMP1 – Sediment quality

Table 6-2: SMP1 – Sediment quality

<table>
<tr><th colspan="3">SMP1 – Sediment quality</th></tr>
<tr><td>Rationale</td><td colspan="2">High sediment quality is important for the maintenance of ecosystem function. Sediment is generally of high quality or pristine throughout the region, with the exception of areas of high activity.
In terms of oil spills, the main concerns are the persistence of PAHs and TPHs.
Performance measures include:
• presence and concentration of hydrocarbons and non-hydrocarbons.</td></tr>
<tr><td>Objectives</td><td colspan="2">To monitor the presence, extent and persistence of hydrocarbons within marine sediments following a hydrocarbon spill and associated response activities.</td></tr>
<tr><td>Baseline</td><td colspan="2">• Data from OMP7.
Refer to Appendix A and ICT Toolbox for additional baseline data available.</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">Long-term (>2 weeks) oil spill and response strategies likely, initiated through OMPs 1, 2 or 7.</td></tr>
<tr><td>Termination criteria</td><td colspan="2">Return to baseline levels and/or where pre-contact concentrations are unavailable, the ANZECC & ARMCANZ (2000) guidelines or site specific guidelines will be adopted for comparison, whichever is the lowest.</td></tr>
<tr><td>Tactics</td><td colspan="2">• Access existing baseline data;
• Conduct sampling in conjunction with spill mapping, including pre-exposure samples where possible; and
• Shoreline and bottom samples of sediments.
Sampling tactics are detailed within Guideline S.8 (Obtaining sediment samples) (AMSA 2003a).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Field assessment team x minimum 3 people per team;
• Sampling vessel with geo-referencing;
• Corers/grabs;
• NATA accredited laboratory for sample analysis;
• Sample containers and preservative solution;
• Sample storage and refrigeration; and
• Decontamination/washing facilities.</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• BMT Oceanica with Astron support.
• Chemcentre</td><td>Sampling planned by technical advisor experienced in sediment sampling. Sampling can be performed by unsupervised technicians. Samples analysed by NATA accredited laboratory. Water and sediment quality samples can be taken concurrently.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Throughout region with grain size varying with distance from shore and stratified by subtidal and intertidal sediments.
Spatial control locations depend upon nature of spill but readily located at non-impacted shoreline and subtidal regions.</td></tr>
<tr><td>Design elements</td><td colspan="2">Sediment sampling detailed within Guideline S.8 (Obtaining sediment samples) (AMSA 2003a).
Gradient-based survey, control chart values over time, in relation to baseline values and guidelines (ANZECC & ARMCANZ 2000).</td></tr>
</table>

SMP1 – Sediment quality	
During and post-spill activities	**During**: Establish sediment monitoring program. **Post-spill**: Monitor and report until termination.
Implementation	Samples will be taken in shallow water along shorelines, and in deeper offshore sites. This will require a marine vessel and ability to approach shorelines. Sediment and water samples should be taken concurrently.
Analysis and reporting	Samples analysed by NATA accredited laboratory. Data stored in spatially explicit database, analysed as control charts, and presented as environmental report card section.

6.3 SMP2 – Water quality

Table 6-3: SMP2 – Water quality

SMP2 – Water quality	
Rationale	Water quality is important the maintenance of ecosystem health and function. Waters within the EMBA are relatively pristine, with the exception of areas of high activity. Performance measures include: • Presence and concentration of hydrocarbons and non-hydrocarbons.
Objectives	To monitor the changes in water quality associated with a hydrocarbon spill and associated response activities.
Baseline	• Data from OMP4. Refer to Appendix A and ICT Toolbox for additional baseline data available.
Initiation criteria	Long-term (>2 weeks) oil spill and response strategies likely, initiated by OMP4.
Termination criteria	Return to baseline levels and/or where pre-contact concentrations are unavailable, the ANZECC & ARMCANZ (2000) Guidelines for Marine Water Quality 99% species protection level or site specific guidelines will be adopted for comparison, whichever is the lowest.
Tactics	• Conduct sampling in conjunction with spill mapping, including pre-exposure samples where possible; and • Water samples at various depths. Sampling tactics are detailed within Guidelines M.6 and M.7 (Sampling surface oil slicks and films and Sampling of subsurface water) (AMSA 2003a).
Indication of resources required	• Field assessment team x minimum 3 people per team; • Sampling vessel with geo-referencing; • Niskin bottle/pump system for sample collection; • NATA accredited laboratory for sample analysis; • Sample containers and preservative solution; • Sample storage and refrigeration; and • Decontamination/washing facilities.

SMP2 – Water quality		
Possible provider(s) and competencies	• BMT Oceanica with Astron support. • Chemcentre	Sampling planned by technical advisor experienced in water sampling. Sampling can be performed by unsupervised technicians. Samples analysed by NATA accredited laboratory. Water and sediment quality samples can be taken concurrently.
Spatial extent	Related to gradient in oil spill density. Spatial control location depend upon nature of spill but readily located at non-impacted shoreline and subtidal regions.	
Design elements	Sampling detailed within Guidelines M.6 (Sampling surface oil slicks and films) and M.7 (Sampling of subsurface water) (AMSA 2003a). Gradient-based survey, control chart values over time, in relation to baseline values and guidelines (ANZECC & ARMCANZ, 2000).	
During and post-spill activities	**During**: Establish water monitoring program, transferred from OM to SM. **Post-spill**: Monitor and report until termination.	
Implementation	Samples will be taken in shallow water along shorelines, and in deeper offshore sites. This will require a marine vessel and ability to approach shorelines. Sediment and water quality samples should be taken concurrently.	
Analysis and reporting	Samples analysed by NATA accredited laboratory. Data stored in spatially explicit database, analysed as control charts, and presented as environmental report card section.	

6.4 SMP3 – Coral reef communities

Table 6-4: SMP3 – Coral reef communities

SMP3 – Coral reef communities	
Rationale	Corals are important primary producers that provide food, substrate and shelter for a diversity of marine life, including vertebrates and fish. They also protect coastlines from wave erosion and provide important substrate for algae. Undisturbed intertidal and subtidal coral reefs occur in several locations throughout the EMBA and are generally considered to be in good condition. Performance measures include: • Abundance (% cover or number of individuals per m^2); • Diversity of species; • Mortality (% cover affected); • Mortality of grazing fauna; and • Water and sediment quality.
Objectives	To monitor the changes in coral reef extent and composition as a consequence of a hydrocarbon spill and associated response activities.
Baseline	• Data from OMP4. Refer to Appendix A and ICT Toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2 or 4 predicts coral reef communities may be impacted by a hydrocarbon spill.

<table>
<tr><th colspan="3">SMP3 – Coral reef communities</th></tr>
<tr><td>Termination criteria</td><td colspan="2">Coral cover and diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).</td></tr>
<tr><td>Tactics</td><td colspan="2">• Access existing baseline data;
• Conduct pre-exposure surveys of high priority protection areas and areas with data gaps;
• Post-impact monitoring to be conducted in collaboration with DBCA and Department of Fisheries (DoF);
• Remotely Operated Vehicles (ROVs) and commercial divers experienced in Benthic Primary Producer Habitat (BPPH) classification; and
• Collection of water and sediment samples for analysis.
These tactics are detailed within Guideline M.12 (Monitoring damage to marine flora) (AMSA 2003a); Bancroft (2003); Duke et al. (2010); RPS (2009); Bancroft (2009); and Hill and Wilkinson (2004).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Field assessment team with experience in ROV operation and coral reef surveying - minimum of 2 per team;
• Sampling vessel and geo-referencing;
• NATA accredited laboratory for sample analysis;
• Sample containers and preservative solution;
• Sample storage and refrigeration;
• Decontamination/washing facilities; and
• ROV, digital cameras and video cameras (high definition with Global Positioning System [GPS]).</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• BMT Oceanica</td><td>Planned by technical advisor, with field team experienced in the operation of ROVs and experience in BPPH classification.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Throughout EMBA, at appropriate depths – Dampier Archipelago, Montebello and Barrow Islands.
Spatial control locations depend upon nature of spill.</td></tr>
<tr><td>Design elements</td><td colspan="2">Follow established protocols (e.g. Bancroft 2009; RPS, 2009; Hill and Wilkinson, 2004).
Spatio-temporal designs including BACI elements where possible. Control charting of indicators: diversity and extent.</td></tr>
<tr><td>During and post-spill activities</td><td colspan="2">During: Pre-impact, post spill monitoring where feasible.
Post-spill: Monitor and report until termination.</td></tr>
<tr><td>Implementation</td><td colspan="2">Requires marine transport of divers, and ROVs to island and mainland sites. Access will be dependent upon sea conditions.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">Data stored in spatially explicit database, analysed as control charts and/or BACI design and presented as environmental report card section.</td></tr>
</table>

6.5 SMP4 – Mangrove communities

Table 6-5: SMP4 – Mangrove communities

SMP4 – Mangrove communities		
Rationale	Mangroves are important primary producers, which provide food for microscopic organisms, which are then preyed upon by other animals. Mangrove leaves also provide a food source for larger animals such as turtles. Several animals are restricted to mangrove habitats. Six mangrove species occur within the EMBA, with many populations in the region relatively undisturbed. Mangroves are possibly the most sensitive shoreline habitat – being sensitive to both contact with hydrocarbons, due to the importance of root contact with air and dependence upon burrowing organisms. Performance measures include: • Abundance (% cover or no. individuals per m^2); • Leaf area index; and • Oil cover/impact.	
Objectives	To monitor the changes in mangrove cover and health as a consequence of a hydrocarbon spill and associated response activities.	
Baseline	• Data from OMPs 4 and 6. Refer to Appendix A and ICT Toolbox for additional baseline data available.	
Initiation criteria	OMPs 1, 2, 4 or 6 predict mangrove communities may be impacted by a hydrocarbon spill.	
Termination criteria	Mangrove cover and health consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).	
Tactics	• Conduct pre-exposure surveys of mangroves where possible; • Post-impact monitoring to be conducted in collaboration with DBCA and DoF; • Remote sensing/satellite imagery; • Infauna assessment; and • Ground survey – biomass and damage assessment. These tactics are detailed within Guideline S.14 (Guideline for monitoring damage to coastal flora) (AMSA 2003a); Astron (2010); RPS (2009); and English *et al.* (1997).	
Indication of resources required	• Field assessment team x minimum 2 people per team; • Sampling vessel with geo-referencing; • Sampling equipment (provided and specified by provider, i.e. photometer, measuring tapes); and • Remote sensing/satellite imagery.	
Possible provider(s) and competencies	• Astron; and • Landgate (satellite imagery).	Planned by technical advisor, with the field team experienced in assessment of mangrove health, or similar vegetation. Remotely sensed imagery processed by experienced analyst prior to statistical analysis.
Spatial extent	**Several locations throughout the region**: Barrow and Montebello Islands, Dampier archipelago, many mainland coastal sites	

SMP4 – Mangrove communities	
Design elements	Canopy cover and plant health indicators assessed following established protocols (Astron) for on-ground assessment. Remote sensing image libraries (e.g. Normalised Difference Vegetation Index [NDVI]) allow control charting of any site (Astron, 2010). Control charting of indicators: diversity and extent.
During and post-spill activities	**During**: Pre-impact, post spill monitoring where feasible. **Post-spill**: Access and process remotely sensed data, monitor and report until termination.
Implementation	A shallow-draft vessel required to access mangrove. Access dependent upon tides.
Analysis and reporting	On ground data stored in spatially explicit database, analysed as control charts and/or spatio-temporal (e.g. BACI) design and presented as environmental report card section. Remotely sensed imagery derived indices of plant condition (e.g. NDVI), analysed through control charts and presented in report cards.

6.6 SMP5 – Macroalgae and seagrasses

Table 6-6: SMP5 – Macro algae and seagrasses

SMP5 – Macro algae and seagrasses	
Rationale	Macroalgal and seagrass communities are important primary producers which also provide refuge areas and food for fish, turtles, dugongs and invertebrates. Seagrass and microalgae also increase structural diversity and stabilise soft substrates. Performance measure include: • Abundance (spatial extent); • Abundance (% cover); • Biomass; • Diversity of species; • Habitat recruitment and recovery; • Individual health condition; and • Water and sediment quality.
Objectives	To monitor the changes in macroalgal and seagrass diversity and biomass as a consequence of a hydrocarbon spill and associated response activities.
Baseline	• Data from OMPs 4, 6 and 7. Refer to Appendix A (macro algal and seagrass communities) and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2, 4, 6 or 7 predict macro algal and seagrass communities may be impacted by a hydrocarbon spill.
Termination criteria	Macroalgal and seagrass cover and diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).
Tactics	• Access existing baseline data; • Remote sensing for spatial extent; • Post-impact monitoring to be conducted in collaboration with DBCA; • Towed video, ROV or diver survey using transects or random/regular quadrat assessment;

<table>
<tr><th colspan="3">SMP5 – Macro algae and seagrasses</th></tr>
<tr><td></td><td colspan="2">Collection of samples for assay for individual health and condition assessment; and
Collection of water and sediment samples for analysis.
These tactics are detailed within Guideline M.12 (Guideline for monitoring damage to marine flora) (AMSA 2003a); RPS (2009); Chevron (2014); English et al. (1997); Hochberg (2011), Andréfouët et al. (2005); Kobryn et al. (2011); van Keulen and Langdon (2011); and Colquhoun et al. (2007).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">Field assessment team x minimum 3 people per team;
Sampling vessel and geo-referencing;
NATA accredited laboratory for sample analysis;
Sample containers and preservative solution;
Decontamination/washing facilities;
Waterproof digital still cameras and video cameras (high definition with GPS) and ROV array; and
Remote sensing/satellite imagery.</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>BMT Oceanica</td><td>Planned by technical advisor, with the field team experienced in the operation of ROVs and experience in BPPH classification.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Macroalgae and seagrass meadows occur in particular areas throughout the EMBA. Macroalgae are dependent upon light penetration and are found to a depth ~20m, mainly associated with hard substrates, while seagrass is also dependent upon light penetration and establishes on soft substrates. Brown algae dominate communities found in the Barrow and Montebello Islands and Dampier Archipelago. Seagrass is typically dispersed among microalgae, where soft sediments occur.</td></tr>
<tr><td>Design elements</td><td colspan="2">As per current baseline monitoring (e.g. Chevron 2014).
Remote sensing image libraries allow control charting of any site (Astron 2010), e.g. Kobryn et al. (2011).
Control charting of indicators: diversity and extent.</td></tr>
<tr><td>During and post-spill activities</td><td colspan="2">During: Pre-impact, post spill monitoring where logistically feasible.
Post-spill: Access and process remotely sensed data, monitor and report until termination.</td></tr>
<tr><td>Implementation</td><td colspan="2">Requires marine transport of divers, and ROVs to island and mainland sites. Access will be dependent upon sea conditions.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">Data stored in spatially explicit database, analysed as control charts and/or BACI design and presented as environmental report card section. Remotely sensed imagery derived indices analysed through control charts and presented in report cards.</td></tr>
</table>

6.7 SMP6 – Subtidal soft-bottom communities

Table 6-7: SMP6 – Subtidal soft-bottom communities

<table>
<tr><th colspan="3">SMP6 – Subtidal soft-bottom communities</th></tr>
<tr><td>Rationale</td><td colspan="2">Soft-bottom zones are generally of simple structure, low productivity and diversity. Silt habitats occur in more sheltered shoreline areas, while sand occurs in offshore regions. Such habitats support burrowing and filter-feeding organisms and a range of surface foraging organisms. Sediments in the region are generally considered to be of good condition.
Performance measures includes:
• Diversity of species;
• Abundance (% cover or density);
• Mortality of grazing fauna; and
• Water and sediment quality.</td></tr>
<tr><td>Objectives</td><td colspan="2">To characterise the status of subtidal benthic habitats and quantify any impacts to functional groups, abundance and density as a consequence of a hydrocarbon spill and associated response activities.</td></tr>
<tr><td>Baseline</td><td colspan="2">• Data from OMP4.
Refer to Appendix A and ICT toolbox for additional baseline data available.</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">OMPs 1, 2 or 4 predict subtidal soft-bottom communities may be impacted by a hydrocarbon spill.</td></tr>
<tr><td>Termination criteria</td><td colspan="2">Sediment infaunal diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).</td></tr>
<tr><td>Tactics</td><td colspan="2">• Access existing baseline data;
• Conduct pre-exposure surveys of high priority protection areas and areas with data gaps;
• Post-impact monitoring to be conducted in collaboration with DBCA and DoT;
• Marine survey via snorkel or surface supply using transects or random/regular quadrat assessment; and
• Collection of water and sediment samples for analysis.
These tactics are detailed within Guideline M.12 (Guideline for monitoring damage to marine flora) (AMSA 2003a); and van Keulen and Langdon (2011).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Field assessment team x minimum 3 people per team;
• Sampling vessel with geo-referencing;
• ROV operators;
• NATA accredited laboratory for sample analysis;
• Sample containers and preservative solution;
• Decontamination/washing facilities;
• Sample storage and refrigeration;
• Waterproof digital still cameras and video cameras (high definition with GPS) and ROV array; and
• Satellite imagery.</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• BMT Oceanica</td><td>Planned by technical advisor, with the field team experienced in the operation of ROVs and/or grab sampling and experience in BPPH classification.</td></tr>
</table>

SMP6 – Subtidal soft-bottom communities	
Spatial extent	Throughout EMBA.
Design elements	Benthic grab samples, fauna identified by expert. Sampling regime follows sediment sampling: initial gradient analysis, and follow up control charting of faunal diversity and abundance. ROV assessment.
During and post-spill activities	**During**: Preparation, establish sampling gradient based on operational sediment samples. **Post-spill**: Monitor and report until termination.
Implementation	Requires marine transport to offshore sites, with some locations as subset of those sampled for sediments and water.
Analysis and reporting	Data stored in spatially explicit database, analysed as control charts and/or BACI design and presented as environmental report card section.

6.8 SMP7 – Intertidal sand and mudflat communities

Table 6-8: SMP7 – Intertidal sand and mudflat communities

SMP7 – Intertidal sand and mudflat communities	
Rationale	Intertidal sand and mudflat communities are primary producer habitats which support invertebrate fauna, which in turn provides a valuable food source for shorebirds. High diversity of infauna (particularly molluscs) occur within these habitats. At high tide, these habitats become foraging grounds for vertebrates such as rays and sharks. While there is some disturbance to the intertidal sand and mudflat communities, such as on Barrow Island, most of the communities in the area of interest are generally in an undisturbed condition. Performance measures include: • Infaunal samples; • Abundance (number of individuals per m^3); and • Diversity of species.
Objectives	To characterise the status of intertidal sand and mudflat communities and quantify any impacts to functional groups, abundance and density as a consequence of a hydrocarbon spill and associated response activities.
Baseline	• Data from OMPs 4, 6 and 7. Refer to Appendix A and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2, 4, 6 or 7 predict intertidal sand and mudflat communities may be impacted by a hydrocarbon spill.
Termination criteria	Intertidal sediment infaunal diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).
Tactics	• Conduct pre-exposure surveys of sand and mudflats where possible; • Post-impact monitoring to be conducted in collaboration with DBCA and DoF; and • Ground survey – transects, infaunal samples. These tactics are detailed within Kohn (2003).

SMP7 – Intertidal sand and mudflat communities		
Indication of resources required	• Field assessment team x minimum 2 people per team; • Helicopter or sampling vessel with geo-referencing; • GPS; • Sample containers and preservative solution; • Sample storage and refrigeration; • Decontamination/washing facilities; • Handheld digital still cameras and video cameras (high definition with GPS); and • Sampling equipment (provided and specified by provider, i.e. corers/grabs).	
Possible provider(s) and competencies	• BMT Oceanica	Planned by technical advisor, with the field team experienced in intertidal assessment surveys.
Spatial extent	Shorelines, Barrow Island and Montebellos, Dampier Archipelago. Muddy tidal flats common feature of mainland coast	
Design elements	Infaunal invertebrate sampling to be implemented using the methodology described in Kohn (2003). Due to minimal baseline data, and high variability, pre-impact sampling, based on oil spill trajectory predictions most desirable.	
During and post-spill activities	**During**: Preparation, establish sampling gradient based on operational sediment samples and oil spill trajectory predictions. **Post-spill**: Monitor and report until termination.	
Implementation	Requires marine transport to offshore sites, overland transport to some mainland sites, with some locations as subset of those sampled for sediments and water.	
Analysis and reporting	Data stored in spatially explicit database, analysed as control charts and/or BACI design and presented as environmental report card section. BACI design and inference most likely.	

6.9 SMP8 – Rocky shore/intertidal reef platform communities

Table 6-9: SMP8 – Rocky shore/intertidal reef platform communities

SMP8 – Rocky shore/intertidal reef platform communities	
Rationale	Rocky shores predominate most of islands and provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds. Large tides tend to create large degree of horizontal zonation amongst taxa. Performance measures include: • Abundance (% cover or number of individuals per m^2); • Diversity of species; • Mortality (% cover affected); • Mortality of grazing fauna; and • Water and sediment quality.
Objectives	To monitor the changes in diversity and cover of rocky shore invertebrates and algae as a result of hydrocarbon spill and associated response.
Baseline	• Data from OMPs 4 and 6. Refer to Appendix A and ICT toolbox for additional baseline data available.

<table>
<tr><th colspan="3">SMP8 – Rocky shore/intertidal reef platform communities</th></tr>
<tr><td>Initiation criteria</td><td colspan="2">OMPs 1, 2, 4 or 6 predict rocky shore/intertidal reef platform communities may be impacted by a hydrocarbon spill.</td></tr>
<tr><td>Termination criteria</td><td colspan="2">Invertebrate and algae cover and diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).</td></tr>
<tr><td>Tactics</td><td colspan="2">• Conduct pre-exposure surveys of mangroves where possible;
• Post-impact monitoring to be conducted in collaboration with DBCA and DoF; and
• Ground survey – transects.
These tactics are detailed within Macfarlane and Burchett (2003).</td></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Field assessment team x minimum 2 people per team;
• Helicopter or available vessel;
• Sample containers and preservative solution;
• Decontamination/washing facilities; and
• Handheld digital still cameras and video cameras (high definition with GPS).</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• BMT Oceanica</td><td>Field team experienced in sampling of invertebrates and algae of shorelines.
Experienced marine biologist or taxonomist to identify sample specimens.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Barrow Island, Dampier Archipelago (most common habitat), mainland coast.</td></tr>
<tr><td>Design elements</td><td colspan="2">Rocky shoreline monitoring of epifauna macro-invertebrates and algae should focus on the intertidal region and its subregions. Recommended methods for monitoring community structure and population density are those of Macfarlane and Burchett (2003). Quadrat size should be adjusted according to the density of the taxa in question. Quadrats should be photo documented.</td></tr>
<tr><td>During and post-spill activities</td><td colspan="2">During: Pre-impact, post spill monitoring where logistically feasible.
Post-spill: Monitor and report until termination.</td></tr>
<tr><td>Implementation</td><td colspan="2">Requires marine transport to offshore sites, overland transport to some mainland sites. Access dependent upon sea conditions and tides.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">Data stored in spatially explicit database, analysed as control charts and/or BACI design and presented as environmental report card section. Remotely sensed imagery derived indices analysed through control charts and presented in report cards.</td></tr>
</table>

6.10 SMP9 – Turtles

Table 6-10: SMP9 – Turtles

SMP9 – Turtles	
Rationale	All six species found in Australian waters may occur within the EMBA. Green, flatback, hawksbill, loggerhead and leatherback turtles have been recorded within the Barrow and Montebello Islands, while four species nest there (all but leatherback). Three species occur in the Lowendal Island group. Intertidal and subtidal regions form important foraging habitat and all species undergo long migrations. Performance measures include: • Abundance (number or density); • Species; • Mortality; and • Oil distribution (impact) on individuals (post-exposure).
Objectives	To monitor turtle abundance and diversity a result of hydrocarbon spill and associated response.
Baseline	• Data from OMPs 6 and 8. Refer to Appendix A and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2, 6 or 8 predicts turtles (individual animals and/or nesting sites) may be impacted by a hydrocarbon spill.
Termination criteria	Turtle abundance and diversity consistent with baseline levels (e.g. no control chart breaches and/or significant difference to control sites).
Tactics	• Conduct aerial transects of all high priority protection areas and reference areas, pre-impact assessment of nesting beaches where possible; • Post-impact monitoring using repeat-measures aerial and vessel-based transects, nest beach surveys, in collaboration with DBCA and other data custodians; • Aerial surveys along strip-transect lines; • Vessel-based surveys along transects including collection of tissues from carcasses; and • Nesting surveys. These tactics are detailed within Guidelines M.11 (Guideline for monitoring damage to marine megafauna) and/or S.13 (Guideline for monitoring damage to coastal marine reptiles) (AMSA 2003a); Eckert *et al.* (1999); Marsh and Sinclair (1989); Pendoley (2012); and Astron (2006).

<table>
<tr><th colspan="3">SMP9 – Turtles</th></tr>
<tr><td>Indication of resources required</td><td colspan="2">Aerial survey
• Experienced aerial survey observers x 2;
• Fixed wing aircraft/helicopter (including pilot/s).
Vessel-based survey
• Experienced vessel survey observers x 2;
• Personnel with pathology or veterinary skills x 1;
• Sampling vessel and geo-referencing;
On-ground survey
• Field assessment team x minimum 2 people per team.
• NATA accredited laboratory for sample analysis and necropsy;
• Sample containers and preservative solution;
• Sample storage and refrigeration;
• Decontamination/washing facilities; and
• Sampling equipment (provided and specified by provider).</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• Astron;
• BMT Oceanica; and
• Pathology or veterinary collection and testing – Murdoch University, Perth Zoo or Pilbara OWRP resource list.</td><td>Field team experienced in aerial and/or vessel surveys of marine faun.
At least one team member experienced in handling and tissue sampling of fauna.
Tissue samples assessed for toxicology at experienced marine laboratory.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Barrow Island and Montebellos.
Dampier Archipelago. Rosemary Island has been identified as the focus for hawksbill turtle nesting in WA.
Various mainland nesting sites.</td></tr>
<tr><td>Design elements</td><td colspan="2">Established methodologies and baselines (e.g. Pendoley, 2012; Astron, 2006) maintained to form control charts based on consecutive breeding seasons. Comparisons amongst nesting sites of impacted and non-impacted sites.</td></tr>
<tr><td>During and post-spill activities</td><td colspan="2">During: Pre-impact, post spill monitoring where logistically feasible. Tissue samples and analysis of oiled turtles.
Post-spill: Monitor and report until termination.</td></tr>
<tr><td>Implementation</td><td colspan="2">Requires transport to offshore sites and/or, overland transport to some beach sites. Access dependent upon sea conditions and tides.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">Data stored in spatially explicit database, analysed as control charts and presented as environmental report card section.</td></tr>
</table>

6.11 SMP10 – Marine mammals

Table 6-11: SMP10 – Marine mammals

SMP10 – Marine mammals	
Rationale	Includes cetaceans – whales and dolphins. There is the potential for an array of listed Threatened or Migratory cetaceans to be in the EMBA although there are no major breeding, calving or feeding grounds. The migratory paths of some species may be in close proximity, e.g. humpback whales. Dugongs typically inhabit the warm, shallow waters around the Montebello Islands, Lowendal Islands and Barrow Islands, however, their population status is currently largely unknown. Performance measures include: • Abundance (number or density); • Species; and • Mortality.
Objectives	To monitor short and long-term impacts to marine mammal as a result of a hydrocarbon spill and associated response activities.
Baseline	• Data from OMPs 6 and 8. Refer to Appendix A and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2, 6 or 8 predict marine mammals may be impacted by a hydrocarbon spill.
Termination criteria	Marine mammal health is considered to be consistent with baseline levels. Use of spatial resources is considered to be consistent with baseline levels.
Tactics	• Conduct aerial transects of all high-priority protection areas and reference areas; • Access existing data from DBCA, DoF, I-GEMS, etc.; • Post-impact monitoring using repeat-measures aerial and vessel-based transects; • Aerial surveys along strip-transect lines; • Vessel-based surveys along transects including collection of tissues from carcasses; and • Passive Acoustic Monitoring. These tactics are detailed within Guidelines M.11 (Guideline for monitoring damage to marine megafauna) and/or S.11 (Guideline for monitoring damage to coastal marine mammals) (AMSA 2003a); Marsh and Sinclair (1989); and OTSOPA (2003).
Indication of resources required	**Aerial survey** • Trained marine mammal observer (MMO) x 1; • Experienced aerial survey observer x 1; and • Fixed wing aircraft/ helicopter (including pilot/s). **Vessel-based survey** • Trained MMO x 1; • Experienced vessel survey observer x 2; • Personnel with pathology or veterinary skills x 1; • Survey vessel and geo-referencing; • NATA accredited laboratory for sample analysis and necropsy; • Sample containers and preservative solution;

SMP10 – Marine mammals		
	• Sample storage and refrigeration; • Decontamination/washing facilities; and • Sampling equipment (provided and specified by provider).	
Possible provider(s) and competencies	• Astron; • BMT Oceanica; and • Pathology or veterinary collection and testing – Murdoch University, Perth Zoo or Pilbara OWRP resource list.	Field team experienced in aerial and/or vessel surveys of marine fauna, with at least one team member a trained MMO. At least one team member experienced in handling and tissue sampling of fauna. Tissue samples assessed for toxicology at experienced marine laboratory.
Spatial extent	Dugongs and 10 whale species, with humpback whales most likely to be encountered. Barrow Island, Montebellos: five common dolphin species, and several less common or occasional.	
Design elements	This program will quantify lethal and non-lethal impacts to marine mammals, sampled opportunistically. Modification to behaviours (breeding, foraging) in terms of use of space will be quantified. Assessment of spatial usage through boat survey and opportunistic samples of tissues samples for toxicological assessment.	
During and post-spill activities	**During**: Respond to mammal locations as determined by operational monitoring. **Post-spill**: Health assessments, until termination.	
Implementation	Requires marine transport throughout EMBA to opportunistically assess fauna and aerial sea. Dependent upon air and sea conditions.	
Analysis and reporting	Habitat usage patterns compared with previous data, toxicological samples compared against known baselines. Data stored in spatially explicit database, analysed as control charts and presented as environmental report card section.	

6.12 SMP11 – Seabirds and shorebirds

Table 6-12: SMP11 – Seabirds and shorebirds

SMP11 – Seabirds and shorebirds	
Rationale	The region supports around 25 migratory shorebirds and 20 resident shorebirds, and approx. 30 seabirds. Shorebird foraging is most highly concentrated on tidal mudflats, while seabirds tend to nest on offshore islands. Performance measures include: • Abundance (number or density); • Species; • Breeding effort (proportion of breeding attempts) and output (proportion of breeding attempts resulting in fledglings); and • Oil distribution on individuals (post-exposure).
Objectives	To monitor changes in abundance and diversity of shorebirds and seabirds as a result of a hydrocarbon spill and associated response activities. To monitor lethal and sub-lethal effects of oil spills on bird assemblages.
Baseline	• Data from OMPs 6 and 8. Refer to Appendix A and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2, 6 or 8 predicts seabirds and shorebirds (individual animals and/or nesting sites) may be impacted by a hydrocarbon spill.
Termination criteria	Bird abundances and diversity are considered to be consistent with baseline levels. Oiled birds are no longer recovered.
Tactics	• Access existing baseline data; • Post-impact monitoring using ground-based repeat-measures at identified sites; • Vessel-based surveys along transects including collection of tissues from carcasses; and • Ground surveys during breeding season including collection of tissues from carcasses. These tactics are detailed within Guideline S.12 (Guideline for monitoring damage to coastal birds) (AMSA 2003a); Surman and Nicholson (2009); Dunlop *et al.* (2001); and Ronconi and Burger (2009).
Indication of resources required	• Experienced seabird biologist/ornithologist x 1; • Personnel with pathology or veterinary skills x 1; • Survey vessel and geo-referencing; • NATA accredited laboratory for sample analysis and necropsy; • Sample containers and preservative solution; • Decontamination/washing facilities; and • Sampling equipment (provided and specified by provider, i.e. burrow scope, video goggles)

SMP11 – Seabirds and shorebirds		
Possible provider(s) and competencies	• Astron • BMT Oceanica • UWA.	Field team experienced in bird surveys and identification. At least one team member experienced in handling and tissue sampling of fauna. Tissue samples assessed for toxicology at experienced laboratory.
Spatial extent	Important bird areas (IBAs) (see intertidal mudflats), including seabirds across coastal islands, including Barrow Island. The Dampier Archipelago and Cape Preston region also comprise important nesting sites for a minimum of 16 seabird species.	
Design elements	Established bird survey protocols (shoreline counts, point counts, etc.). Regular surveys at range of sites as component of bird atlasing. Structured surveys pre-impact, impact sites and spatial controls. Also quantification of lethal and non-lethal impacts to oiled birds, sampled opportunistically. Guideline S.12 for Monitoring Damage to Coastal Birds (AMSA, 2003a).	
During and post-spill activities	**During**: Respond to oiled birdlife locations as determined by OM. Pre-impact surveys where possible. **Post-spill**: Bird assemblage monitoring and health assessments, until termination.	
Implementation	Requires marine transport to offshore islands. Mainland sites accessible by vehicle or, occasionally vessel only. Dependent upon sea conditions.	
Analysis and reporting	Data stored in spatially explicit database. Control charting of long term trends using bird atlas data. BACI designs for site-specific surveys of impacted and non-impacted sites. Presented as environmental report card section.	

6.13 SMP12 – Invertebrates

Table 6-13: SMP12 – Invertebrates

SMP12 – Invertebrates	
Rationale	Comprised of tropical assemblages common throughout the Indo-Pacific region. Invertebrate species (excluding corals) include sponges, cnidarians (jellyfish, anemones), worms, bryozoans (sea mosses), crustaceans (crabs, lobsters, etc.), molluscs (cuttlefish, baler shells, giant clams, etc.), echinoderms (starfish, sea urchins) and sea squirts. They are an important food source for a variety of marine animals including migratory birds and fishes. Invertebrate assemblages are generally poorly understood and documented and very little biological data or research exists for invertebrates and invertebrate communities for the region beyond fisheries data. Assemblages varying in relation to depth and substrate. Performance measures include: • Abundance (% cover or no. individuals per m^2); • Mortality; • Individual health and condition; and • Water and sediment quality.
Objectives	To monitor changes in invertebrate biomass and/or cover and diversity as a result of a hydrocarbon spill and associated response activities.

SMP12 – Invertebrates		
Baseline	• Data from OMP4. Refer to Appendix A and ICT toolbox for additional baseline data available.	
Initiation criteria	OMPs 1, 2 or 4 predicts invertebrates may be impacted by a hydrocarbon spill.	
Termination criteria	Invertebrate biomass and diversity are considered to be consistent with baseline levels for range of habitats. Water quality (see SMP2) is at recommended baseline levels.	
Tactics	• Access existing baseline data; • Conduct pre-exposure surveys of high priority protection areas and areas with data gaps; • Post-impact monitoring to be conducted in collaboration with DBCA and DoF; • Ground survey using transects or random/regular quadrat assessment; • Collection of samples for assay for individual health and condition assessment; and • Collection of water and sediment samples for analysis. These tactics are detailed within Guideline S.10 (Guideline for monitoring damage to invertebrate beach fauna) (AMSA 2003a); Hill and Wilkinson (2004); and Duke *et al.* (2010).	
Indication of resources required	• Field assessment team x minimum 3 people per team; • Sampling vessel and geo-referencing; • NATA accredited laboratory for sample analysis; • Sample containers and preservative solution; • Sample storage and refrigeration; • Decontamination/washing facilities; and • Handheld digital still cameras and video cameras (high definition with GPS).	
Possible provider(s) and competencies	• BMT Oceanica with support from UWA, WA Museum and/or Aquanel.	Field team experienced in invertebrate sampling for range of habitats, experience in establishing video transects, commercial divers, and in situ and laboratory identification.
Spatial extent	Throughout EMBA, with varying habitat-associated assemblages. Assemblages varying on water depth and substrate. Dampier Archipelago may be a hotspot (Human and McDonald, 2009).	
Design elements	Range of techniques (Hill and Wilkinson, 2004), dependent upon habitat. Intertidal shorelines (fixed transects, see rocky shorelines), soft-bottom habitats – grab sampling (see soft bottoms). Sampling based on hydrocarbon gradient, and control-impact design. Video transects of hard surfaced subtidal areas (see coral). Based on observed hydrocarbon gradients and oiled non-oiled site comparison, stratified by habitat type.	
During and post-spill activities	**During**: Establish post spill pre-impact samples. **Post-spill**: Assemblage monitoring until termination.	
Implementation	Requires marine transport to offshore sites and marine or terrestrial transport to mainland sites. Dependent upon sea conditions. Program will be closely integrated with other programs: coral reef surveys, benthic, and intertidal sampling. Invertebrate sampling specialists should accompany these monitoring sorties.	

SMP12 – Invertebrates	
Analysis and reporting	Control charting of long-term trends using invertebrate assemblage data. BACI designs for site-specific surveys of impacted and non-impacted sites. Data stored in spatially explicit database, analysed as control charts and presented as environmental report card section.

6.14 SMP13 – Finfish

Table 6-14: SMP13 – Finfish

SMP13 – Finfish	
Rationale	Fish communities play an important ecological role in the North-West Marine Region, both near-shore and in the open ocean. These communities are comprised of small and large pelagic fish; sharks, skates and rays; and other demersal fish. EMBA overlays area of high species richness, including habitat for pipefish and seahorses. It is likely that reef fish populations are connected through long distance dispersal of eggs or larvae. Inshore regions support a wide ranging tropical fish fauna. Performance measures include: • Abundance (number or density); • Species; • Mortality; and • Exposure and health.
Objectives	To monitor changes in finfish abundance and diversity as a result of hydrocarbon spill and associated response. To monitor lethal and sub-lethal effects of oil spills on finfish assemblages.
Baseline	• Data from OMP3. Refer to Appendix A and ICT toolbox for additional baseline data available.
Initiation criteria	OMPs 1, 2 or 3 predicts finfish may be impacted by a hydrocarbon spill.
Termination criteria	Fish abundances and diversity are considered to be consistent with baseline levels. Water quality (SMP2) termination criteria is met. No further oiled fish are recovered.
Tactics	• Access existing baseline data; • Issue, collate and record observational data record sheets to emergency response vessels; • Post-impact monitoring; using repeat-measures data; • Towed video survey using line transects for reef fish and Baited Remote Underwater Video (BRUV) for pelagic species; • Commercial and charter fisheries records; • Recreational fishing catch and effort survey records; and • Collection and analysis of muscle tissue and gut samples of indicator species. These tactics are detailed within Hill and Wilkinson (2004); Green and Bellwood (2009); Watson *et al.* (2010); Harvey and Shortis (1995); Babcock *et al.* (2008); Fitzpatrick and Harvey (2008); Gagnon and Rawson (2012); and Burns *et al.* (2011).

<table>
<tr><th colspan="3">SMP13 – Finfish</th></tr>
<tr><td>Indication of resources required</td><td colspan="2">• Scientists trained in fish identification and necropsy and ROV/BRUV operations x 2;
• Sampling vessel and geo-referencing;
• NATA accredited laboratory for sample analysis and necropsy;
• Sample containers and preservative solution;
• Sample storage and refrigeration;
• Decontamination/washing facilities; and
• Sampling equipment (provided and specified by provider i.e. stereo BRUV arrays and ROV arrays and necessary equipment on vessel for deployment).</td></tr>
<tr><td>Possible provider(s) and competencies</td><td>• Astron
• BMT Oceanica
• UWA Marine Ecology Group
• Murdoch University
• Curtin University.</td><td>Field team experienced in reef fish surveys, BRUV operation, and/or sampling of fish for tissue samples.
Samples assessed for toxicology at experienced laboratory.</td></tr>
<tr><td>Spatial extent</td><td colspan="2">Throughout EMBA, with varying habitat-associated assemblages. Coral and mangrove associated fish predominating in Dampier Archipelago.</td></tr>
<tr><td>Design elements</td><td colspan="2">Follow established methods: Hill and Wilkinson (2004); Green and Bellwood (2009); Watson et al. (2010); Harvey and Shortis (1995).
Deployment of BRUV based on hydrocarbon spill gradient as defined by OM. Stratified by habitat.
Tissue samples for analysis as defined by Gagnon and Rawson (2012) and Burns et al. (2011).</td></tr>
<tr><td>During and post-spill activities</td><td colspan="2">During: Establish post spill pre-impact BRUV samples, opportunistic gross and tissue samples.
Post-spill: Systematic tissue samples, and assemblage monitoring until termination.</td></tr>
<tr><td>Implementation</td><td colspan="2">Requires marine transport to offshore sites and deployment of BRUVs. Dependent upon sea conditions. Program will closely be integrated with fisheries scientific monitoring.</td></tr>
<tr><td>Analysis and reporting</td><td colspan="2">Data stored in spatially explicit database. Control charting of long term trends using fish assemblage data. BACI designs for site specific surveys of impacted and non-impacted sites. Toxicological data compared to baselines. Presented as environmental report card section.</td></tr>
</table>

6.15 SMP14 – Fisheries and aquaculture

Table 6-15: SMP14 – Fisheries and aquaculture

SMP14 – Fisheries and aquaculture	
Rationale	A high diversity of fishes comprised of an Indo-West Pacific assemblage, with a number of biodiversity hotspots. Fisheries include the Pilbara Demersal Finfish Fishery, the Mackerel Fishery, the WA North Coast Shark Fishery, and the Joint Authority Northern Shark Fishery. Offshore and coastal. These are multi-species fisheries, generally targeting a variety of reef fishes and shark species. The environment is highly conducive to pearl production. There are no other major aquaculture projects in the region. Performance measures include: • Catch rate; • Species; • Mortality; and • Exposure and health.
Objectives	To monitor changes in fisheries catch, animal health and seafood quality as a result of a hydrocarbon spill and associated response activities.
Baseline	• Data from OMP3. Refer to Appendix A and ICT toolbox for additional baseline data available.
Spatial extent	Fisheries throughout the region in addition to several pearling leases, including Lowendal Islands, Montebello Islands, Dampier Archipelago.
Initiation criteria	OMPs 1, 2 or 3 predicts fisheries and aquaculture species may be impacted by a hydrocarbon spill.
Termination criteria	Fisheries catches within impact area considered to be consistent with baseline levels. No oiled fish recovered. Tissue samples present toxicants at baseline levels. No olfactory effects detected. Water quality (see SMP2) is at recommended baseline levels.
Tactics	• Initiate post-spill spatio-temporal sampling of focal fish taxa; • Obtain baseline fisheries data – Fisheries catch data provided by DoF; • Collection and analysis of muscle tissue and gut samples of indicator species; and • Olfactory testing. These tactics are detailed within McCrea-Strub *et al.* (2011); Rawson *et al.* (2011); and Gagnon and Rawson (2012).

SMP14 – Fisheries and aquaculture		
Indication of resources required	• Scientists trained in fish identification and necropsy x 2; • Sampling vessel and geo-referencing; • NATA accredited laboratory for sample analysis and necropsy; • Sample containers and preservative solution; • Sample storage and refrigeration; • Decontamination/washing facilities; and • Sampling equipment (provided and specified by provider i.e. fish traps, sampling equipment).	
Possible provider(s) and competencies	• Astron • BMT Oceanica • UWA Marine Ecology Group • Murdoch University • Curtin University.	Field team experienced in targeted pelagic and demersal fish sampling, and experience in tissue sampling and processing. Qualified laboratory to analyses tissue samples.
Design elements	Analysis of annual fisheries data. • Sampling of target species as per Gagnon and Rawson (2012) (gradient analysis); • Targeted fish species also form data from finfish monitoring (see above); • Olfactory tests, following Rawson *et al.* (2011); and • Sentinel pearl oysters placed at appropriate sites, based on gradient of exposure and sampled staggered in time.	
During and post-spill activities	**During**: Establish post spill pre-impact samples. **Post-spill**: Assemblage monitoring until termination.	
Implementation	Requires marine transport to offshore sites, and shallower shoreline sites. Dependent upon sea conditions. Program to some extent integrated with finfish studies.	
Analysis and reporting	Data stored in spatially explicit database. Control charting of long-term trends using invertebrate assemblage data and presented using environmental report cards. BACI designs for site-specific surveys of impacted and non-impacted sites. Fisheries data analysed following McCrea-Strub *et al.* (2011).	

6.16 SMP15 – Heritage

VOGA have identified the need to prepare a SMP for natural, indigenous and historic heritage areas that may reside within the area of a potential hydrocarbon spill. Seven places within the EMBA are listed on the National Heritage list (see Wandoo Facility EP; Section 3.4.1). The Ningaloo Marine Area (Commonwealth waters), HMAS Sydney II and JSK Kormoran Shipwreck sites, and the Mermaid Reef – Rowley Shoals are also listed on the Commonwealth Heritage List.

The places within the EMBA are listed on the National Heritage list (see Wandoo Facility EP; Section 3.4.1). The Ningaloo Marine and the Mermaid Reef – Rowley Shoals are monitoring through the fauna and flora OMP and SMPs. Therefore SMP15 will focus on the monitoring of shipwrecks and possible degradation overtime from the presence of hydrocarbons entrained in the water column.

The monitoring tactics to monitor the change in historic shipwrecks is yet to be defined by VOGA. VOGA will work with monitoring consultants to determine to appropriate tactics and resources required to adequately monitor impacts to shipwrecks. This will be completed by Q1 2017 (no high risk activities, i.e. drilling, scheduled to be undertaken prior to this period).

Table 6-16: SMP15 – Heritage

SMP15 – Heritage	
Rationale	Historic shipwrecks of National and State heritage value are protected under the *Historic Shipwrecks Act 1976* (Cth) and *Maritime Archaeology Act 1973* (WA) and are listed on the National Shipwreck Database and the Western Australian Museum Shipwreck Database. There are no known shipwrecks within the Permit Area, but an extensive number within the EMBA. Whilst the impact of entrained hydrocarbons and chemical dispersant on shipwrecks is thought to be low, it is relatively unknown. The Western Australian Museum lists 'significant' shipwrecks along the Western Australian coast. These, including HMAS Sydney II and JSK Kormoran Shipwreck sites (approximately 150 nm off Carnarvon), only these sites will be considered when initiating SMP15 for monitoring.
Objectives	To monitor changes in the integrity of significant shipwrecks as a result of a hydrocarbon spill and associated response activities.
Baseline	*To be determined.*
Spatial extent	Significant shipwrecks throughout the region predicted to be impacted.
Initiation criteria	*To be determined.*
Termination criteria	*To be determined.*
Tactics	Potential tactics may include: 1. Archaeological sites plans and creating photo-mosaics for each shipwreck to discern how the sites change over time; 2. Conducting ROV video surveys of the shipwrecks and their resident biota for comparison with pre-spill ROV video footage; 3. Collecting 3D sonar scans of diagnostic features on the shipwrecks to monitor site formation processes and potential degradation over time; 4. Obtaining sediment, water, coral, wood, and metal (including rusticle) samples for a microbiological and molecular ecological study of shipwreck communities, a comprehensive physical and geochemical analysis, and a corrosion study across the shipwrecks in differentially spill-impacted and unimpacted areas; and 5. Deploying experiment platforms for short term studies of in situ biofilm recruitment and corrosion processes.

SMP15 – Heritage	
Indication of resources required	Potential resources may include: • Field assessment team - minimum 4 people per team; • Sampling vessel with geo-referencing; • ROV operators; • NATA accredited laboratory for sample analysis; • Sample containers and preservative solution; • Decontamination/washing facilities; • Sample storage and refrigeration; • Waterproof digital still cameras and video cameras (high definition with GPS) and ROV array; and • Sampling equipment (provided and specified by provider, i.e. fluorometer).
Possible provider(s) and competencies	• BMT Oceanica • ChemCentre
Design elements	*To be determined.*
During and post-spill activities	*To be determined.*
Implementation	*To be determined.*
Analysis and reporting	*To be determined.*

7 Data transfer and governance

Data governance refers is the management of data and its quality, generation and enforcement of data policies and standards and risk management surrounding the handling of environmental and biodiversity data in the unlikely event of an incident (NOPSEMA, 2012).

7.1 Transfer of data from the field

Due to the potential remote location of sampling areas and limited methods of communication, consideration of data transfer is required. During OM, specifically during the early stages of an incident, the prompt communication of data collected in the field is required to inform the VOGA ICT and NEBA. Potential data transfer methodologies and resources required have been identified for various levels of communication in Table 7-1.

Table 7-1: Transfer of field data methodologies and resources

Communication availability	Potential data transfer method	Potential resources required
Satellite coverage only	• Trimble/tablet data transferred to computer. • Photos of data sheets taken by camera, transferred to computer. • Email via satellite broadband. • Observational data/records may also be relayed by voice over satellite phone if reception allows.	• Tablet or trimble. • Laptop computer. • Trimble USB cable. • Camera and USB cable. • Satellite internet modem (hire or rent a satellite phone) or vessel satellite if available.
Satellite and mobile (voice only)	• Trimble/tablet data transferred to computer. • Photos of data sheets taken by camera. • Email via satellite broadband. • Observational data/records may also be relayed by voice over. • Phone if reception allows.	• Tablet or trimble. • Laptop computer. • Trimble USB cable. • Camera and USB cable. • Satellite internet modem (hire or rent a satellite phone) or vessel satellite if available.
Satellite and mobile (voice and data)	• Trimble/tablet data transferred to computer. • Photos of data sheets taken by camera/mobile phone. • Email via mobile broadband (laptop) or using mobile phone.	• Tablet or trimble. • Laptop computer. • Camera or mobile phone. • USB cables for trimble/camera/phone. • Mobile broadband USB.

Communication availability	Potential data transfer method	Potential resources required
Satellite, mobile (voice and data) and land based communications	• Trimble/tablet data transferred to computer. • Photos of data sheets taken by camera/mobile phone. • Email via land based communications if available, or mobile broadband. • Laptop or mobile phone.	• Tablet or trimble. • Laptop computer. • Camera or mobile phone. • USB cables for trimble/camera/phone. • Mobile broadband USB. • Access permission for land-based communications.

7.2 Data interpretation

7.2.1 Operational monitoring data

Operational monitoring data is used to gain situational awareness and inform decisions within an IAP. Data from the field from a range of contractors will be provided directly to the ICT Planning Team (Planning Chief) (i.e. oil spill trajectory modelling, visual assessments and surveillance).

For OMP that include a scientific monitoring component, results will be provided to the MC for QA/QC prior to reporting the information to the ICT for consideration in their response planning.

7.2.2 Scientific monitoring data

Scientific monitoring data will be collated by the primary monitoring contractor (Astron) and transferred to the ICT via the MC, or delegate. However as this data will be more long-term in nature, a more thorough analysis will be undertaken before being provided to the Planning Team ICT.

Data analysis will be undertaken following the strategy outlined in Appendix B. Environmental report cards will be the strategy employed for scientific data interpretation, communication and decision making. Appropriate management responses to environmental report cards are reliant on environment information of sufficient quality and design and require robust assessment.

Environmental report cards are designed to provide decision makers with a readily interpretable summary of the state of a range of environmental variables. They summarise environmental and biodiversity monitoring information, allowing trends in condition (states of the environment) to be easily identified. They inform incident response decisions based on changes to trend and condition and provide a clear consensus for management decisions.

Environmental report cards will provide several reporting outcomes:

- provide a template or structure for summarising and communicating trends in biodiversity and environmental values;
- communicate trends in values to managers and regulators in a simple, easy to interpret format;
- indicate the effectiveness of incident responses;
- allow a consensus interpretation of the data; and

- provide an indication of the quality or reliability of the data.

7.3 Data governance and storage

A data warehouse provides the most reliable technology infrastructure to ensure that data governance principles are met, namely assurance of data quality, data profiling for quality control, ensuring information security, and the persistence and integrity of the data over time. A Data Management Officer and team will be responsible for ensuring that all data received will meet minimum data quality targets, resolve issues in the delivery of data, and provide requirements for the design and ongoing development of the data warehouse and data availability.

Electronic data will be backed up daily in the field by the Field Monitoring Teams. Once transferred to the office based Data Management Team, all field data will be stored in a secure data warehouse that will also be backed up daily.

8 Roles and responsibilities

8.1 Integration with VOGA ICT

The Wandoo Field OSCP outlines when the OSMP and specific OM programs will be activated by the Planning Chief within the first 48 hours. Monitoring results from the Monitoring Coordination Team will liaise with the ICT Environment Unit via the MC (Section 8.2.1).

The monitoring tasks undertaken by Field Monitoring Teams will fit into the relevant functions in operations as required, e.g. the OMP4 team will integrate into the Marine Unit when conducting sampling, fluorometry and visual observations (Figure 8-1). This ensures that resources in high demand (e.g. vessels and aircraft) are used to their full capability wherever possible.

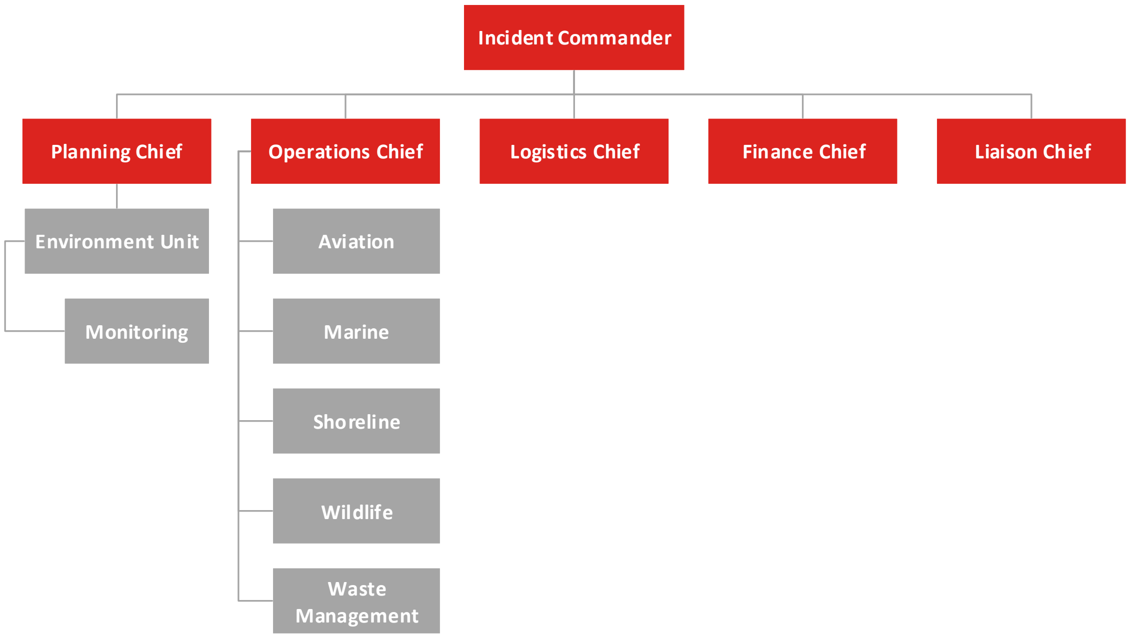


Figure 8-1: Relevant VOGA ICT units integration with monitoring

8.2 Monitoring Coordination Team

The Monitoring Coordination Team coordinates the oil spill standby and response services and contains four core positions (Figure 8-2). The roles and responsibilities of the Monitoring Coordination Team apply to all phases of the standby, response, and recovery process. Prior to commencement of standby, all personnel will be aware of their relevant roles and responsibilities. Deputies will be assigned to all key roles (MC, Operations Officer, Planning and Logistics Officer, Safety Advisor, Technical Advisors and Data Management Lead) in the event they become unavailable or are mobilised to site.

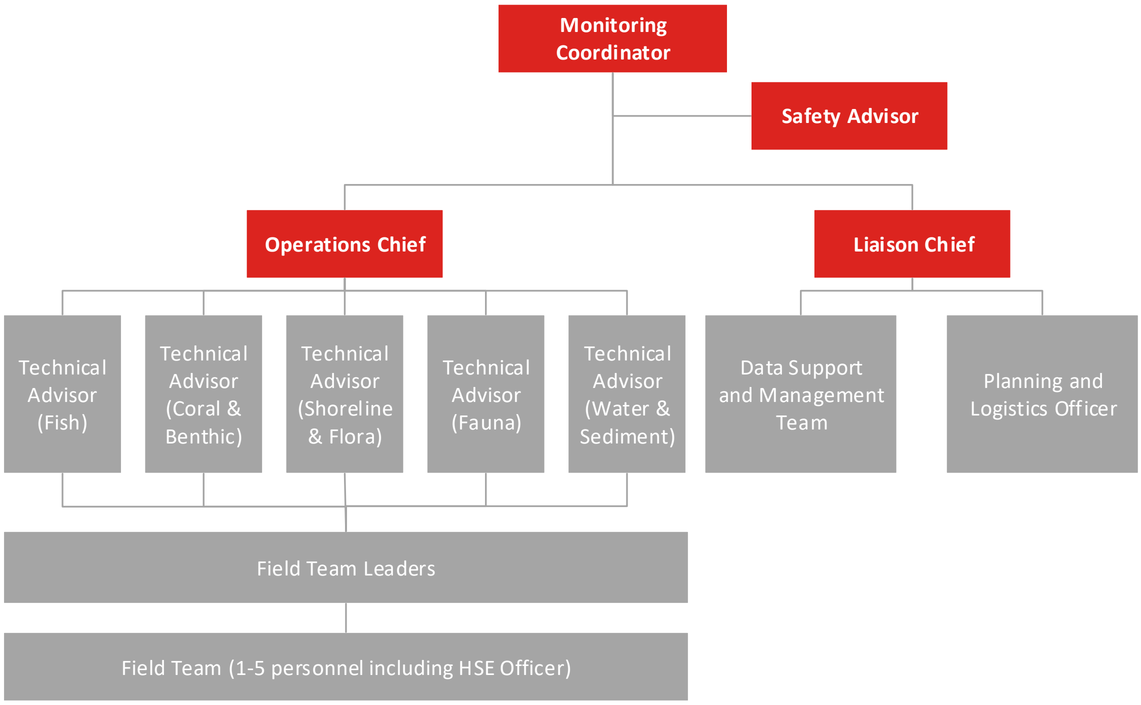


Figure 8-2: Structure of the Monitoring Coordination Team

8.2.1 Monitoring Coordinator

The MC is ultimately accountable for the management of standby and coordination of a response and, as necessary, will delegate duties to the following roles. Oversees all activities at all stages with respect to standby and any response that may be required.

A critical function of the MC is to be the single point of contact between the VOGA ICT and the monitoring team and coordinate communications between the Technical Advisory Team and the VOGA Planning Team if required.

8.2.2 Operations Chief

Responsibilities include reporting to the MC, responsible for implementing decisions on resource allocation in the event of an incident; specifically the resources that are to be allocated and the locations at which they are required.

8.2.3 Logistics and Planning Officer

The Logistics and Planning Officer responsibilities include reporting to the MC and liaising closely with the Operations Chief. Key responsibilities include training coordination, communications and the practicalities of mobilisation and demobilisation of personnel resources to and from site.

8.2.4 Safety Advisor

The Safety Advisors responsibilities include providing support and advice to all levels of management, staff and equipment staff with the relevant information to operate within the relevant Health, Safety and Environment (HSE) Management System.

8.3 Support Teams

Several teams have been assembled to assist the functions of the monitoring control team. These teams comprise experienced and qualified personnel.

8.3.1 Technical Advisory Team

The role of the Technical Advisor is to oversee and provide advice on the collection of data. One Technical Advisor will be assigned to each monitoring scope. Each advisor will have a thorough understanding of the receptors they are assigned. This is crucial as the role will be dynamic and Technical Advisor will need to be responsive to changing circumstances. Technical Advisors should be available to work directly with the MC and/or VOGA ICT and are responsible for:

- determining scopes for monitoring in conjunction with the Planning Chief;
- ensuring field-based leaders and teams are adequately equipped and trained to collect data in the event of an oil spill;
- review Standard Operating Procedures (SOPs) for currency prior to commencement of standby; and
- preparation of reports and interpretation of data.

8.3.2 Field Monitoring Teams

One member of the Field Team will be assigned the role of Field Team Lead. The responsibilities of this role include:

- understanding the details of monitoring methods;
- having adequate field data collection sheets and survey specific equipment readily available;
- reviewing of monitoring methods for currency on a regular basis;
- ensuring awareness and understanding of QA/QC procedures; and
- assisting with the preparation of reports.

The monitoring teams comprise individuals who will mobilise to site in the event of an incident. The responsibilities of team members include the following:

- notification of unavailability to the MC during any given week should this circumstance arise;
- responding to emails from the MC requesting checks of availability; and
- undertake monitoring and collect data in accordance with OMP/SMP specifications, HSE guidelines and work method statements.

8.3.3 Data Support and Management Team

The data management, GIS personnel and data analysts responsibilities include the following:

- spatial analysis for pre-mobilisation planning;
- preparation of field maps and data;

- manage data collected by the monitoring team, as well as existing data that need to be accessed in the event of an oil spill;
- present data in an appropriate and informative format for the MC to make timely decisions; and
- analysis and interpretation/presentation of data in the form of environmental report summaries (dashboard or environmental report cards) in the period following a spill.

9 Contractor Standby Manual

9.1 Overview

A service provider has been contracted by VOGA to provide standby services during well construction operations for the OMPs and SMPs. The contractor maintains a state of readiness including incident response training, internal training and inductions, prepared and on-call personnel, prepared and on-call equipment, monitoring of resources, sub-contractor and supplier agreements which provides the capacity to provide standby and response services.

The Standby Manual represents a key planning document that enables a state of readiness of the resources required to enact operational and scientific monitoring in the event of an incident. Further, it enables these resources to be utilised promptly, efficiently and safely. Although it is most likely that the Standby Manual (Astron, 2018) will be used in response to a Level 3 spill; should a Level 1 or Level 2 spill require a monitoring response, the Standby Manual may also be used to guide the process.

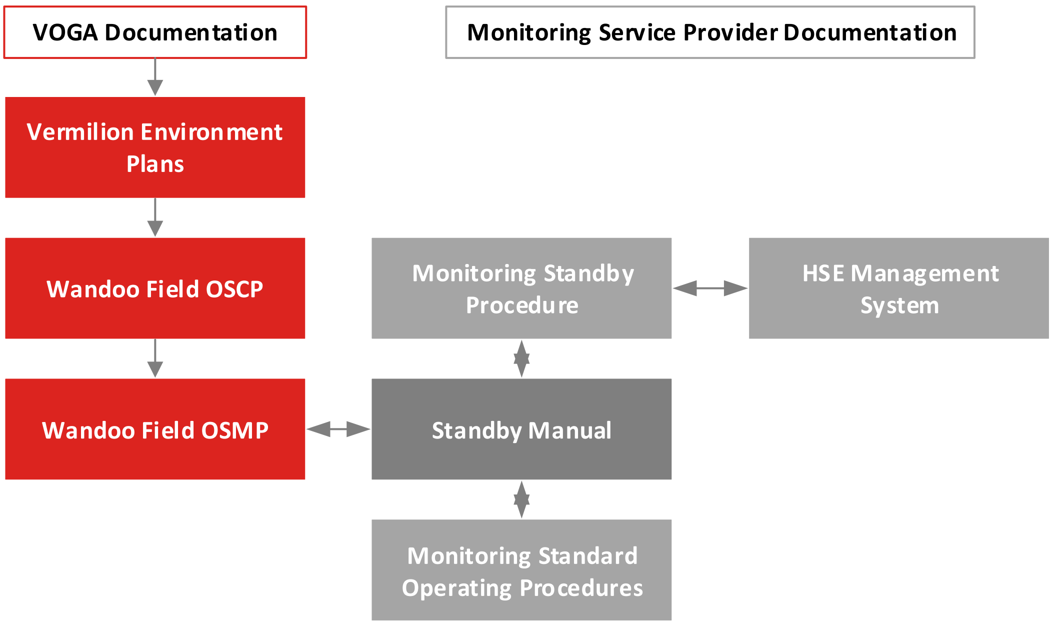


Figure 9-1: VOGA and service provider key documentation flowchart

The Standby Manual contains the following information:

- Preparation and Planning – the resources, systems and arrangements that are to be in place.
- Standby – how resources will be maintained in a state of readiness.
- Response – how resources will be prioritised and mobilised in the event of a spill and how they will be maintained and supported should they be mobilised.
- Stand Down – Processes for demobilising, submission of data, restoring physical resources and repatriating and caring for human resources.

Recovery is a vital phase of incident response however is outside the scope of the document.

The service provider is responsible for ensuring that the Standby Manual is maintained with the most recent information prior to each standby campaign, or as required during standby.

9.2 Preparation and planning

The organisational structure includes the implementation of this OSMP, and how this structure interacts with the VOGA ICT. Personnel on the standby teams are selected on the basis of experience, qualifications, training and long-term availability. Field teams mobilised are responsible to execute and capture the required monitoring data. Table 9-1 outlines the proposed makeup of monitoring teams.

Table 9-1: Proposed teams to be mobilised in the event of an oil spill (note that those personnel listed as team lead/supervisor are assigned those roles in addition to data collection roles)

Reporting to	Team breakdown	Experience level
Technical Advisors	Field Team Lead (one per team of six).	>2 years' experience in relevant scientific field team leader experience.
Field Team Lead	Field Monitoring Team members (minimum team size of two, maximum team size of six).	Comprising experienced and field ready scientists and technicians.
Technical Advisors/ Field Team Lead	HSE Officer (one per team).	HSE Officer.

An inventory of all resources (people, equipment and services) and relevant contact numbers will be kept by each organisation on standby.

9.2.1 Activation

VOGA will advise the service provider of an incident using the process on the first page of the Standby Manual (Astron, 2018). An Activation Form will be submitted to Astron as soon as possible following verbal notification by the VOGA ICT, providing important information to assist with response planning. Once activated the service provider will follow the Response Process checklist. Response personnel will be ready to mobilise from Perth airport within 48 hours of activation.

9.3 Standby

All members of the standby teams will be briefed by the MC at the commencement of the standby period. The briefing will outline the roles, responsibilities and accountabilities of each of the teams and team members. Roles and responsibilities are outlined in Section 8. Personnel will be briefed as necessary throughout the standby phase.

The Planning and Logistics Officer is responsible for communicating fortnightly availability updates to VOGA during the standby phase. It is the responsibility of the MC to communicate with the Team Leads to ensure they are satisfied with the quality of standby preparations.

Personnel listed as available on fortnightly updates will comply with the following be:

- within communication reach, that is, have phone coverage at all times. If leaving areas of reception for extended periods of time, personnel will be deemed unavailable during this time; and
- accessible to Perth airport or any other port deemed appropriate within a period of 48 hours.

The following key items of equipment will be available during standby with a minimum number identified as available to meet the requirements of the incident phase:

- satellite phone or mobile phone;
- marine Very High Frequency (VHF) or Ultra High Frequency (UHF) radios;
- camera;
- Emergency Position-Indicating Radio Beacon (EPIRB); and
- safety equipment (i.e. personal protection equipment).

Additional units will be sourced from external suppliers where necessary.

9.4 Response

From the point at which an incident is declared, the monitoring response provider(s) will be deemed to be in the response phase. The declaration of an incident will occur from the Incident Commander to the monitoring response provider(s) via the VOGA ICT-MC communications channel. All subsequent communications during the response phase will proceed through this channel unless other arrangements are agreed.

The monitoring field teams will sit under the operations function of the VOGA ICT, as such the Operations Chief and Logistics Chief (in liaison with the MC and monitoring Operations Officer) will be responsible for the organisation of survey logistics; this includes flights, vessel hire, helicopter/fixed wing hire, accommodation and messing. The monitoring service provider(s) will be responsible for ensuring personnel are able to access the Perth Airport, or another location deemed suitable by the ICT and the monitoring response provider(s).

Scopes will be issued within 24 hours of the initiation trigger. Time to mobilisation to ground, specified within the scope will be between 48-72 hours, depending on the nature of the scope. Post-incident/pre-mobilisation planning will include:

- review of appropriate methodology;
- acquisition of any OM data detailing spill trajectory and sensitive receptors at risk;
- determination of monitoring priorities; and
- resources required and where monitoring should initially occur.

A suitable duration for each rotation or survey of monitoring will be determined in conjunction with the chosen monitoring response provider(s).

9.5 Stand down

There are a number of possibilities for stand down depending on events during the standby period. In the absence of an incident, the OM and SM response provider(s) will stand down at the completion of well construction operations. Following an incident, the time at which stand down commences will be declared by the MC upon direction from the Incident Commander. SM will continue until the termination criteria are reached.

Once well construction operations have ceased in the absence of an incident, the monitoring response provider(s) will stand down from the standby phase and complete a lessons learnt review with VOGA.

After standing down, it is the responsibility of the MC to run a lessons-learnt meeting between VOGA, the monitoring response provider(s) and other appropriate stakeholders. Multiple lessons learnt meetings will occur should a response phase be required. It is the responsibility of the MC to ensure that lessons learnt are communicated to the relevant stakeholder groups. The lessons discussed should include both positive actions to be reinforced and lessons for actions that could be improved in future standby or response campaigns.

10 Resourcing and capability

10.1 Resourcing

Specific scientific personnel and equipment required for monitoring will be supplied by technical specialists engaged to undertake specific tactics within OMPs and/or SMPs. Potential providers based on existing contracts with VOGA are listed in Table 10-1.

Table 10-1: Monitoring potential providers

Provider	Capability	Contact	Activation
Astron	Scientific Monitoring. Various monitoring scopes as identified within the SMPs.	[redacted]	As per VOGA service agreement.
BTM Oceanica	Scientific Monitoring. Various monitoring scopes as identified within the SMPs.	[redacted]	As per VOGA service agreement with Astron.
Laboratories (i.e. ChemCentre, NMI)	Operational and Scientific Monitoring. Environmental chemistry, emergency response, analytical chemistry and forensic science.	[redacted]	Engaged via Astron.
Landgate	OM Satellite Synthetic Aperture Radar (SAR). Can provide satellite images for emergency response in approximately 14 hours depending on where the satellites are in orbit. Can provide images at a resolution of 500km down to 5m.	[redacted]	Account created. Activated by the VOGA User Representative Contact.
Murdoch University Perth Zoo Massey University Pilbara vets	Operational & Scientific Monitoring.	[redacted]	Through DBCA/AMOSC as per the WA OWRP and Pilbara OWRP.

Provider	Capability	Contact	Activation
RPS APASA	3D plume trajectory modelling.	[redacted]	As per 'Client Instructions - How to Activate Spill Modelling Response Procedures with RPS APASA and Interpret Subsequent Results'.
UWA Marine Ecology Group	Scientific Monitoring. Various monitoring scopes as identified within the SMPs.	[redacted]	Engaged via Astron.
Curtin University Ecotoxicology Group	Scientific Monitoring. Various monitoring scopes as identified within the SMPs.	[redacted]	Engaged via Astron.

10.1.1 Minimum resources

Table 10-2 details the OSMPs that may required for the first 48 hours, 5 days, 10 days and 20 days, based on analysis of OSTM and environmental sensitivities for a worst case scenario.

Resources required for beyond 20 days are planned for in the IAP process of the response for operational monitoring and the monitoring planning coordinator for the scientific monitoring. VOGA's response capability provides for a minimum of 20 days response activities.

Table 10-3 lists the initial and ongoing resources required for each operational and scientific monitoring program. These are minimum requirements for planning purposes that will be reassessed in an actual spill response.

Table 10-2: Operational and scientific monitoring resources timing

Resources for planning purposes within 48 hours	Resources for planning purposes within first 5 days	Resources for planning purposes within first 10 days	Resources for planning purposes within first 20 days
OMP1 – Spill surveillance and tracking; and OMP2 – Hydrocarbon characterisation and weathering.	Information generated from OMP1 & 2 will trigger the next phase. E.g. if impact to sensitivities are predicted within 96 hrs then the OMPs would be initiated prior to real time impact predictions. Resources can be available onsite for use within 72 hours if required. OMP3 – Fish tainting OMP4 – Oil in the water column OMP5 – Oil encounter rate OMP6 – Shoreline assessment OMP7 – Oil in sediments OMP8 – Wildlife	Results from OMPs are continuously integrated into the IAP process for the next operational period and are re-designed/re-allocated as required given the specifics of the actual spill scenario. SMPs are triggered as appropriate	OMPs will be terminated when the: relevant SMPs have been initiated (if triggered) and results transferred as appropriate; or OMP is no longer contributing to or influencing spill response decision making as per the OSMP.

Table 10-3: Minimum OSMP resource requirements

OMP/SMP	Minimum Resources Required		
	Resources	Team Composition & Competency	Personnel Numbers
OMP1 – Spill surveillance and tracking	External trained aerial observers; RPS; and Landgate (Satellite imagery – SAR).	N/A	N/A
OMP2 – Hydrocarbon characterisation and weathering	BMT Oceanica with Astron support; and ChemCentre.	Field assessment team with experience in surface water sampling, minimum 3 people per team	2 teams = 6
OMP3 - Fish tainting	BMT Oceanica with Astron support.	Field assessment team with experience in collection of pelagic and benthic fish species, minimum 3 people per team	1 team = 3

OMP/SMP	Minimum Resources Required		
	Resources	**Team Composition & Competency**	**Personnel Numbers**
OMP4 – Oil in the water column	BMT Oceanica with Astron support; and RPS APASA (3D Plume Trajectory Modelling).	Field assessment team with experience in water sampling, minimum 3 people per team	2 teams = 6 Can be run concurrently with OMP7 (same team utilised)
OMP5 – Oil encounter rate	Not applicable. Operational monitoring activities to be undertaken utilising resources identified in the OSCP for the relevant response strategies.	N/A	N/A
OMP6 – Shoreline assessment	BMT Oceanica with Astron support State Response Team (DoT) AMOSC Core Group	Field assessment team with experience in shoreline sampling, minimum 3 people per team	2 teams = 6 Can be run concurrently with OMP8 (same team utilised)
OMP7 – Oil in Sediments	BMT Oceanica with Astron support	Field assessment team with experience in shoreline sediment sampling, minimum 3 people per team	2 teams = 6 Can be run concurrently with OMP4 (same team utilised)
OMP8 – Wildlife	Astron; BMT Oceanica; and DBCA Wildlife handlers.	Refer to Sections 4.2, 4.3 and 5 of the WAOWRP. Refer to Sections 3 and 4 of Pilbara Region OWRP.	6 x 2 teams = 12 ≥1 x turtle experience ≥1 x marine mammal experience ≥1 x aerial survey experience ≥1 x seabird/shorebird experience Can be run concurrently with OMP6 (same team utilised)
SMP1 – Sediment quality	BMT Oceanica with Astron support.	Field assessment team, minimum 3 people per team including: • scientist with experience in deep sea sediment sampling • scientist with infauna identification capacity	2 teams = 6 Can be run concurrently with SMP2 (same team utilised)

OMP/SMP	Minimum Resources Required		
	Resources	**Team Composition & Competency**	**Personnel Numbers**
SMP2 – Water quality	BMT Oceanica with Astron support.	Field assessment team with experience in water sampling, minimum 3 people per team	2 teams = 6
SMP3 – Coral reef communities	BMT Oceanica	Field assessment team, minimum 3 people per team including: • divers, ROV operators or towed video operators • senior marine scientist with experience in coral reef communities	2 teams = 6 Can be run concurrently with SMP5 (same team utilised)
SMP4 – Mangrove communities	Astron; and Landgate (satellite imagery).	Field assessment team, minimum 2 people per team including senior scientist with experience in mangrove condition assessment	2 teams = 4
SMP5 – Macroalgae and seagrasses	BMT Oceanica	Field assessment team, minimum 3 people per team including: • divers, ROV operators or towed video operators • senior marine scientist with experience in benthic habitats	2 teams = 6 Can be run concurrently with SMP5 (same team utilised)
SMP6 – Subtidal soft-bottom communities	BMT Oceanica	Field assessment team, minimum 3 people per team including: • senior marine scientist with experience in subtidal soft-bottom communities • divers, ROV operators or towed video operators	2 teams = 6
SMP7 – Intertidal sand and mudflat communities	BMT Oceanica	Field assessment team, minimum 2 people per team including senior scientist with experience in shoreline macroinvertebrates	2 teams = 4 Can be run concurrently with SMP8 (same team utilised)

OMP/SMP	Minimum Resources Required		
	Resources	**Team Composition & Competency**	**Personnel Numbers**
SMP8 – Rocky shore/intertidal reef platform communities	BMT Oceanica	Field assessment team, minimum 2 people per team including senior scientist with experience in shoreline macroinvertebrates	2 teams = 4 Can be run concurrently with SMP8 (same team utilised)
SMP9 – Turtles	Astron; BMT Oceanica; and Personnel with pathology or veterinary skills – Murdoch University, Perth Zoo or Pilbara OWRP resource list.	Field assessment team, minimum 6 people per team including: **Aerial survey** Experienced aerial survey observers x 2 **Vessel-based survey** Experienced vessel survey observers x 2 Personnel with pathology or veterinary skills x 1 **On-ground survey** Field assessment team x minimum 2 people per team.	2 x aerial survey observers 2 x vessel survey observers 2 x 1 team (on-ground) = 6 Can be run concurrently with SMP10 allowing 2 teams of 4 for vessel and aerial surveys
SMP10 – Marine Mammals	Astron; BMT Oceanica; and Personnel with pathology or veterinary skills – Murdoch University, Perth Zoo or Pilbara OWRP resource list.	**Aerial survey** Trained marine mammal observer (MMO) x 1; Experienced aerial survey observer x 1. **Vessel-based survey** Trained marine mammal observer x 1; Experienced vessel survey observer x 1; Personnel with pathology or veterinary skills x 1.	2 x aerial survey observers (≥1 x trained MMO) 2 x Vessel survey observers(≥1 x trained MMO) = 4 Can be run concurrently with SMP9 allowing 2 teams of 4 for vessel and aerial surveys
SMP11 – Seabirds and shorebirds	Astron BMT Oceanica UWA Marine Ecology Group	Field assessment team, minimum 2 people per team including: • experienced ornithologist/ seabird biologist • personnel with pathology or veterinary skills	2 teams = 4

OMP/SMP	Minimum Resources Required		
	Resources	**Team Composition & Competency**	**Personnel Numbers**
SMP12 - Invertebrates	BMT Oceanica	Field assessment team, minimum 3 people per team including: • senior marine scientist with experience in invertebrate identification • divers, ROV operators or towed video operators	2 teams = 6
SMP13 – Finfish	Astron BMT Oceanica Murdoch University	Field assessment team, minimum 2 people per team including: • scientist trained in fish identification and necropsy • marine scientist with ROV/BRUV operation experience.	1 team = 2 Can be run concurrently with SMP14.
SMP14 – Fisheries and aquaculture	Astron BMT Oceanica Murdoch University; UWA Marine Ecology Group; Curtin University Ecotoxicology Group	Field assessment team, minimum 2 people per team including: • scientist trained in fish identification and necropsy • marine scientist with ROV/BRUV operation experience.	1 team = 2 Can be run concurrently with SMP13.
SMP15 - Heritage	BMT Oceanica	Field assessment team, minimum 4 people per team including divers, ROV operators or towed video operators • 2 x senior scientists with deep sea experience • 2 x environmental scientists with deep sea experience	1 team = 4

10.2 Logistics and capability management

The Wandoo Field OSCP [WAN-2000-RD-0001] and the Oil Spill Response Capability Review [VOG-7000-RH-0009] describe the resources that have been identified for oil spill response activities, and providers with whom VOGA has established contracts or agreements. These resources will be accessed to provide monitoring teams with transport, accommodation and catering.

The VOGA Emergency Response Logistics Management Plan [VOG-7000-RH-0008] contains outputs from the identification of resources required and the scope of works/services required to deliver those resources. It is maintained as live document based on the resources identified and the Contractor Scope of Works in the Oil Spill Response Capability Review [VOG-7000-RH-0009].

10.3 Assurance activities

The two key performance and assurance activities for the OSMP are:

- exercises; and
- inspections and audits.

These activities are detailed in Section 8.4 of the overarching Wandoo Field Oil Spill Contingency Plan – Planning and Preparedness (WAN-2000-RD-0001.01) and associated Emergency Response Schedule (VOG-1100-YH-0001).

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Surman, C.A., and Nicholson, L.W. (2008). 'Monitoring of annual variation in seabird breeding colonies throughout the Lowendal Group of islands: 2008 Annual Report', unpublished report to Apache Energy Ltd. by Halfmoon Biosciences.

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APPENDICES

Appendix A: Baseline data

Table A-1: Summary of current and target states and available baseline/monitoring data for identified high biodiversity values within the EMBA. Target states are described in terms of relevant environmental disturbance regimes

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
Sediment quality – OMP7/ SMP1	Dampier Archipelago *Background quality is high, generally undisturbed and uncontaminated*	*Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change from background levels, as a result of human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area:* Maintained in a natural state, except for designated areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Woodside Energy Ltd 2015, Chemical and Ecological Monitoring of Mermaid Sound (ChEMMS), Dampier Peninsula - 1985 to 2015, unpublished data Department of Environment and Conservation (DEC) 2006a, Background Quality of the Marine Sediments of the Pilbara Coast, Marine Technical Report Series, No. MTR 1. Department of Environment and Conservation, Perth. WorleyParsons 2011, Dampier Marine Services Facility Assessment on Proponent Information, report to the Environmental Protection Authority. Appendix 9, WorleyParsons 2011. MScience 2007, Dampier Port Authority: DCW Capital Dredging: Sediment Quality. Unpublished report to the Dampier Port Authority, Dampier, WA MScience 2004, Dampier Harbour Port Upgrade – Extended Dredging Program: Sediment Quality Assessment; MSA17R3. Unpublished report to Hamersley Iron Pty Ltd, Perth	Woodside DBCA Dampier Port Authority Dampier Port Authority Dampier Port Authority
	Barrow Island *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Chevron Australia Pty Ltd 2011, Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline. Chevron Australia Pty Ltd 2016, Gorgon Gas Development Marine Environmental Quality Management Plan 2016. Chevron Australia Pty Ltd 2011, Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Offshore Feed Gas Pipeline and the Marine Component of the Crossing, Chevron Australia, Perth.	Chevron Chevron Chevron DBCA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Department of Environment and Conservation (DEC) 2006a, Background Quality of the Marine Sediments of the Pilbara Coast, Marine Technical Report Series, No. MTR 1. Department of Environment and Conservation, Perth.	
	Montebello Islands *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Astron Environmental Services 2012, Montebello Islands Pre-well Construction Survey, unpublished report to Vermilion Oil & Gas (Australia) Pty Ltd. Bancroft K, Field S, Evans R, Shedrawi G 2011, Sediment quality. In KP Bancroft (ed), Western Australian Marine Monitoring Program: annual marine protected area condition pressure response report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Islands Marine Management Area annual report, 2011, Department of Environment and Conservation, Kensington, WA. Department of Environment and Conservation (DEC) 2006a, Background Quality of the Marine Sediments of the Pilbara Coast, Marine Technical Report Series, No. MTR 1. Department of Environment and Conservation, Perth.	Astron/VOGA DBCA DBCA
	Lowendal Islands *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Department of Environment and Conservation (DEC) 2006a, Background Quality of the Marine Sediments of the Pilbara Coast, Marine Technical Report Series, No. MTR 1. Department of Environment and Conservation, Perth.	DBCA
Water quality – OMP4/ SMP2	Dampier Archipelago *Pristine, localised disturbance*	*Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change from background levels, as a result of human activities.	Wenziker K McAlpine K, Apte S and Masini R 2006, Background Quality for Coastal Marine Waters of the North West Shelf, Western Australia, Final Technical Report, CSIRO and DoE, Canberra	CSIRO DBCA Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Department of Parks and Wildlife, 2015, Pluto LNG Environmental Offset D Program – Research and Monitoring in the Proposed Dampier Marine Reserves, Annual Report, Department of Parks and Wildlife, Perth. Woodside Energy Ltd 2015, Chemical and Ecological Monitoring of Mermaid Sound (ChEMMS), Dampier Peninsula - 1985 to 2015, unpublished data Pilbara Ports Authority 2018, Marine Water Quality, unpublished data.(Mermaid Sound)	Pilbara Ports Authority
	Barrow Island *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Chevron Australia Pty Ltd 2011, Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline.C Styan, T Elsdon, M Marnane, M Carey, C Morgan, T Rouphael, P de Lestang 2013, Knowledge gained from marine environmental monitoring during dredging at Barrow Island, in APPEA Journal and Conference Proceedings, Transforming Our Energy Future, Brisbane Queensland 26-29 May 2013.	Chevron Chevron
	Montebello Islands *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Montebello Islands Pre-well Construction Survey for VOGA. Wenziker K McAlpine K, Apte S and Masini R 2006, Background Quality for Coastal Marine Waters of the North West Shelf, Western Australia, Final Technical Report, CSIRO and DoE, Canberra	Astron (VOGA)* CSIRO
	Lowendal Islands *Pristine, localised disturbance*	*Sanctuary and recreation zones:* No change from background levels, as a result of human activity.	Wenziker K McAlpine K, Apte S and Masini R 2006, Background Quality for Coastal Marine Waters of the North West Shelf, Western Australia, Final Technical Report, CSIRO and DoE, Canberra	CSIRO

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area: No change from background levels, except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% (by area) of these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		
Coral reef communities – OMP4/ SMP3	Dampier Archipelago *Good condition with only limited disturbance evident from human activities.*	1. No loss of coral diversity as a result of human activity in the proposed reserves. 2. The abundance targets for coral reef communities will be as noted below. *Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area:* No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Armstrong, SJ 2009, Assessing the effectiveness of sanctuary zones in the proposed Dampier Archipelago Marine Park: Data collected during the 2007 survey, Department of Environment and Conservation, Perth. Blakeway, DR and Radford, B 2005, 'Scleractinian Corals of the Dampier Port and Inner Mermaid Sound: species list, community composition and distributional data', in JA. Stoddart and SE. Stoddart (eds), Corals of the Dampier Harbour: Their Survival and Reproduction During the Dredging Programs of 2004, MScience Pty Ltd, Perth. Stoddart, J. A., Grey, K. A., Blakeway, D. R., & Stoddart, S. E. (2004). Rapid high-precision monitoring of coral communities to support reactive management of dredging in Mermaid Sound, Dampier, Western Australia. Corals of the Dampier Harbour: Their Survival and Reproduction During the Dredging Programs of, 31-48. Morrison, PF 2004, 'A general description of the subtidal habitats of the Dampier Archipelago, Western Australia', Records of the Western Australian Museum Supplement, vol. 66, pp. 51-59. URS 2003, Review of Coral Surveillance Monitoring for the ChEMMS Programme. Unpublished report to Woodside. Pluto LNG Development: Final Report on Coral and Water Monitoring [Mscience report 2010	DBCA MScience Author Jacobs (SKM) Woodside Woodside Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Woodside Energy Ltd - Dredging and Post Dredge: Coral Health and Water Quality Monitoring, Dampier - 2007 to 2010	
	Barrow Island *Undisturbed, good condition*	1. No loss of coral reef community diversity as a result of human activity. 2. The abundance targets for coral reef communities will be: *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Richards ZT & Rosser NL 2012, 'Abundance, distribution and new records of scleractinian corals at Barrow Island and Southern Montebello Islands, Pilbara (Offshore) Bioregion', Journal of the Royal Society of Western Australia, vol. 95, pp. 155-165. Chevron Australia 2013, Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report, Year 2: 2012-2013. C Styan, T Elsdon, M Marnane, M Carey, C Morgan, T Rouphael, P de Lestang 2013, Knowledge gained from marine environmental monitoring during dredging at Barrow Island, APPEA Journal and Conference Proceedings, Transforming our energy future, Brisbane Queensland 26-29 May 2013. Bancroft, KP 2009, Establishing long-term coral community monitoring sites in the Montebello/ Barrow Islands marine protected areas: data collected in December 2006, Marine Science Program Data Report Series MSPDR4, Department of Environment and Conservation, Perth. RPS Bowman Bishaw Gorham 2005, Gorgon Development on barrow Island technical report: intertidal habitats, Technical Appendix C9, unpublished report to ChevronTexaco Australia pty Ltd, Perth.	WAM/RPS Chevron Chevron DBCA Chevron
	Montebello Islands *Undisturbed, good condition*	1. No loss of coral reef community diversity as a result of human activity. 2. The abundance targets for coral reef communities will be: *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the	Bancroft KP 2009, Establishing long-term coral community monitoring sites in the Montebello/Barrow Islands marine protected areas: Data collected in December 2006. Marine Science Program Data Report Series MSPDR4 January 2009. Marine Science Program, Science Division, Departmentof Environment and Conservation, Perth, Western Australia. 68p.	DBCA WAM

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Western Australian Museum (1993) A Survey of the Marine Fauna and Habitats of the Montebello Islands. Berry, P.F. (ed). A report to the Department of Conservation and Land Management by the Western Australian Museum, Perth.	
	Lowendal Islands *Undisturbed*	1. No loss of coral reef community diversity as a result of human activity. 2. The abundance targets for coral reef communities will be: *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft KP 2009, Establishing long-term coral community monitoring sites in the Montebello/Barrow Islands marine protected areas: Data collected in December 2006. Marine Science Program Data Report Series MSPDR4 January 2009. Marine Science Program, Science Division, Departmentof Environment and Conservation, Perth, Western Australia. 68p. Western Australian Museum (1993) A Survey of the Marine Fauna and Habitats of the Montebello Islands. Berry, P.F. (ed). A report to the Department of Conservation and Land Management by the Western Australian Museum, Perth.	DBCA WAM

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
Mangrove communities – OMP6/ SMP4	Dampier Archipelago *Extensive losses of mangroves in the Dampier area due to industrial activities. However, the remaining mangroves in the proposed reserves are generally in a pristine condition apart from some localised disturbances due to human activities.*	1. No loss of mangrove diversity as a result of human activity in the proposed reserves. 2. The abundance targets for mangrove communities will be as noted below. *Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Landsat, Worldview 2/3 Satellite imagery (mangrove health) Biota Environmental Sciences and, Dampier Solar Salt Field Mangrove Monitoring, unpublished data to Rio Tinto, Perth. Astron Environmental Services 2007, Mangrove Condition and Rehabilitation Monitoring King Bay, Burrup Peninsula, Annual Report - July 2007, Annual Environmental Compliance Report 2007. Unpublished report to Mermaid Marine Australia Ltd. SKM 2012, Mangrove Monitoring Program Report. Rev 1. 12 July 2012 [Appendix D, Upgrade of Marine Services Facility, King Bay, Dampier Ministerial Statement No. 535 2011-12 Annual Compliance and Mermaid Marine Australia (2012); Associated to MAS535] 2006-2012 Performance Review July 2012, unpublished report to Mermaid Marine Australia Ltd. Aecom 2010, Mangrove Condition and Rehabilitation Monitoring Report, Appendix H, Annual Environmental Compliance Report 2009 - 2010, unpublished report to Mermaid Marine Limited. Aecom 2009, Mangrove Condition and Rehabilitation Monitoring Report 2008, Appendix H, Annual Environmental Complaince Report 2009, unpublished report to Mermaid Marine Pty Ltd Woodside Energy Ltd 2015, Chemical and Ecological Monitoring of Mermaid Sound (ChEMMS), Dampier Peninsula - 1985 to 2015, unpublished data, Woodside Energy Ltd, Perth	Astron Dampier Salt Mermaid Marine Mermaid Marine Mermaid Marine Mermaid Marine Woodside
	Barrow Island *Undisturbed with localised disturbance*	1. No loss of mangrove community diversity as a result of human activity in the reserves. 2. The abundance targets for mangrove communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity.	Landsat, Worldview 2/3 Satellite imagery (mangrove health) Astron Environmental Services 2014, Barrow Island Post-development mangrove survey Gorgon Gas	Astron Chevron DBCA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Development, unpublished report for Chevron Australia (+ Other consultants) Bancroft KP 2013, 'Mangrove communities', in K.P. Bancroft (ed), Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013, Department of Parks and Wildlife, Kensington, WA. pp. 71–101.	
	Montebello Islands *Undisturbed with localised disturbance*	1. No loss of mangrove community diversity as a result of human activity in the reserves. 2. The abundance targets for mangrove communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Landsat, Worldview 2/3 Satellite imagery (mangrove health) Astron Environmental Services 2012, Montebello Islands Pre-well Construction Survey, unpublished report to Vermilion Oil & Gas (Australia) Pty Ltd. Bancroft KP 2013, 'Mangrove communities', in K.P. Bancroft (ed), Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013, Department of Parks and Wildlife, Kensington, WA. pp. 71–101.	Astron Astron/VOGA Chevron
	Lowendal Islands *Undisturbed, good condition*	1. No loss of mangrove community diversity as a result of human activity in the reserves. 2. The abundance targets for mangrove communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones.	Landsat, Worldview 2/3 Satellite imagery (mangrove health) V&C Semeniuk Research Group 1999, Summary report. Mangroves of the Lowendal Islands and Monte Bello Islands incorporating: 1. Results of survey July 1997, 2. Baseline survey for the islands, 3. Assessment of monitoring statistics. Unpublished report to Apache Energy Ltd.	Astron Quadrant

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		Unzoned areas of the marine management area: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		
Macroalgal and seagrass communities – OMP6/ SMP5	Dampier Archipelago *Generally undisturbed, some localised disturbances due to human activity.*	1. No loss of macro algal and seagrass diversity as a result of human activity in the proposed reserves. 2. The abundance targets for macro algal and seagrass communities will be as noted below. *Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Morrison, PF 2004, 'A general description of the subtidal habitats of the Dampier Archipelago, Western Australia', Records of the Western Australian Museum Supplement, vol. 66, pp. 51-59. WorleyParsons 2009, Dampier Marine Services Facility Benthic Habitat Report, report to the Environmental Protection Authority, Perth Comparison of the Dampier Port Fringing Reef Benthic Community with Nearby Reef Areas [Report to the Dampier Port Authority] [Macrogalgae and seagrass communities] Woodside Energy Ltd 2008, Pluto Development: Habitat Mapping of Mermaid Sound, Airborne Hyperspectral Survey - 2007 to 2008, unpublished data.	Author Worley Parsons PPA Woodside
	Barrow Island *Generally undisturbed*	1. No loss of macro algal and seagrass community diversity as a result of human activity in the reserves. 2. The abundance targets for macro algal and seagrass communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft K, Field S, Evans R, Shedrawi G (2011). Seagrass communities. In KP Bancroft (ed), Western Australian Marine Monitoring Program: annual marine protected area condition pressure response report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Islands Marine Management Area annual report, 2011. Department of Environment and Conservation, Kensington, WA. pp. 52–58	Chevron

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
	Montebello Islands *Generally undisturbed*	1. No loss of macro algal and seagrass community diversity as a result of human activity in the reserves. 2. The abundance targets for macro algal and seagrass communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft K, Field S, Evans R, Shedrawi G (2011). Seagrass communities. In KP Bancroft (ed), Western Australian Marine Monitoring Program: annual marine protected area condition pressure response report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Islands Marine Management Area annual report, 2011. Department of Environment and Conservation, Kensington, WA. pp. 52–58	Chevron
	Lowendal Islands *Generally undisturbed*	1. No loss of macro algal and seagrass community diversity as a result of human activity in the reserves. 2. The abundance targets for macro algal and seagrass communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Quadrant Energy 2011, Macroalgae Monitoring - Lowendal Islands - 2001 - 2011, unpublished data.	Quadrant
Subtidal soft-bottomed communities – SMP6	Dampier Archipelago *Generally undisturbed*	1. No loss of subtidal soft-bottom community diversity as a result of human activity in the proposed reserves. 2. The abundance targets for subtidal soft-bottom communities will be as noted below.	SKM (2008). Pluto LNG Project - Baseline Marine Habitat Survey. Report Prepared in Accordance with the requirements of Ministerial Condition 6-11 of the Pluto Ministerial Statement. Poore, G. C., Avery, L., Błażewicz-Paszkowycz, M., Browne, J., Bruce, N. L., Gerken, S., ... & Syme, A. (2015). Invertebrate diversity of the unexplored	SKM/Jacobs Author Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	marine western margin of Australia: taxonomy and implications for global biodiversity. Marine Biodiversity, 45(2), 271-286. Woodside Energy Ltd - North West Shelf Baseline Marine Survey, Infauna and Sediment Quality – 2006	
	Barrow Island *Generally undisturbed with localised disturbance*	*Sanctuary and recreation zones*: No change, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and the conservation area of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% of the total area of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft KP (2013). Soft sediment communities. In *Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013* (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 126–127 Poore, G. C., Avery, L., Błażewicz-Paszkowycz, M., Browne, J., Bruce, N. L., Gerken, S., ... & Syme, A. (2015). Invertebrate diversity of the unexplored marine western margin of Australia: taxonomy and implications for global biodiversity. Marine Biodiversity, 45(2), 271-286. Woodside Energy Ltd - North West Shelf Baseline Marine Survey, Infauna and Sediment Quality – 2006 Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline 2015	DBCA Author Woodside Chevron
	Montebello Islands	*Sanctuary and recreation zones*: No change, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and the conservation*	Bancroft KP (2013). Soft sediment communities. In *Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park,*	DBCA Author Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
	Generally undisturbed with localised disturbance	*area of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% of the total area of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	*Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013* (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 126–127 Poore, G. C., Avery, L., Błażewicz-Paszkowycz, M., Browne, J., Bruce, N. L., Gerken, S., ... & Syme, A. (2015). Invertebrate diversity of the unexplored marine western margin of Australia: taxonomy and implications for global biodiversity. Marine Biodiversity, 45(2), 271-286. Woodside Energy Ltd - North West Shelf Baseline Marine Survey, Infauna and Sediment Quality – 2006 Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline 2015	Chevron
	Lowendal Islands *Generally undisturbed with localised disturbance*	*Sanctuary and recreation zones*: No change, as a result of human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and the conservation area of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% of the total area of these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft KP (2013). Soft sediment communities. In *Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013* (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 126–127 Poore, G. C., Avery, L., Błażewicz-Paszkowycz, M., Browne, J., Bruce, N. L., Gerken, S., ... & Syme, A. (2015). Invertebrate diversity of the unexplored marine western margin of Australia: taxonomy and implications for global biodiversity. Marine Biodiversity, 45(2), 271-286. Woodside Energy Ltd - North West Shelf Baseline Marine Survey, Infauna and Sediment Quality – 2006 Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline 2015	DBCA Author Woodside Chevron

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
Intertidal sand and mudflat communities – OMP6/ SMP7	Dampier Archipelago *Generally undisturbed, localised disturbance*	1. No loss of intertidal sand and mudflat community (including samphire community) diversity as a result of human activity in the proposed reserves. 2. The abundance targets for intertidal sand and mudflat communities (including samphire communities) will be as noted below. *Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Kohn, A. J. (2003). Infaunal invertebrates of an intertidal sand flat, Dampier, Western Australia. In Proceedings of the Eleventh International Marine Biological Workshop: The Marine Flora and Fauna of Dampier, Western Australia, Western Australian Museum, Perth (pp. 109-130). Woodside Energy Ltd - Chemical and Ecological Monitoring of Mermaid Sound (ChEMMS), Dampier Peninsula - 1985 to 2015.	Author Woodside
	Barrow Island *Undisturbed, localised disturbance*	1. No loss of intertidal sand/mudflat community diversity as a result of human activity in the reserves. 2. The abundance targets for intertidal sand/mudflat communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft KP (2013). Intertidal sand/mudflat communities. In Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013 (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 124–125 RPS Bowman Bishaw Gorham 2005, Gorgon Development on barrow Island technical report: intertidal habitats, Technical Appendix C9, prepared for ChevronTexaco Australia pty Ltd, report No: R03211	DBCA Chevron
	Montebello Islands *Undisturbed, localised disturbance*	1. No loss of intertidal sand/mudflat community diversity as a result of human activity in the reserves. 2. The abundance targets for intertidal sand/mudflat communities will be as noted below.	Bancroft KP (2013). Intertidal sand/mudflat communities. In Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report:	DBCA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		Sanctuary and recreation zones: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013 (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 124–125	
	Lowendal Islands *Undisturbed, localised disturbance*	1. No loss of intertidal sand/mudflat community diversity as a result of human activity in the reserves. 2. The abundance targets for intertidal sand/mudflat communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft KP (2013). Intertidal sand/mudflat communities. In Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013 (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 124–125	DBCA
Rocky shore communities - OMP6/ SMP8	Dampier Archipelago *Generally undisturbed*	1. No loss of rocky shore community (including intertidal reef platform) diversity as a result of human activity in the proposed reserves. 2. The abundance targets for rocky shore communities (including intertidal reef platforms) will be as noted below. *Sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones*: No change due to human activities. *General use, special purpose (multiple use) and special purpose (pearling or aquaculture) zones of the marine park and conservation areas of the marine management area*: No change except in areas approved by the appropriate	Woodside Energy Ltd - Chemical and Ecological Monitoring of Mermaid Sound (ChEMMS), Dampier Peninsula - 1985 to 2015.	Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Commercial (aquaculture) areas and unzoned areas of the marine management area*: Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		
	Barrow Island *Undisturbed*	1. No loss of rocky shore/intertidal reef platform community diversity as a result of human activity in the reserves. 2. The abundance targets for rocky shore/intertidal reef platform communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft, KP 2009, Establishing long-term coral community monitoring sites in the Montebello/ Barrow Islands marine protected areas: data collected in December 2006, Marine Science Program Data Report Series MSPDR4, Department of Environment and Conservation, Perth. RPS Bowman Bishaw Gorham 2005, Gorgon Development on barrow Island technical report: intertidal habitats, Technical Appendix C9, prepared for ChevronTexaco Australia pty Ltd, report No: R03208	DBCA Chevron
	Montebello Islands *Undisturbed*	1. No loss of rocky shore/intertidal reef platform community diversity as a result of human activity in the reserves. 2. The abundance targets for rocky shore/intertidal reef platform communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft, KP 2009, Establishing long-term coral community monitoring sites in the Montebello/ Barrow Islands marine protected areas: data collected in December 2006, Marine Science Program Data Report Series MSPDR4, Department of Environment and Conservation, Perth	DBCA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
	Lowendal Islands *Undisturbed*	1. No loss of rocky shore/intertidal reef platform community diversity as a result of human activity in the reserves. 2. The abundance targets for rocky shore/intertidal reef platform communities will be as noted below. *Sanctuary and recreation zones*: No change due to human activity. *General use, special purpose (benthic protection) and special purpose (pearling) zones of the Montebello Islands Marine Park and conservation areas of the marine management area*: No change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% (by area) of this habitat in these zones. *Unzoned areas of the marine management area:* Maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.	Bancroft, KP 2009, Establishing long-term coral community monitoring sites in the Montebello/ Barrow Islands marine protected areas: data collected in December 2006, Marine Science Program Data Report Series MSPDR4, Department of Environment and Conservation, Perth	DBCA
Turtles – OMP8/ SMP9	Dampier Archipelago *Populations are probably stable in the proposed reserves*	1. No loss of turtle diversity as a result of human activity in the proposed reserves. 2. No loss in turtle abundance as a result of human activity in the proposed reserves.	Rosemary Island Hawksbill Turtle Tagging Program Flatback Turtle Program on Delambre Island	DBCA DBCA
	Barrow Island *Stable population, however trends are unclear*	1. No loss of turtle diversity as a result of human activity in the reserves. 2. No loss of turtle abundance as a result of human activity in the reserves.	Chevron Australia Pty Ltd (Chevron) 2014, 'Gorgon Gas Development and Jansz Feed Gas Pipeline: Long-term Marine Turtle Management Plan', Chevron Australia, Perth.	Chevron
	Montebello Islands *Stable population, however trends are unclear*	1. No loss of turtle diversity as a result of human activity in the reserves. 2. No loss of turtle abundance as a result of human activity in the reserves.	Pendoley Environmental 2012, 'Marine turtle distribution in the Balla Balla and Wider Pilbara Region of Western Australia', unpublished report to Forge Resources Ltd. Astron Environmental Services (Astron) 2012, 'Montebello Islands Pre-well Construction Survey', unpublished report to Vermilion Oil & Gas (Australia) Pty Ltd.	Pendoley VOGA
	Lowendal Islands	1. No loss of turtle diversity as a result of human activity in the reserves. 2. No loss of turtle abundance as a result of human activity in the reserves.	Astron Environmental Services (Astron) 2006, 'Reindeer Project: Turtle Nest Survey at 40 Mile Beach', unpublished report to Apache Energy Limited.	Quadrant

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
	Stable population, however trends are unclear			
Marine mammals – OMP8/ SMP10	Dampier Archipelago *Population of cetaceans in the proposed reserves is generally undisturbed; the population status of dugongs in the proposed reserves is unknown*	1. No loss of marine mammal diversity as a result of human activity in the proposed reserves. 2. No loss of marine mammal abundance as a result of human activity in the proposed reserves.	Jenner KCS, Jenner MNM and McCauley RD (2010) A description of megafauna distribution and abundance in the SW Pilbara using aerial and acoustic surveys - Final Report. Perth, Western Australia. Unpublished report for URS Pty Ltd Jenner KCS, Jenner MNM and McCabe KA (2001) Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. APPEA Journal 2001 Jenner, C. and Jenner, M. (2010). Field Report: A description of Humpback Whale and other Mega fauna Distribution and Abundance in the Western Pilbara Using Aerial surveys - 2009/2010. Supporting document 9.1, Apendix 1 Anketell Point Port Development Proposal Public. D Allen, S. J., Cagnazzi, D. D., Hodgson, A. J., Loneragan, N. R., & Bejder, L. (2012). Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. Pacific Conservation Biology, 18(1), 56. Woodside Energy Ltd (2015). Baseline Marine Megafauna Survey, Dampier Peninsula - 2009 to 2012. VOGA Metadata Report 2018.	URS Author Author Murdoch Woodside
	Barrow Island *Dugong population unknown. Cetacean population stable*	1. No loss of marine mammal diversity as a result of human activity in the reserves. 2. No loss in marine mammal abundance as a result of human activity in the reserves.	Jenner KCS, Jenner MNM and McCauley RD (2010) A description of megafauna distribution and abundance in the SW Pilbara using aerial and acoustic surveys - Final Report. Perth, Western Australia. Unpublished report for URS Pty Ltd Jenner KCS, Jenner MNM and McCabe KA (2001) Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. APPEA Journal 2001	URS Author Author Murdoch Chevron

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Jenner, C. and Jenner, M. (2010). Field Report: A description of Humpback Whale and other Mega fauna Distribution and Abundance in the Western Pilbara Using Aerial surveys - 2009/2010. Supporting document 9.1, Apendix 1 Anketell Point Port Development Proposal Public. D Allen, S. J., Cagnazzi, D. D., Hodgson, A. J., Loneragan, N. R., & Bejder, L. (2012). Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. Pacific Conservation Biology, 18(1), 56. Chevron Australia Pty Ltd (Chevron) 2014, 'Wheatstone Project. Dugong Research Plan', Chevron Australia, Perth.	
	Montebello Islands *Dugong population unknown. Cetacean population stable*	1. No loss of marine mammal diversity as a result of human activity in the reserves. 2. No loss in marine mammal abundance as a result of human activity in the reserves.	Jenner KCS, Jenner MNM and McCauley RD (2010) A description of megafauna distribution and abundance in the SW Pilbara using aerial and acoustic surveys - Final Report. Perth, Western Australia. Unpublished report for URS Pty Ltd Jenner KCS, Jenner MNM and McCabe KA (2001) Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. APPEA Journal 2001 Jenner, C. and Jenner, M. (2010). Field Report: A description of Humpback Whale and other Mega fauna Distribution and Abundance in the Western Pilbara Using Aerial surveys - 2009/2010. Supporting document 9.1, Apendix 1 Anketell Point Port Development Proposal Public. D Allen, S. J., Cagnazzi, D. D., Hodgson, A. J., Loneragan, N. R., & Bejder, L. (2012). Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. Pacific Conservation Biology, 18(1), 56.	URS Author Author Murdoch DBCA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Raudino, H., Hunt, T., & Waples, K. (2018). Records of Australian humpback dolphins (Sousa sahulensis) form an offshore island group in Western Australia	
	Lowendal Islands *Dugong population unknown. Cetacean population stable*	1. No loss of marine mammal diversity as a result of human activity in the reserves. 2. No loss in marine mammal abundance as a result of human activity in the reserves.	Jenner KCS, Jenner MNM and McCauley RD (2010) A description of megafauna distribution and abundance in the SW Pilbara using aerial and acoustic surveys - Final Report. Perth, Western Australia. Unpublished report for URS Pty Ltd Jenner KCS, Jenner MNM and McCabe KA (2001) Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. APPEA Journal 2001 Jenner, C. and Jenner, M. (2010). Field Report: A description of Humpback Whale and other Mega fauna Distribution and Abundance in the Western Pilbara Using Aerial surveys - 2009/2010. Supporting document 9.1, Apendix 1 Anketell Point Port Development Proposal Public. D Allen, S. J., Cagnazzi, D. D., Hodgson, A. J., Loneragan, N. R., & Bejder, L. (2012). Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. Pacific Conservation Biology, 18(1), 56.	URS Author Author Murdoch
Seabirds and shorebirds – OMP8/ SMP11	Dampier Archipelago – Rosemary Island *Probably stable population*	1. No loss of seabird and shorebird diversity as a result of human activity in the proposed reserves. 2. No loss of seabird and shorebird abundance as a result of human activity in the proposed reserves.	Shorebirds 2020 Program - Australia's National Shorebird Monitoring Program https://birdata.com.au/about_atlas.vm Dunlop, J. N. (2017) Sentinel Seabirds: A Guide to Using Marine Birds to Monitor Marine Ecosystems. Northern Agricultural Catchment Council, Geradlton.	Birdlife Australia Birdlife Australia Northern Agricultural Catchment Council Inc.
	Barrow Island	1. No loss of seabird and shorebird diversity as a result of human activity in the reserves.	Shorebirds 2020 Program - Australia's National Shorebird Monitoring Program	Birdlife Australia

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
	Stable population	2. No loss of seabird and shorebird abundance as a result of human activity in the reserves.	https://birdata.com.au/about_atlas.vm Dunlop, J. N. (2017) Sentinel Seabirds: A Guide to Using Marine Birds to Monitor Marine Ecosystems. Northern Agricultural Catchment Council, Geradlton. Gorgon Gas Development and Jansz Gas Pipeline: Five-year Environmental Performance Report (August 2010 - August 2015) Bancroft KP (2013). Seabirds, shorebirds and migratory waders. In Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013 (ed KP Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 157–160 Astron 2014 Wheatstone Project. Barrow Island Shorebird Survey Baseline Update, unpublished report for Chevron Australia Pty Ltd.	Birdlife Australia Northern Agricultural Catchment Council Inc. Chevron DBCA Chevron
	Montebello Islands *Stable population*	1. No loss of seabird and shorebird diversity as a result of human activity in the reserves. 2. No loss of seabird and shorebird abundance as a result of human activity in the reserves.	Shorebirds 2020 Program - Australia's National Shorebird Monitoring Program https://birdata.com.au/about_atlas.vm Dunlop, J. N. (2017) Sentinel Seabirds: A Guide to Using Marine Birds to Monitor Marine Ecosystems. Northern Agricultural Catchment Council, Geradlton. Gorgon Gas Development and Jansz Gas Pipeline: Five-year Environmental Performance Report (August 2010 - August 2015) Bancroft KP (2013). Seabirds, shorebirds and migratory waders. In Western Australian Marine Monitoring Program: annual marine protected area biodiversity assets and social values report: Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area, 2012-2013 (ed KP	Birdlife Australia Birdlife Australia Northern Agricultural Catchment Council Inc. Chevron DBCA Astron/VOGA

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Bancroft). Department of Parks and Wildlife, Kensington, WA. pp. 157–160 Astron Environmental Services (Astron) 2012, 'Montebello Islands Pre-well Construction Survey', unpublished report to Vermilion Oil & Gas (Australia) Pty Ltd.	
	Lowendal Islands *Stable population*	1. No loss of seabird and shorebird diversity as a result of human activity in the reserves. 2. No loss of seabird and shorebird abundance as a result of human activity in the reserves.	Shorebirds 2020 Program - Australia's National Shorebird Monitoring Program https://birdata.com.au/about_atlas.vm Dunlop, J. N. (2017) Sentinel Seabirds: A Guide to Using Marine Birds to Monitor Marine Ecosystems. Northern Agricultural Catchment Council, Geradlton. Astron 2018 Quadrant Environmental Monitoring Program - Varanus and Airlie Islands Seabird Monitoring Annual Report 2017/18 Astron 2018 Quadrant Environmental Monitoring Program - Varanus and Airlie Islands Shearwater Monitoring Annual Report 2017/18	Birdlife Australia Birdlife Australia Northern Agricultural Catchment Council Inc. Quadrant Quadrant
Finfishes – OMP3/ SMP13/ SMP14	Dampier Archipelago *Undisturbed, some localised impacts on selected site-attached species.*	No loss of finfish abundance in the sanctuary zones of the marine park and conservation areas (flora/fauna protection) in the marine management area as a result of human activity within the proposed reserves (short-term). 1. No loss of finfish diversity as a result of human activity in the proposed reserves. 2. No loss of protected finfish species abundance as a result of human activities in the proposed reserves. 3. Abundance and size composition of finfish species in sanctuary zones of the marine park and conservation areas (flora/fauna protection) in the marine management area to be at natural levels. 4. Management targets for abundance of target finfish species in all other areas to be determined by the DoF in consultation with CALM and stakeholders.	State of the Fisheries Reports provides fisheries summary. Travers MJ, Potter IC, Clarke KR, Newman SJ and Hutchins JB 2010, The inshore fish faunas over soft substrates and reefs on the tropical west coast of Australia differ and change with latitude and bioregion. Journal of Biogeography 2010, 37, 148-169 Caputi, N., de Lestang, S., Hart, A., Kangas, M., Johnston, D. & Penn, J. 2014. Catch Predictions in Stock Assessment and Management of Invertebrate Fisheries Using Pre-Recruit Abundance - Case Studies From Western Australia. Reviews in Fisheries Science & Aquaculture, 22 (1), pg: 36-54 Caputi, N., Feng, M., Pearce, A., Benthuysen, J., Denham, A., Hetzel, Y., Matear, R., Jackson, G., Molony, B., Joll, L. & Chandrapavan, A. 2014.	DOF (Annual) Murdoch U., UWA, Dept of Fisheries DOF DOF DOF DOF DOF DBCA DBCA Woodside

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Management implications of climate change effect on fisheries in Western Australia, Part 1: Environmental change and risk assesssment. Department of Fisheries, Perth WA Bellchambers, L. M., How, J., Evans, S., Pember, M., de Lestang, S. and Caputi, N. 2017. Resource Assessment Report Western Rock Lobster Enviornmental Resources of Western Australia. Department of Fisheries, Perth WA Gaughan, D.J. and Santoro, K. (eds). 2018. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries. Department of Primary Industries and Regional Development, Western Australia. Armstrong, SJ 2009, Assessing the effectiveness of sanctuary zones in the proposed Dampier Archipelago Marine Park: Data collected during the 2007 survey, Department of Environment and Conservation, Perth. Armstrong SJ 2008, Assessing the effectiveness of sanctuary zones in the proposed Dampier Archipelago Marine Park. Marine Science Program Data Report Series: MSPDR6. December 2008. Marine Science Program, Department of Environment and Conservation, Perth, Western Australia. 17p. SKM 2008, Pluto LNG - Baseline Marine Habitat Survey, unpublished report to Woodside Energy. Prepared in Accordance with Requirements of Ministerial Condition 6-11 of the Pluto Ministerial Statement, Rev 1, 21 November 2008	
	Barrow Island *Stable population, localised impact on some species*	No loss of finfish species abundance in the sanctuary zones in the marine parks as a result of human activity within the reserves (short-term). 1. No loss of finfish diversity as a result of human activity in the reserves. 2. No loss in protected finfish species abundance as a result of human activity in the reserves.	State of the Fisheries Reports provides fisheries summary. Travers MJ, Potter IC, Clarke KR, Newman SJ and Hutchins JB 2010, The inshore fish faunas over soft substrates and reefs on the tropical west coast of	DOF (Annual) Murdoch U., UWA, Dept of Fisheries DOF

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		3. Abundance and size composition of finfish species in sanctuary zones of the marine parks to be at natural levels. 4. Management targets for abundance of targeted finfish species in all other areas to be determined in consultation with Department of Fisheries and peak bodies.	Australia differ and change with latitude and bioregion. Journal of Biogeography 2010, 37, 148-169 Caputi, N., de Lestang, S., Hart, A., Kangas, M., Johnston, D. & Penn, J. 2014. Catch Predictions in Stock Assessment and Management of Invertebrate Fisheries Using Pre-Recruit Abundance - Case Studies From Western Australia. Reviews in Fisheries Science & Aquaculture, 22 (1), pg: 36-54 Caputi, N., Feng, M., Pearce, A., Benthuysen, J., Denham, A., Hetzel, Y., Matear, R., Jackson, G., Molony, B., Joll, L. & Chandrapavan, A. 2014. Management implications of climate change effect on fisheries in Western Australia, Part 1: Environmental change and risk assesssment. Department of Fisheries, Perth WA Bellchambers, L. M., How, J., Evans, S., Pember, M., de Lestang, S. and Caputi, N. 2017. Resource Assessment Report Western Rock Lobster Enviornmental Resources of Western Australia. Department of Fisheries, Perth WA Gaughan, D.J. and Santoro, K. (eds). 2018. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries. Department of Primary Industries and Regional Development, Western Australia. Chevron Australia Pty Ltd 2011, Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Offshore Feed Gas Pipeline System and the Marine Component of the Shore Crossing. Chevron Australia Pty Ltd 2014, Gorgon Gas Development and Jansz Feed Gas Pipeline Post-Development Coastal and Marine State and Environmental Impact Report: Year 2: 2012-2013.	DOF DOF DOF DOF Chevron Chevron DBCA Chevron Chevron Chevron Chevron

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Fitzpatrick B, Bancroft KP, Shedrawi G 2010, Gorgon dredging monitoring program April 2010 field survey: Fish community, benthic community and pressure field monitoring. MSP Metatdatta Report July 2010. Marine Science Program, Department of Environment and Conservation, Perth, Western Australia. 11p. Field S, Shedrawi G, Evans R 2011, Effects of the Gorgon dredging program on selected aspects of the marine biodiversity of the Montebello Barrow Island MPAs. Unpublished abstract. 48th Australian Marine Sciences Association Conference, Fremantle, 3-7 July, 2011. Mscience 2015, Post development dredge monitoring for Chevron, unpublished data to Chevron. Bond T, Harvey, E, Birt, M, Saunders, B, Driessen, D, Fullwood, L 2013, Barrow Island Post Dredge Survey 2011, unpublished report produced by The University of Western Australia for Chevron. Bond T, Harvey, E, Birt, M, Saunders, B, Driessen, D, Fullwood, L 2013, Barrow Island Post Dredge Survey 2012, unpublished report produced by The University of Western Australia for Chevron.	
	Montebello Islands *Stable population, localised impact on some species*	No loss of finfish species abundance in the sanctuary zones in the marine parks as a result of human activity within the reserves (short-term). 1. No loss of finfish diversity as a result of human activity in the reserves. 2. No loss in protected finfish species abundance as a result of human activity in the reserves. 3. Abundance and size composition of finfish species in sanctuary zones of the marine parks to be at natural levels. 4. Management targets for abundance of targeted finfish species in all other areas to be determined in consultation with Department of Fisheries and peak bodies.	State of the Fisheries Reports provides fisheries summary. Travers MJ, Potter IC, Clarke KR, Newman SJ and Hutchins JB 2010, The inshore fish faunas over soft substrates and reefs on the tropical west coast of Australia differ and change with latitude and bioregion. Journal of Biogeography 2010, 37, 148-169 Caputi, N., de Lestang, S., Hart, A., Kangas, M., Johnston, D. & Penn, J. 2014. Catch Predictions in Stock Assessment and Management of Invertebrate Fisheries Using Pre-Recruit Abundance - Case Studies From Western Australia. Reviews in Fisheries Science & Aquaculture, 22 (1), pg: 36-54	DOF (Annual) Murdoch U., UWA, Dept of Fisheries DOF DOF DOF DOF DOF

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			Caputi, N., Feng, M., Pearce, A., Benthuysen, J., Denham, A., Hetzel, Y., Matear, R., Jackson, G., Molony, B., Joll, L. & Chandrapavan, A. 2014. Management implications of climate change effect on fisheries in Western Australia, Part 1: Environmental change and risk assesssment. Department of Fisheries, Perth WA Bellchambers, L. M., How, J., Evans, S., Pember, M., de Lestang, S. and Caputi, N. 2017. Resource Assessment Report Western Rock Lobster Enviornmental Resources of Western Australia. Department of Fisheries, Perth WA Gaughan, D.J. and Santoro, K. (eds). 2018. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries. Department of Primary Industries and Regional Development, Western Australia.	
	Lowendal Islands *Stable population, localised impact on some species*	No loss of finfish species abundance in the sanctuary zones in the marine parks as a result of human activity within the reserves (short-term). 1. No loss of finfish diversity as a result of human activity in the reserves. 2. No loss in protected finfish species abundance as a result of human activity in the reserves. 3. Abundance and size composition of finfish species in sanctuary zones of the marine parks to be at natural levels. 4. Management targets for abundance of targeted finfish species in all other areas to be determined in consultation with Department of Fisheries and peak bodies.	State of the Fisheries Reports provides fisheries summary. Travers MJ, Potter IC, Clarke KR, Newman SJ and Hutchins JB 2010, The inshore fish faunas over soft substrates and reefs on the tropical west coast of Australia differ and change with latitude and bioregion. Journal of Biogeography 2010, 37, 148-169 Caputi, N., de Lestang, S., Hart, A., Kangas, M., Johnston, D. & Penn, J. 2014. Catch Predictions in Stock Assessment and Management of Invertebrate Fisheries Using Pre-Recruit Abundance - Case Studies From Western Australia. Reviews in Fisheries Science & Aquaculture, 22 (1), pg: 36-54 Caputi, N., Feng, M., Pearce, A., Benthuysen, J., Denham, A., Hetzel, Y., Matear, R., Jackson, G., Molony, B., Joll, L. & Chandrapavan, A. 2014. Management implications of climate change effect on fisheries in Western Australia, Part 1: Environmental	DOF (Annual) Murdoch U., UWA, Dept of Fisheries DOF DOF DOF DOF DOF

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
			change and risk assesssment. Department of Fisheries, Perth WA Bellchambers, L. M., How, J., Evans, S., Pember, M., de Lestang, S. and Caputi, N. 2017. Resource Assessment Report Western Rock Lobster Enviornmental Resources of Western Australia. Department of Fisheries, Perth WA Gaughan, D.J. and Santoro, K. (eds). 2018. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries. Department of Primary Industries and Regional Development, Western Australia.	
Invertebrates – OMP4/ SMP12	Dampier Archipelago *Undisturbed*	No loss of invertebrate abundance in the sanctuary zones of the marine park and conservation areas (flora/fauna protection) in the marine management area as a result of human activity within the proposed reserves. 1. No loss of invertebrate diversity as a result of human activity in the proposed reserves. 2. No loss of protected invertebrate species abundance as a result of human activities in the proposed reserves. 3. Abundance and size composition of invertebrate species in sanctuary zones of the marine park and conservation areas (flora/fauna protection) in the marine management area to be at natural levels. 4. Management targets for abundance of target invertebrate species in all other areas to be determined by the DoF in consultation with CALM and stakeholders.	Marsh, LM and Morrison, SM 2004, 'Echinoderms of the Dampier Archipelago, Western Australia', Records of the Western Australian Museum Supplement, vol. 66, pp. 293-342. Sinclair Knight Merz 2006, Pluto LNG Development Offshore Marine Environmental Survey.	Department of Aquatic Zoology (Marine Invertebrates) Western Australian Museum Woodside
	Barrow Island *Stable population*	No loss of invertebrate species abundance in the sanctuary zones in the marine parks and in the conservation area in the marine management area as a result of human activity in the reserves (short-term). 1. No loss of invertebrate diversity as a result of human activity in the reserves. 2. No loss in protected invertebrate species abundance as a result of human activity in the reserves.	Chevron Australia Pty Ltd (Chevron) 2011, 'Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Offshore Feed Gas Pipeline System and the Marine Component of the Shore Crossing', Chevron Australia, Perth. Chevron Australia 2013 'Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline	Chevron Chevron Chevron Chevron

Ecological value	Current state	Target state	Baseline monitoring	Source/*data custodian
		3. Abundance and size composition of invertebrate species in sanctuary zones of the marine parks and the conservation area in the marine management area to be at natural levels. 4. Management targets for abundance of targeted invertebrate species in all other areas to be determined in consultation with DoF and peak bodies.	State and Environmental Impact Report, Year 2: 2012-2013. Chevron Australia. 2014. Gorgon Gas Development and Jansz Feed Gas Pipeline: Post- Development Coastal and Marine State and Environmental Impact Survey Report: Offshore feed gas pipeline systems and marine component of the shore crossing, Year 1: 2013. Chevron Australia Pty Ltd, Perth, Western Australia Gorgon Gas Development and Jansz Feed Gas Pipeline Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline 2015	
	Montebello Islands *Stable population*	No loss of invertebrate species abundance in the sanctuary zones in the marine parks and in the conservation area in the marine management area as a result of human activity in the reserves (short-term). 1. No loss of invertebrate diversity as a result of human activity in the reserves. 2. No loss in protected invertebrate species abundance as a result of human activity in the reserves. 3. Abundance and size composition of invertebrate species in sanctuary zones of the marine parks and the conservation area in the marine management area to be at natural levels. 4. Management targets for abundance of targeted invertebrate species in all other areas to be determined in consultation with DoF and peak bodies.	Nil	
	Lowendal Islands *Stable population*	No loss of invertebrate species abundance in the sanctuary zones in the marine parks and in the conservation area in the marine management area as a result of human activity in the reserves (short-term). 1. No loss of invertebrate diversity as a result of human activity in the reserves. 2. No loss in protected invertebrate species abundance as a result of human activity in the reserves. 3. Abundance and size composition of invertebrate species in sanctuary zones of the marine parks and the conservation area in the marine management area to be at natural levels. 4. Management targets for abundance of targeted invertebrate species in all other areas to be determined in consultation with DoF and peak bodies.	Quadrant Energy - Macroalgae Monitoring - Lowendal Islands - 2001 - 2011	Quadrant

Appendix B:

Data analysis and environmental report cards

Data analysis and environmental report cards

The OSMP includes an appropriate strategy for reporting and communicating findings to relevant audiences. Environmental report cards are the central to the strategy for data interpretation, communication and decision making.

Environmental report cards are designed to provide managers with a readily interpretable summary of the state of a range of environmental variables. They summarise environmental and biodiversity monitoring information, allowing trends in condition (states of the environment) to be easily identified. They inform incident response decisions based on changes to trend and condition and provide a clear consensus for management decisions.

Environmental report cards are increasingly recognised as important tools for compiling, summarising and reporting on environmental and biodiversity states for a range of different ecosystems and scales (Dennison *et al.,* 2007; Burgman *et al.,* 2012).

Environmental report cards provide several positive reporting outcomes:

- Provide a template or structure for summarising and communicating trends in biodiversity and environmental values;
- Communicate trends in values to managers and regulators in a simple, easy to interpret format;
- Indicate the effectiveness of incident responses;
- Allow a consensus interpretation of the data; and
- Provide an indication of the quality or reliability of the data.

Appropriate management responses to environmental report cards are reliant on environment information of sufficient quality and design. These attributes require robust assessment.

Environmental report card elements

Report cards summarise complex data in a readily interpretable manner, to support adaptive management decisions and allow and evaluation of management effectiveness (Stem et al. 2005, Hockings et al. 2006). Information is reduced in terms of text, or numbers, with an emphasis on visual display: colours, arrows and possibly codes. Each report card should represents a suite of related environmental variables and their most recent state (Figure C-1). Environmental report cards should include several features:

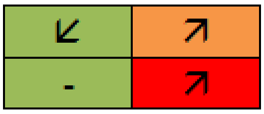
"Dashboard lights"

Trigger	
(red)	Impact
(orange)	Threat
(green)	No impact or threat
(grey)	Not measured

Colour gradients are employed to indicate the state (condition) of each environmental variable, and may indicate a suggested management response (i.e. following a traffic light scheme: green – proceed as normal, red – management intervention is required and amber – caution, continue monitoring). These should be based on defined trigger levels, which may be quantitative, semi-quantitative and/or based on expert knowledge (e.g. DAFWA, 2013). Quantitative approaches include control charts, in which current observations are compared to a preferred baseline, or other statistical tests which compare observations to a pre-impact state and/or un-impacted control sites (Burgman 2005; Burgman *et al.,* 2012; Gove *et al.,* 2013).

Recent trends

Recent trends, which can indicate the response to management intervention are indicated by series of arrows (for instance, a variable may be in a poor state, but improving). These will often be the main indicator to qualify short-term response effectiveness.



Data quality

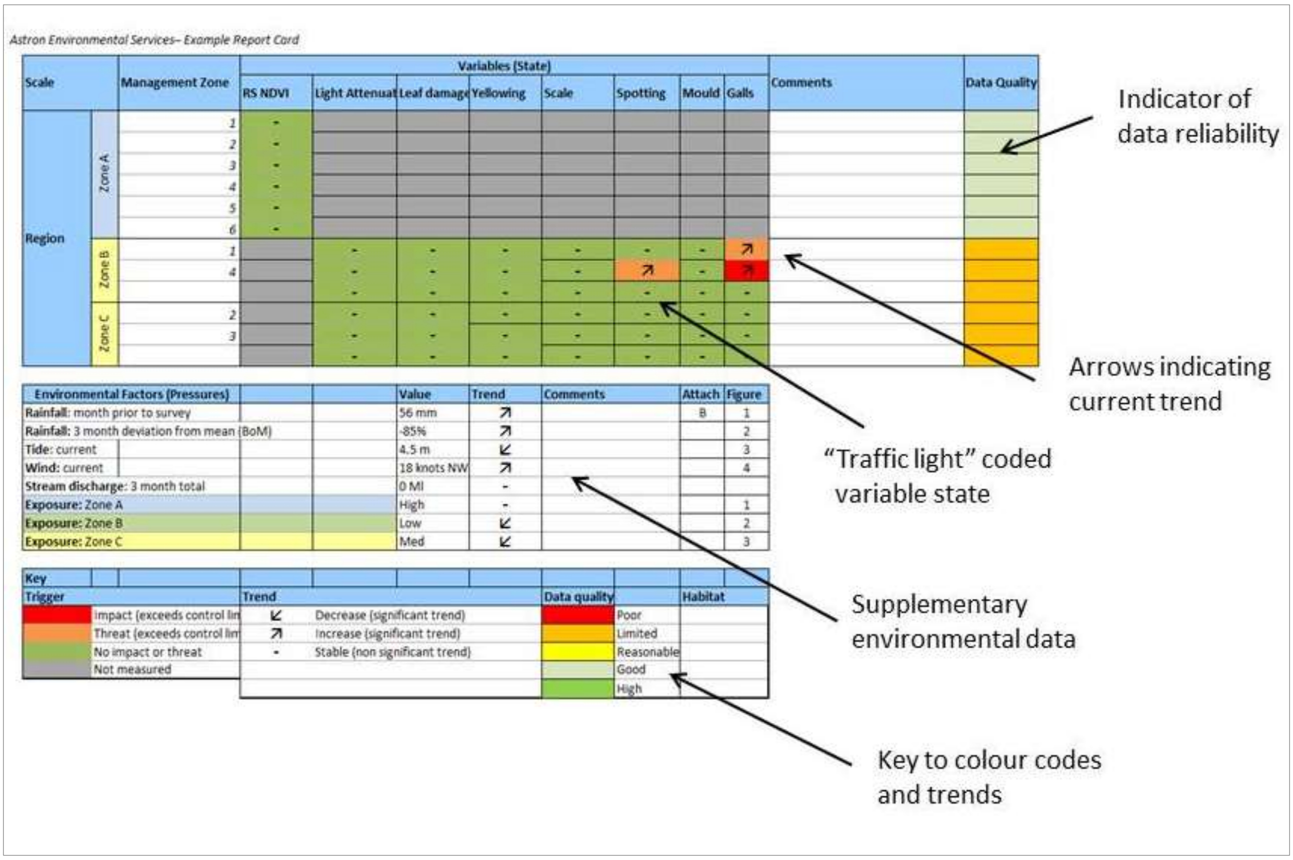
Data quality will vary amongst environmental variables, and it is necessary to provide some indication as to the reliability or confidence in the trends demonstrated. This indicator weight the interpretation of current state and recent trends in the data. A metric for quantifying data quality is necessary.

Data quality	
(red)	Poor
(orange)	Limited
(yellow)	Reasonable
(pale green)	Good
(green)	High

Other information

Management responses based on information provided in report cards will be contingent on other variables, including weather and sea conditions. Up to date displays of such environmental variables, provided by agencies such as the Bureau of Meteorology, would be included (Figure C-1).

Figure C-1: Example environmental report card, highlighting the important elements, including current state and trend, and an indicator of data quality



In the case of the VOGA environmental report card scheme, the focus of each report will be a single Scientific Monitoring receptor and includes all variables monitored, within all locations considered. Early in an incident response the environmental report card will be a series of linked spread sheet tabs: the data, a series of analyses which include tests determining whether an impact is detected, and the report card itself summarising the observed environmental states. The analyses are usually performed in external software and links between the various elements are performed manually.

In the event of an incident, a fully mature information system will navigate these folders, incorporate new data from these folders into the information system, and automatically update the report card elements to be viewed online via a web-interface. Part of the automated process will include a set of the agreed checks which determine the quality and reliability of the data. Once new data are incorporated, a pre-defined set of statistical and analytical methods can be applied to the data. An established set of rules and methodologies determines whether an environmental state has exceeded tolerable baseline levels (Burgman, 2005; Burgman *et al.,* 2012; Gove *et al.,* 2013). As elsewhere, these rules may incorporate expert opinion or be data driven, such as a control chart plot exceeding a two standard deviation control limit, or a rejected null hypothesis test within a BACI monitoring framework.

The mechanism by which environmental monitoring data is managed and reported during an incident is an important consideration. The delivery of a report card is best facilitated through a centralised information platform, where information from different sources can be synthesised into the one end product via an efficient and governed workflow. A further step in the development of the system is to project the data onto a spatially explicit platform, which allows full navigation, and the ability to “drill down” through data layers. Astron has developed a prototype spatially explicit web-based platform for this purpose. This allows the user to identify spatial data housed within the information system and then rapidly access this information. As the information platform is centralised, then environmental report cards can be easily revised and updated as new information is captured and ingested into the information system.

Data analysis

According to NOPSEMA (2014), the SM program design “must allow the impacts from the spill and response activities to be measured and to be separated from natural variation occurring in the environment”. Due to their unplanned and accidental nature, hydrocarbon spills represent particular challenges in terms of statistical design and analysis (Skalski, 1995). True replication and randomization are generally limited. Unpredictably also precludes an ideal set of baseline at anticipated control and impact sites. However, the spatially fixed nature of an oil platform and oil spill trajectory modelling allows for some planning for likely baseline, impact and control data, but still with the proviso that any spill will largely be unpredictable before its initiation. It is in this environment that monitoring designs and analysis call for creative, flexible, pragmatic yet justifiable and reliable approach.

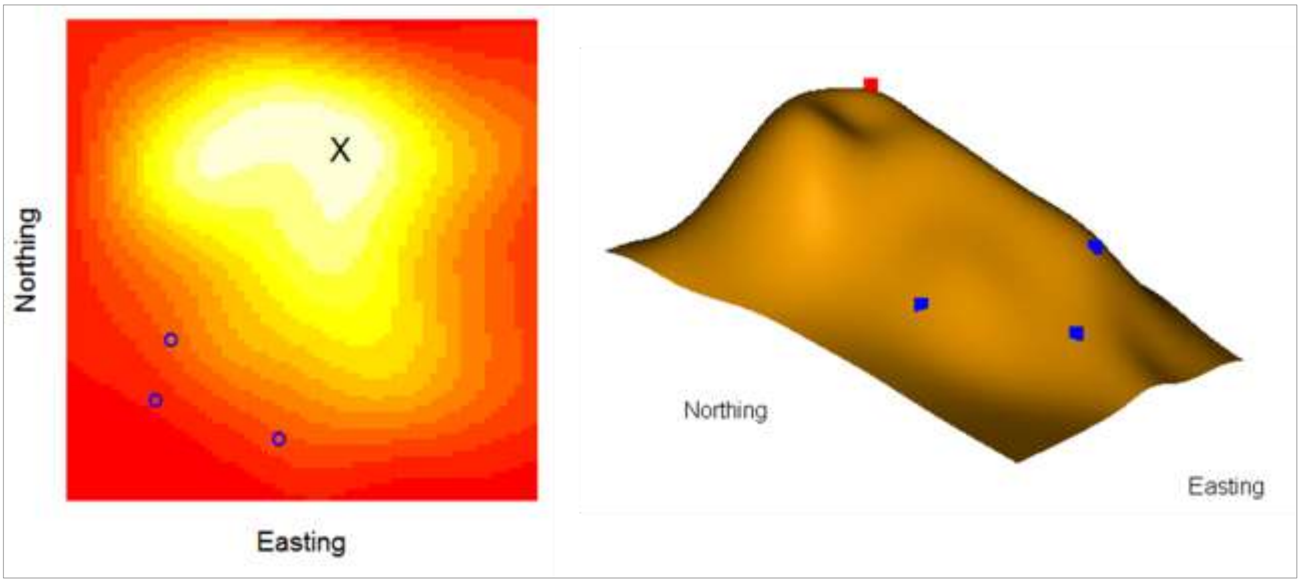
Ideally, monitoring and analysis would incorporate the most comprehensive set of spatial and temporal variation possible. Incorporating both spatial and temporal data allows for a broad range of statistical and graphical approaches, such as generalised additive mixed models and control charts. For simplicity three separate methodologies which are used to detect environmental change, while accounting for natural variation in the environment are described. But ideally, these approaches are integrated to optimize clarity, statistical power and robustness. Precise approach will depend upon the variation in sites available and the availability and duration of the baseline data collected. Three approaches are described below. Gradient analysis focusses on the spatial component, Control Charts focus on the temporal component, while BACI designs are the simplest of the more sophisticated spatio-temporal designs.

Gradient analysis

The most rudimentary of impact monitoring, generally focussing on the spatial component of post-spill impact is the gradient sampling design (Ellis and Schneider, 1997). This approach was used to quantify hydrocarbon effects of the Montara oil spill on fish health (Gagnon and Rawson, 2011). Sites are sampled at varying distances from the source of disturbance (e.g. the emission point of an oil spill). The gradient sampling design is used to detect the extent of impact, and to understand how the intensity of a disturbance determines the degree of impact (assuming that the disturbance is of lower intensity the further away it is from its original point source). Analysis of data from the gradient sampling design is generally regression analysis, but can incorporate a range of analytical approaches including Generalised Additive Models which allow greater flexibility (Figure C-2).

The advantage of gradient analysis is that it can be established post-spill. The disadvantage is that the spill is not randomly located and its location may be confounded with underlying environmental variables. This is best dealt with by incorporating environmental covariates into the statistical model.

Figure C-2: An example of gradient analysis, including a fitted Generalised Additive Model in three dimensions. The relationship is between a hydrocarbon concentration and distance from source ("X" or red dot)



Statistical control charts

Statistical control charts are a "means of displaying monitoring information in simple, practical and scientifically credible ways…" (Burgman *et al.,* 2012) and are increasingly applied to environmental monitoring and to identify significant environmental change (Anderson and Thompson 2004; Gove *et al.,* 2013; Stringell *et al.,* 2013). Control charts are produced using data collected over a series of time steps. Control limits are determined from an initial 'reference' period and are a function of the variation around the long-term mean of the recorded data. In terms of oil spill monitoring, this would usually be a period prior to a disturbance event. Once a disturbance has occurred, if a measurement exceeds the control limits, then a significant impact of disturbance is indicated. Control charts are monitored until the variable of interest returns to within the control limits.

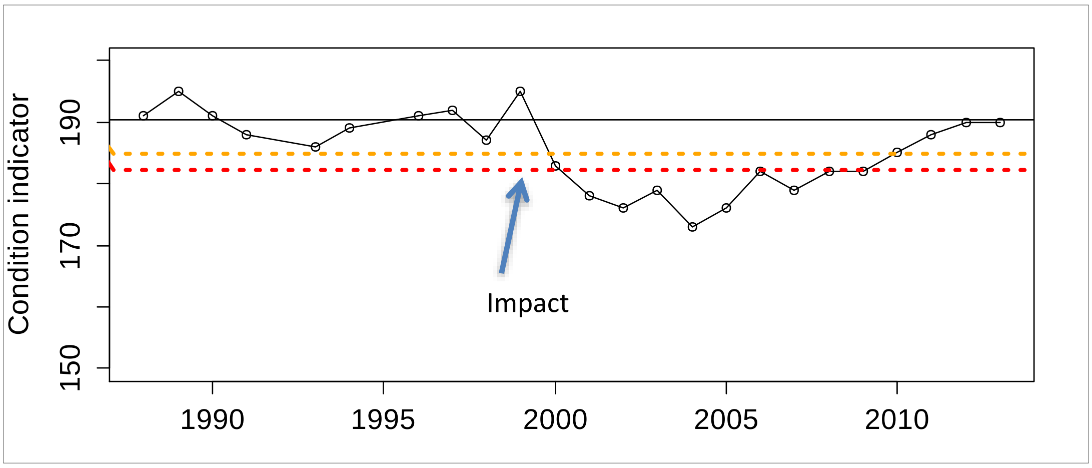
In terms of current ongoing monitoring programs, these data serve as baseline data, used to populate control charts. Based on this data, control limits are estimated, and further post spill data are incorporated as it becomes available in order to quantify environmental impact. To increase strength of inference control charts should be created for each treatment (impacted and non-impacted). In particular, control charts provide implicit termination criteria for SM by indicating when the variable of interest has returned to reasonable and tolerable values.

A particular advantage of statistical control charts is their ability to account for natural variation through time, and hence significant temporal changes in biological communities may be detected even when monitoring has been conducted at only one site. The critical requirement for statistical control charts is that at any given site, there is a sufficiently long reference period to capture the full extent of natural variation in biological communities at that site. There should also not be increasing or decreasing trends in the variable of interest in the reference period. If no pre-spill baseline data is available, alternative approaches include deriving control limits from a knowledge of the biological system or pre-determined thresholds (see below). The following sections summarise three variations of control charts, each appropriate for a particular type of data.

Univariate control charts

When one wishes to analyse one variable at a time, a univariate control chart may be used (Montgomery, 2007; Gove *et al.,* 2013). Examples of such variables are total percentage cover of coral in a transect, percentage cover of mangrove in a transect or remotely sensed image, or the number of breeding pairs of a species of seabird (Figure C-3).

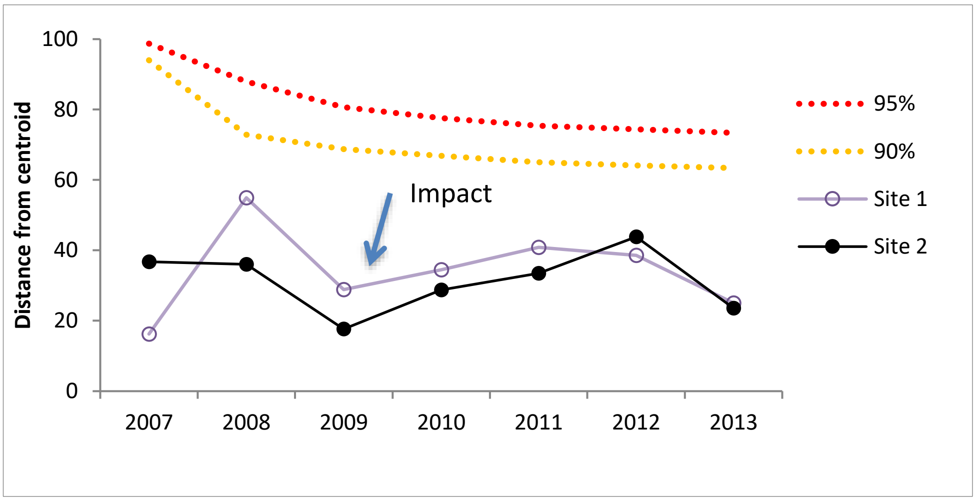
Figure C-3: An example of univariate statistical control chart, changes in an indicator of habitat condition. The solid dark line represents the long-term mean of the condition indicator. The dotted yellow line represents the mean – 2 SD, and the dotted red line, mean – 3 SD. Following a disturbance in 1999, the initial control limit was breached, and in 2001, the final control limit was breached. The indicator recovered to pre-impact levels in 2010



Multivariate control charts

Multivariate control charts are used to examine changes in the whole species assemblage rather than a single species (Anderson and Thompson, 2004) (Figure C-4).

Figure C-4: A multivariate control chart, demonstrating changes in the composition of a bird assemblage at two sites. No large changes in the breeding bird composition can be detected at any of the two sites studied, hence in an environmental report card, this value would appear as a green light. The results represent a summary of temporal change in the composition of breeding birds at each site. The value on the *y*-axis (i.e. distance from centroid) represents the change from the previous years. For example, the value for 2007 is the change from 2006. The value for 2008 is the change from the mean of 2006 and 2007

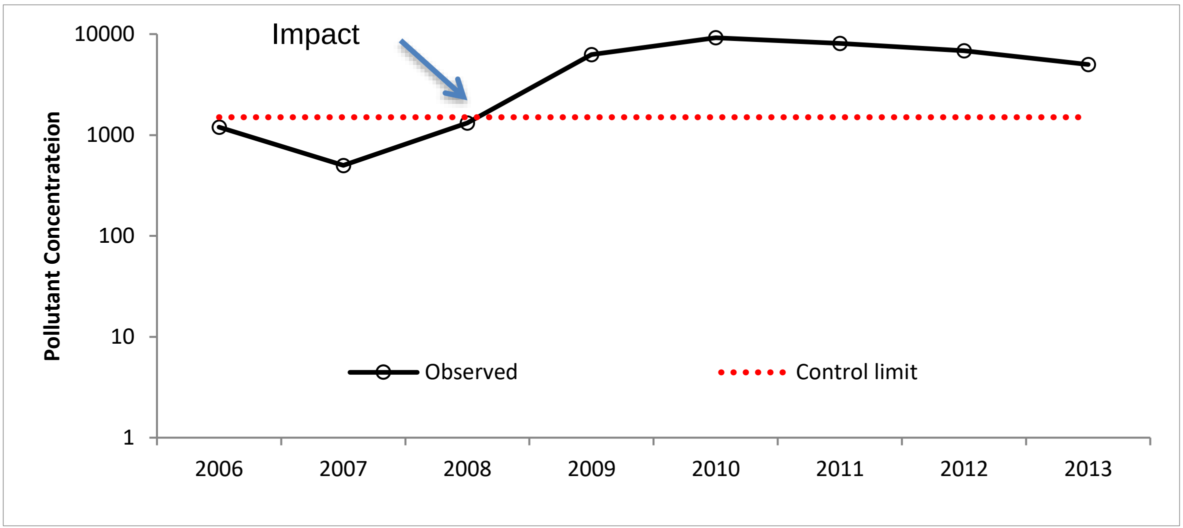


There are challenges in interpreting multivariate control charts. Firstly, multivariate control charts do not show the direction of change and therefore it is not possible to link compositional change to particular variables (in this example, species). Secondly, defining significantly large changes is challenging. In Figure C-4, the two dotted lines delineate a measure of likelihood of a change occurring. An observation above the 95% line would be unlikely (5%) to be purely by chance.

Reference control charts

Reference control charts are similar to statistical control charts in that the time-series data are used but differ in that the control limits are not set by variation in baseline data but are set by an understanding of the biological communities in question or regulatory requirements (Figure C-5).

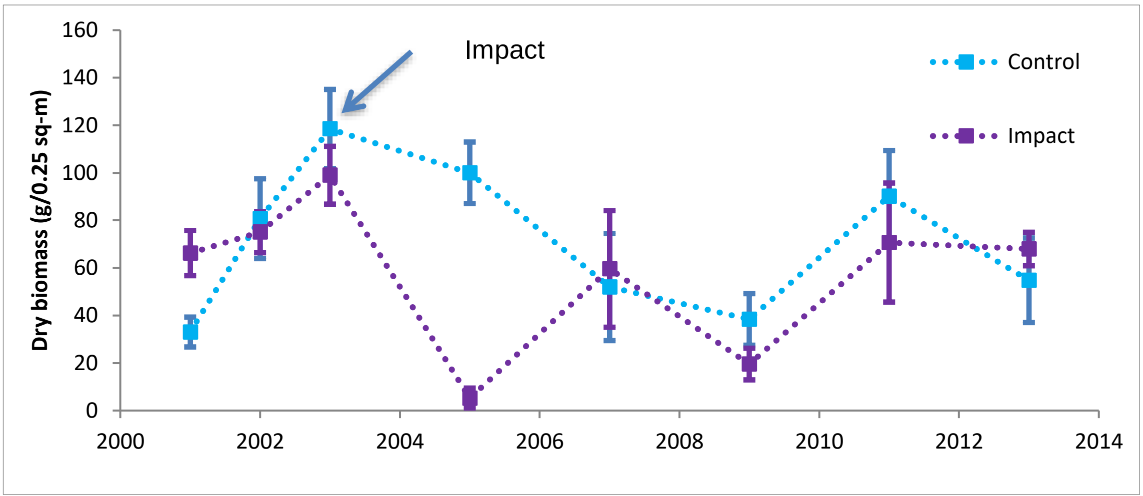
Figure C-5: An example of reference control chart demonstrating changes in water quality in reference to an established pollutant threshold



BACI design

BACI designs are a popular experimental design used for detecting impacts of disturbance (Stewart-Oaten and Bence, 2001). In contemporary statistics, BACI is not so much a discrete approach as one point on a broad continuum of statistical frameworks allowed by procedures such as Mixed Models. Sampling units are established both in areas that are expected to be disturbed and in adjacent areas (with similar biological communities) that are expected to remain undisturbed. The monitoring is carried out prior to the disturbance and continued after the disturbance, and therefore this type of design will often be most effective if it can take advantage of pre-impact conditions.

Figure C-6: An example of monitoring results using BACI design based on the dry biomass of algae. In 2003, an impact has occurred, and the impact site has responded with a significant decline in biomass. By 2007 the impact site has recovered to levels similar to that of the control site. Error bars represent standard errors



In terms of current on-going monitoring programs, such established sites would represent the "before" condition, and following the impact, some of these sites would be "impact" sites, while others would be "control" sites. Individual BACI designs may be tested for each receptor of interest.

Analysis of data from BACI designs is essentially a two-way analysis of variance with time (Before-After) as one factor and disturbance (Control-Impact) as another factor (Gotelli and Ellison, 2004). The effects of disturbance can be detected when there is significant interaction between time and disturbance (resulting from significant difference between Control and Impact after the disturbance).

The major advantage of data from BACI design is that changes in biological communities due to factors other than impact can be factored out by careful experimental design. This design has been further developed to include Multiple Before-After, Control-Impact (MBACI) designs (BACI with multiple and independent disturbed sites, Roberts *et al.,* 2007), and within a mixed-effect model framework in which both unbalanced designs resulting from the MBACI framework and pseudo-replication (Hurlbert, 1984; Underwood, 1994) are properly accounted for (e.g. only one potentially impacted site is available, and so any replicate samples of the disturbed site does not accurately inform any site-to-site differences in impact).If the impact of an oil spill is geographically widespread, then it may be possible to collect data from multiple and independent disturbed sites.

For monitoring programs in marine environments, BACI designs may not be effective in detecting signs of disturbance because biological communities in marine environments tend to undergo large natural variations (Underwood 1991, 1994). Hence understanding the natural variation inherent in datasets and the consequences for interpretation is an important consideration. The critical requirement in BACI design is to locate control/analogue sites that are environmentally similar to the impact site(s). In SM, sampling units may be established after the oil spill if the purpose was to detect recovery of impacted sites.

Table C-1: Summary of data analysis techniques

Analysis type		Description	Strengths	Limitations	Addressing limitations
Gradient analysis		Impact is quantified in terms of distance from spill.	Can be established post-spill.	Does not 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. Does not control for broader spatial scale temporal variation.	Include control charts for control sites which incorporate broad scale temporal variation.
	Multivariate	Multiple variables are combined, monitored and plotted over time, and breaching of control limits tested.	Ability to combine suite of data (e.g., community composition) into one variable. Sites plots not required.	Individual responses are masked. Control limits do not necessarily have biological meaning. Significant control limits challenging to define. Direction of change is undefined.	Compliment with graphical approaches to identify direction of change and individual species responses.
	Reference	Control limits are based on knowledge of biological system (e.g. minimum viable population size, toxicity).	Control limits have recognised biological meaning or consequence.	Control limits may be considered arbitrary.	Use established standards for control limits.
BACI		Quantifies state before and after potential impact, and also at impacted and control sites. Impact is tested by statistical interaction of terms.	Controls for natural variation, by incorporating control sites.	Limited power to detect significant impact. Requires appropriate matching of control (non-impacted) sites. Requires pre-impact data.	Increase power by increasing temporal component. Choose indicators with low natural variability.