WOOLLYBUTT OPERATIONAL AND SCIENTIFIC MONITORING PROGRAM

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ACRONYMS

ACRONYM	Definition
ADIOS II	Automated Data Inquiry for Oil Spills
BACI	Before After Control Impact
BAOAC	Bonn Agreement Oil Appearance Code
BIA	Biologically important areas
CEP	Condensate Export Pipeline
Eni	Eni Australia BV
EP	Environment Plan
GEP	Gas Export Pipeline
HSE	Health, Safety and Environment
KEF	Key ecological features
M-BACI	Multiple BACI
MGO	Marine Grade Oil
NDVI	Normalised Difference Vegetation Index
NOSPEMA	National Offshore Petroleum Safety and Environmental Management Authority
NT DoT	Northern Territory Department of Transport
OMP	Operational and Scientific Monitoring Program
OPEP	Oil Pollution Emergency Plan
OSMP	Operational and Scientific Monitoring Program
ppb	Parts per billion
SAP	Sampling and analysis plan
SMP	Scientific Monitoring Plans
SPM	Single Point Mooring
WA DoT	Western Australian Department of Transport
WHP	Well Head Platform
YGP	Yelcherr Gas Plant
ZPI	Zone of Potential Impact

1. INTRODUCTION

The Operational and Scientific Monitoring Program (OSMP) is the principal plan for providing situational awareness and determining the extent, severity and persistence of environmental impacts from an oil spill and determining whether environmental protection goals are met.

Eni has prepared this OSMP for its activities in the Joseph Bonaparte Gulf, for use in the event of a level 2 or 3 spill. The OSMP provides guidance on how and when monitoring data will be collected in the event of a Level 2 or 3 hydrocarbon spill.

1.1 Scope

In the event of a Level 2 or Level 3 hydrocarbon release or where requested by the Control Agency, a number of monitoring studies may be implemented. Operational Monitoring Plans (OMPs) may be used to inform the spill response and provide contextual information for impact assessment. Scientific Monitoring Plans (SMPs) may be used to evaluate the impacts and recovery to the marine environment. Spill levels are defined in the OPEP.

1.2 Zone of Potential Impact

The ZPI is based on the largest credible spill scenarios identified and modelled during the risk assessment process, these are presented in Table 1.1 along with the thresholds applied. Individual ZPIs for each of the scenarios were combined to create an overall ZPI (Figure 1.1) for the activities.

Table 1.1: Credible spill scenarios and thresholds applied to create ZPI

Spill scenario	Threshold applied to create ZPI
Subsea release of Woollybutt crude due to loss of well control during P&A activities (10,589 m³ over 74 days)	Shoreline contact hydrocarbon (10 g/m²) Surface hydrocarbon (1 g/m²) Entrained hydrocarbon (100 ppb) Dissolved aromatic hydrocarbon (6 ppb)
Subsea release of Woollybutt crude during field management due to corrosion and valve failure (14,490.5 m³ over 365 days)	Shoreline contact hydrocarbon (10 g/m²) Surface hydrocarbons (1 g/m²) Dissolved WAF (6 ppb) Total WAF (70 ppb)
Vessel or IV collision leading to release of (100 m³) marine diesel	Shoreline contact hydrocarbon (10 g/m²) Surface hydrocarbons (1 g/m²) Dissolved WAF (6 ppb) Total WAF (70 ppb)

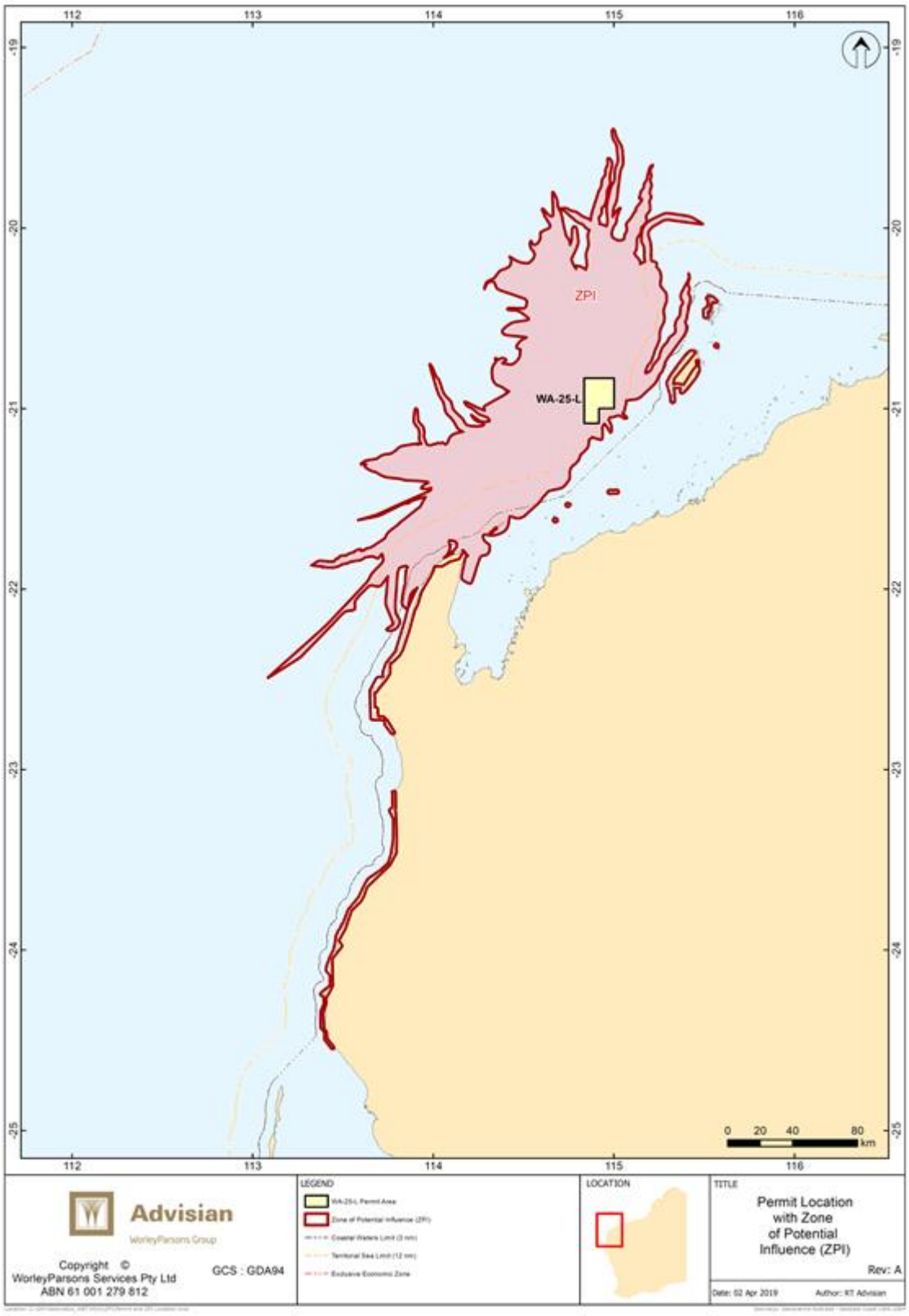

Figure 1.1: Zone of Potential Impact

1.3 Objectives

The overarching objectives of the OSMP are to:

- Guide Eni staff through the decisions and responses which will be required to monitor a spill and any environmentally sensitive receptors surrounding or in contact with the spill.
- Provide overall integrated monitoring logistics and coordination to carry out the operational monitoring studies to inform response planning/measures and scientific monitoring studies to quantify impacts to the environment and their subsequent recovery.
- Provide the strategy for each of the monitoring studies including an overview of the monitoring rationale, objectives, methodology and resources required.
- Determine the magnitude of short and long term environmental impacts associated with the spill (and its response), including the extent, severity and persistence of the impacts.
- Support the planning and execution of the hydrocarbon spill response activities set out in the OPEP.
- Inform remediation efforts, if required.
- Determine whether environmental performance outcomes have been achieved.

The objectives of each operational and scientific monitoring program vary and are presented for each program.

1.4 Operational and Scientific Monitoring

In a response to an oil spill, environmental monitoring may be operational (Type I) or scientific (Type II). Operational and scientific monitoring have very different objectives which significantly influence the monitoring methods likely to be used, the degree of scientific rigour required to meet the monitoring objectives, and the scope of studies. The type of monitoring programme implemented, however, will predominantly depend on the scale and nature of the incident and the potential sensitive receptors at risk. This OSMP consists of:

- Operational Monitoring Programs (OMPs) – aimed at obtaining situational awareness of a spill and providing information on potential impacts to environmental and socioeconomic receptors. A secondary objective of the OMPs is to assess the efficacy and potential impacts (both positive and negative) of spill response strategies.
- Scientific Monitoring Programs (SMPs) – outlines the process for conducting scientific assessment of spill impacts and the recovery of environmental and socio-economic receptors following a spill.
- An Implementation Plan.

The objectives of each OMP and SMP are summarised in Table 1.2 (OMPs) and Table 1.3 (SMPs).

1.4.1 Operational Monitoring Programs

The following OMPs have been developed to obtain and process information regarding the nature and scale of a hydrocarbon spill and the resources at risk, so it can be acted upon as quickly as possible (Table 1.2).

Table 1.2: Operational monitoring programs

Study	Study Title	Description
OMP1	Monitoring of Surface Hydrocarbon Distribution at Sea and Visual Observation of Megafauna	The study will monitor the distribution of hydrocarbons at sea, including the extent and possible exposure to environmental receptors. This study includes: • Aerial and vessel observations • Oil spill trajectory modelling • Satellite imagery • Opportunistic observations of Marine Megafauna Opportunistic observations of marine mammals, large cartilaginous fish or marine reptiles will be recorded to help inform the oiled wildlife response and SMP1.
OMP2	Monitoring of Hydrocarbons: Weathering and Behaviour in Marine Waters	The study will obtain data on the physical and chemical properties of the hydrocarbon that is released. This will be used to inform the selection of response strategies and predict the potential impacts on the environment. This will include in situ hydrocarbon and water sampling and analysis. Data from this study will be used to assist in the determination of the extent of surface, entrained and dissolved hydrocarbons.
OMP3	Shoreline Assessment Surveys	The study will collect pre- and post-impact data for the shorelines, specifically the areas predicted to be impacted by the spill. The study will provide clean up recommendations to inform a shoreline response and data may be used to help inform SMP2 and SMP5.

1.4.2 Scientific Monitoring Programs

Scientific monitoring will provide qualitative or quantitative data for the assessment of short term and longer term impacts and recovery of sensitive receptors.

The monitoring programs listed in Table 1.3 have been selected as relevant for the nature and scale of the Zone of Exposure (Figure 1.1).

Table 1.3: Scientific monitoring programs

Study	Study Title	Description
SMP1	Wildlife Impact Monitoring and Sampling	The study will include determination of cause of death for wildlife carcasses (i.e. tissue analysis) (if any).

Study	Study Title	Description
SMP2	Shoreline Ecological Assessment Aerial Surveys	The study will collect shoreline data to evaluate the presence or absence of sensitive receptors and provide qualitative data on sensitive receptors for the assessment of impacts in SMP5.
SMP3	Assessment of fish for the presence of hydrocarbons	The study will obtain data to determine the presence of hydrocarbons in fish, including species caught by commercial and subsistence fishermen. This will include in-field collection of fish species and lab analysis of the fish caught
SMP4	Fisheries Assessment	The study will collect data to assess the effects on fish and fisheries in the Joseph Bonaparte Gulf arising from the hydrocarbon spill. This will involve desktop and in-field studies.
SMP5	Shoreline Ecological Surveys	The study will obtain data to assess the impacts on and recovery of the shoreline environment. This will include ground surveys, which will be informed by SMP2.
SMP6	Hydrocarbon Fate and Effects Assessment	The study will obtain data to better understand the physical and chemical weathering of the hydrocarbon. This will be used to understand and inform the assessment of impacts on the environment and will follow on from OMP2.
SMP7	Assessment of subtidal benthic communities	The study will assess the potential impacts to subtidal benthic communities through the collection of sediment samples (analysed for the presence/absence of contaminants) and seabed imagery.

Linkages between the environmental sensitivities identified in the EP and the relevant operational and scientific monitoring plans are summarised in Table 1.4.

Table 1.4: Sensitivities to be monitored as part of the OSMP

Sensitivity	Spatial Extent	Hydrocarbon Phase	Applicable OSMP Program
Marine megafauna foraging and migration areas	Most of the megafauna species identified in the EP have the potential to occur across the ZPI and regional waters. See the Woollybutt EP (Section 4) For Zone of Potential Impact see Appendix C of the Woollybutt EP	Surface bound Entrained Dissolved	OMP1, SMP1
Commercial and recreational fish species	Commercial and recreational fishing occurs within the extent of the ZPI and Zone of Exposure. See the Woollybutt EP (Section 4) For Zone of Potential Impact see Appendix C of the Woollybutt EP	Surface bound Entrained Dissolved	OMP2, SMP3, SMP4
Marine avifauna foraging areas	All waters identified in the EP could function as feeding areas for seabirds and/or migratory species. See the Woollybutt EP (Section 4) For Zone of Potential Impact see Appendix C of the Woollybutt EP	Surface bound	OMP1, OMP3, SMP2
Turtle foraging and migration areas	Turtles may travel through the area. See the Woollybutt EP (Section 4) For Zone of Potential Impact see Appendix C of the Woollybutt EP	Surface bound	OMP1, OMP2, SMP1
Intertidal reefs (including coral communities, intertidal limestone pavement and macroalgae communities)	Intertidal reefs are located at: - Ningaloo Reef - Barrow/Montebello Island groups - Muiron Islands	Surface Bound, Entrained and Dissolved	OMP1, OMP2, SMP7
Submerged features	Ancient Coastline at 125 m Depth Contour KEF Continental Slope demersal fish communities KEF Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF Commonwealth Waters Adjacent to Ningaloo Reef KEF	Entrained and Dissolved	OMP1, OMP2, SMP7

1.4.3 Scientific Monitoring Studies Approach

Study Design

To ensure that scientific monitoring plans can maximise the opportunities to utilise data collected from the operational monitoring programs, the Scientific Monitoring studies would be designed during the response phase.

A sampling and analysis plan (SAP) would be prepared for each activated SMP. These plans would be developed by experienced Environmental Consultants from ENI's Environmental Consultancy Panel. A Senior Environmental Consultant from ENI's Environmental Consultancy Panel would be responsible for the preparation of the SAPs. Each SAP would consider which of the below survey designs is most appropriate, with consideration given to the spill trajectory and available baseline data information.

Before After Control Impact (BACI) Study Design

BACI studies may be considered where no baseline data exists and there is sufficient time to collect baseline data prior to impact. Data must also be collected at control/reference site(s) to ensure any temporal changes can be assessed against any natural variation. Where sufficient time is available or where there is sufficient pre-existing baseline data, consideration of a Multiple BACI (M-BACI) study design should be considered, using multiple impact and reference sites with data collected over a period of time before and after impact.

Where suitable existing baseline data is available or where trajectory modelling completed as part of OMP1 shows contact is not predicted within 20 days, this survey approach may be considered.

Eni will notify consultancies of the ENI Environmental Panel Contract at the time of a large spill event (Level 2/3) with the potential for scientific monitoring studies to be triggered, this will allow mobilisation and monitoring to be undertaken within approximately 20 days which allows for sufficient time to source vessels/aircraft, finalise the monitoring design, prepare HSE documentation and mobilise to site.

Inference from Change Over Time

For some spills and some receptors there may not be suitable reference sites that can be considered comparable to the impact sites. Where suitable control/reference sites are not available, an Inference from Change Over Time study design should be considered. This study design is reliant on robust baseline information at sites that will be contacted from the spill. This data could be collected pre-impact where impact is not predicted until at least 20 days to allow for sufficient planning and preparation time, or where there are existing suitable baseline data sets. The data presented in Table 1.4 would be considered during the preparation of the SAP to determine whether the study can be replicated to inform an Inference from Change Over Time study design.

Inference from Change Over Space (gradient design)

This study design would be considered where limited or no pre-impact baseline data exists and data cannot be collected prior to impact. The studies would focus on representative sites at increasing distances from the source of impact (the spill). Additional temporal data may need to be considered when using this study design to account for other environmental factors (seasonality). Control or reference sites may be used in the design of these gradient based studies to help in the assessment of restoration.

Data from OMP1, OMP2 and OMP3 would be used in defining the area impacted from the spill when considering sites to assess the gradient of impact.

SAP assurance measures

A Senior Environmental Consultant from ENI's Environmental Consultancy Panel would be responsible for the preparation of the SAPs.

The following science assurance measures will be applied where appropriate to ensure SAPs are appropriate to meet the study objectives:

- Peer review;
- Input from environmental representatives from relevant State/Territory agencies.

Peer review may be used for SAPs for medium to long term studies. Peer review will be coordinated by the responsible panel consultant, who will select an expert third party provider to undertake the review, including but not limited to specialists identified in Table 1.8.

Input from environmental representatives from relevant State/Territory agencies will be sought through the IMT liaison channels where available.

SAPs will also be prepared in accordance with relevant standards and guidelines, such as the Oil Spill Monitoring Handbook (CSIRO 2016a) and Sediment Quality Assessment (CSIRO 2016b).

1.4.4 Pre Spill Assessment of Potential Study Designs and Approach

The spill modelling presented in the Environment Plan (000105_DV_PR.HSE.1011.000) has been considered when assessing the most suitable study design and assessing the scale of the SMPs.

The modelling results have been used to complete a preliminary screening of study designs Table 1.5. These designs are subject to change dependent on the nature and scale of the actual spill.

Table 1.5: Scientific monitoring programs studies approach

Scientific Monitoring Plan	Sensitivity	Suggested study approach
SMP 1	Marine Fauna	Existing studies will be used to provide context on the existing distribution, behaviour and abundance of marine fauna. Marine fauna observations during and following a spill would be used to assess qualitatively whether marine fauna are demonstrating any signs of stress and whether there are any notable changes to distribution and/or abundance.
	Assessments of the cause of wildlife deaths	This study would use scientific analysis of tissue data and post mortems to determine whether wildlife deaths are caused by hydrocarbon pollution. No baseline data is required for this survey.
	Marine avifauna	Figure 5.11 of the EP shows the locations of BIAs for seabirds in relation to the ZPI. Modelling does not predict contact at impact thresholds, there is expected to be sufficient time to collect pre-impact baseline data at these BIAs in a MBACI survey design if trajectory modelling predicts impact.
SMP2	Shoreline - Aerial Surveys	Data collected as part of SMP2 would be used to inform the SAP for SMP5. Where data is collected prior to impact as part of SMP2 it may be used to inform an MBACI study. Where data is collected post impact it may be used to support a gradient survey design where there is sufficient spatial distribution of a receptor.
SMP3	Fish	A gradient survey design would be used for this study to ensure the area of impact is clearly delineated.
SMP4	Fisheries	A gradient survey design would be used for this study to ensure the area of impact is clearly determined by the study where feasible. An M-BACI study design may also be used where there is suitable pre-impact data for the fishery.
SMP5	Turtle nesting beaches	A major green turtle rookery is located on the west coast of Barrow Island within the ZPI and one of the largest known flatback turtle rookeries in WA is located along the east coast of Barrow Island. The WA loggerhead turtle population nests on mainland beaches from Carnarvon to the Ningaloo Marine Park and offshore islands from Shark Bay to the Muiron Islands (Limpus, 2009). In the event of an extended

Scientific Monitoring Plan	Sensitivity	Suggested study approach
		leak (over 365 days), modelling shows the potential for a maximum of 14.9 m^3 of crude to be stranded on the Ningaloo coast. A qualitative assessment of impacts to turtle nesting would be completed. This would involve a summary of all previous monitoring, literature and observations from the shoreline ecological surveys and analysis of sediment samples collected along impacted coastlines.
	Mangroves	The impacted shorelines are not considered to be a significant mangrove area. Isolated groups of mangroves are within the ZPI, particularly around Barrow Island and along the Ningaloo coastline. Data from aerial surveys and the SMP2 program would be used to determine the baseline health of the mangroves. This would be compared with additional aerial data (including Normalised Difference Vegetation Index (NDVI)) and onground Mangrove surveys to determine whether there has been any impact to mangrove health or distribution. Mangrove health results would be compared with the sediment data when assessing the cause and effect pathway.
SMP6	Water Quality	A gradient survey design would be used to define the area of potential impacts to water quality.
SMP7	Ancient Coastline at 125 m Depth Contour KEF Continental Slope demersal fish communities (CSDFC) KEF Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF Commonwealth Waters Adjacent to Ningaloo Reef KEF	In the event of an extended leak (over 365 days), modelling shows the KEFs of the Ancient Coastline and the CSDFC were predicted to be contacted by total WAF exceeding 70 ppb. An M-BACI study design may also be used where there is suitable pre-impact data. Where impact is localised, a gradient study design may be considered for this SMP.

1.5 OMP and SMP Implementation

Table 1.6 details the contracts that Eni have in place to implement each OSMP program, along with the timeframes to implement from mobilisation.

Table 1.6: OSMP monitoring programs contracts and capability / resourcing requirements

Study	Study Title	Contracts	Timeframes	Required personnel capability / resourcing requirements
OMP1	Monitoring of Surface Hydrocarbon Distribution at Sea and Marine Megafauna Observations	[redacted]	24 hours (AMOSC, OSRL personnel) 24 hours (KSAT) Visual observations from chartered vessels occur within 72 hours of mobilisation. Visual observation – from vessels of opportunity occur within 24 hours of mobilisation. Visual observation – from aircraft/ helicopter within 24 hours of mobilisation. Best endeavours for access to AUV glider via OSRL	Given the small area with any surface expression of floating oil, a single aircraft and observer are considered appropriate for mapping the floating oil distribution. Opportunistic observations of Marine Megafauna would be recorded during each aerial survey. The monitoring team would be required to consist of at least: • 1 x trained observer • 1 x person with oil spill assessment training • Vessel and aircraft operators Additional shoreline assessment teams would be mobilised as required.
OMP2	Monitoring of Hydrocarbons: Weathering and Behaviour in Marine Waters	[redacted]	24 hours (ORSL personnel) Best endeavours basis for access to single monitoring unit (AUV) Typically 48 hours – 5 days (Intertek access) Vessels within 24 hours of mobilisation.	A single monitoring unit (Autonomous Underwater Vehicle (AUV) equipped with fluorometer or towed fluorometry unit) is considered suitable to monitor the progressing spill front. The AUV monitoring team would be required to consist of at least: • 1 x AUV engineer to operate the AUV and support data integration into a response (the engineer would be sourced from the AUV provider); and • 1 x vessel and crew for AUV deployment. OR • 1 x OSRL personnel to operate the OSRL fluorometry unit; and • 1 x vessel and crew for towing the fluorometry unit. Additional water quality analysis equipment may be sourced from Eni's laboratory services provider, Intertek. For further information refer to Section 5.9 (Logistics). Vessels and Aircraft are accessed as per Section 3.
OMP3	Shoreline Assessment Surveys	[redacted]	Onsite within 5 days, or 24 hours prior to shoreline contact (if prolonged time to shoreline contact). Best endeavours basis for access to single monitoring unit (UAV) Vessels and aircrafts within 24 hours of mobilisation.	A single response team may cover approximately 2km per day. Initial team would consist of: • 1 x shoreline assessment team lead / shoreline clean-up specialist; and • 2 x shoreline surveyors. Additional shoreline assessment teams would be mobilised as required, by the control agency. Specifics and further details on the personnel resource requirements are detailed in Section 6.9

Study	Study Title	Contracts	Timeframes	Required personnel capability / resourcing requirements
		[redacted]		For further information on equipment requirements refer to Section 6.7 Refer to Section 6.8 for logistic required for this OMP. Vessels and Aircraft are accessed as per Section 3.
SMP1	Wildlife Impact Monitoring and Sampling	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Vessels and aircrafts within 24 hours of mobilisation.	Given the nature and scale of a spill, one wildlife monitoring team (2 x MFOs) would be mobilised to conduct daily marine fauna observations for a period of at least one month. A vet would also be contracted to complete post mortems and respond to reports of Marine Fauna fatalities. The MFOs may be aboard the response vessel/s or aircraft/s. Specifics and further details on the personnel resource requirements are detailed in Section 7.9 For further information on equipment requirements refer to Section 7.7 Refer to Section 7.8 for logistic required for this SMP. Vessels and Aircraft are accessed as per Section 3.
SMP2	Shoreline Ecological Assessment Aerial Surveys	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Aircrafts within 24 hours of mobilisation. Best endeavours basis for access to Drone / AUV through OSRL.	Initial shoreline monitoring team would be required consisting of: • 1 x Drone operator (where the drone is soured through the Environmental Panel Contracts); • 1 x Environmental Consultant for fieldwork; • 1 x Environmental Consultant for reporting; and • 1 X GIS specialist. • 1 x subject matter expert selected from Table 1.10 or other suitable provider Additional shoreline monitoring teams would be mobilised as required, by the control agency. The OSRL unmanned aerial vehicle (UAV) team would consist of the following additional personnel • 1 x experienced UAV pilot; • 1 x Sensor operator; and • 1 x OSRL response specialist. Specifics and further details on the personnel resource requirements are detailed in Section 8.9 For further information on equipment requirements refer to Section 8.7 Refer to Section 8.8 for logistic required for this SMP. Aircraft are accessed as per Section 3.
SMP3	Assessment of fish for the presence of hydrocarbons	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Typically 48 hours – 5 days (Intertek access) Vessels within 24 hours of mobilisation.	The team for SMP3 would consist of the following personnel. The field team would require experience in the handling of samples for analysis of environmental impacts: • 2 x Environmental Consultants for fieldwork • 1 x Environmental Consultant for reporting • 1 x laboratory for analysis • 1 x subject matter expert selected from Table 1.10 or other suitable provider Specifics and further details on the personnel resource requirements are detailed in Section 9.8. For further information on equipment requirements refer to Section 9.7 Refer to Section 3 for logistic required for this SMP and vessel access.

Study	Study Title	Contracts	Timeframes	Required personnel capability / resourcing requirements
SMP4	Fisheries Assessment	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Typically 48 hours – 5 days (Intertek access) Vessels within 24 hours of mobilisation.	The team for SMP4 would consist of the following personnel: • 2 x Environmental Consultants for fieldwork • 1 x Environmental Consultant for reporting • 1 x Vessel and trawl equipment • 1 x laboratory for analysis • 1 x subject matter expert selected from Table 1.10 or other suitable provider. Specifics and further details on the personnel resource requirements are detailed in Section 10.9. For further information on equipment requirements refer to Section 10.7. Refer to Section 10.8 for logistic required for this SMP. Vessels are accessed as per Section 3.
SMP5	Shoreline Ecological Surveys	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Vessels within 24 hours of mobilisation. Best endeavours basis for participation of Traditional Owners	Given the scale of shoreline contact, one shoreline monitoring team would be required consisting of: • 2 x Environmental Consultants for fieldwork • 1 x Environmental Consultant for reporting • 1 x small vessel for shoreline access • 2 x Traditional Owners to facilitate site access (depending on impact area, consultation and availability). • 1 x subject matter expert selected from Table 1.10 Specifics and further details on the personnel resource requirements are detailed in Section 11.9 For further information on equipment requirements refer to Section 11.7 Refer to Section 11.8 for logistic required for this SMP. Vessels are accessed as per Section 3.
SMP6	Hydrocarbon Fate and Effects Assessment	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Vessels within 24 hours of mobilisation.	The team completing the scope of works for OMP2 would continue to monitor water quality using a sea glider or fluorometry unit. The team would consist of: • 1 x AUV engineer to operate the AUV and support data integration into a response (the engineer would be sourced from the AUV provider); and • 1 x vessel and crew for AUV deployment. OR • 1 x OSRL personnel to operate the OSRL fluorometry unit; and • 1 x vessel and crew for towing the fluorometry unit Specifics and further details on the personnel resource requirements are detailed in Section 12.9.11.9 For further information on equipment requirements refer to Section 12.7. Refer to Section 12.8 for logistic required for this SMP. Vessels are accessed as per Section 3.
SMP7	Subtidal habitat assessment	[redacted]	N/A. Contracting timeframe as per Section 1.5.2 Vessels within 24 hours of mobilisation.	A single team is considered appropriate to implement a gradient monitoring design assessing potential impacts to the submerged features of the KEFs. The team would consist of: • 2 x Environmental Consultants for fieldwork

Study	Study Title	Contracts	Timeframes	Required personnel capability / resourcing requirements
		[redacted]	Best endeavours for ROV, divers and other ancillary services.	• 1 x Environmental consultant for reporting • 1 x vessel with ROV and operators • 1 x commercially qualified diver team (if required) • 2 x towed/drop camera unit • 2 x sediment grabs • 1 x subject matter expert selected from Table 1.10 Specifics and further details on the personnel resource requirements are detailed in Section 13.9. For further information on equipment requirements refer to Section 13.7. Refer to Section 13.8 for logistic required for this SMP. Vessels are accessed as per Section 3.

1.5.1 Environmental Panel Capability

The Eni Environmental and Social Impact Consultancy Services Panel (Contract No. [redacted]) provides an existing framework for immediate engagement of a contractor.

Eni will ensure they have an agreed contract with an Environmental Service Provider capable of supplying personnel to support the OSMP throughout the life of EP. The number of panel contract providers and capability may vary over the five years of the EP but as a minimum the contract will include access to the capability outlined Table 1.6.

The total required number of personnel to implement this OSMP will be dependent on the nature and scale of the spill, however to implement all scientific monitoring plans concurrently, eleven field personnel would be required, based on the total personnel detailed in Table 1.6. Maintaining a panel with the minimum requirements outlined in Table 1.7 ensures access to at least two Senior Environmental professionals to develop the SAPs required to implement the SMPs and to manage the implementation of the SMPs. Maintaining access to at least eleven Environmental Professionals across the panel ensures access to enough consultants to complete the initial field programs required to be implemented by ENIs panel contractors.

Additional support to manage and assist with the implementation of each SMP may be contracted as required depending on the nature and scale of the spill. If additional resources are required, ENI would either contract these directly or request additional resources through the Environmental Panel Contract.

Table 1.7: Environmental Panel Capability

Minimum Requirements	Ability to deliver or contract the following services
Access to a Marine Sciences team with demonstrated experience of conducting marine environmental surveys including: • Marine sediment sampling surveys • Water quality surveys • Mangrove monitoring surveys • Project management of large marine sciences scopes The combined Marine Sciences team has at least eleven (11) Environmental professionals in Australia with an Environmental-based degree, plus at least one GIS professional. Has at least 2 Senior personnel with an Environmental based degree and 12+ years' experience, with demonstrated	Access to a marine sciences team that has the ability to deliver/manage/subcontract the following services: • Fisheries assessments • Shorebird surveys • Turtle monitoring programs • Shoreline ecological assessments • Subtidal habitat assessment

Minimum Requirements	Ability to deliver or contract the following services
environmental study design and implementation experience.	
SMP1 – Wildlife Impact Monitoring and Sampling	
• 2 x MFOs	• 1 x vet • Relevant subject matter experts
SMP2 – Shoreline Ecological Assessment Aerial Surveys SMP5 - Shoreline Ecological Surveys	
• 2 x Environmental Consultant for fieldwork; • 1 x Environmental Consultant for reporting; and • 1 X GIS specialist.	• 1 x subject matter expert
SMP3 - Assessment of fish for the presence of hydrocarbons SMP4 - Fisheries Assessment	
• 2 x Environmental Consultants for fieldwork • 1 x Environmental Consultant for reporting	• 1 x laboratory for analysis • 1 x subject matter expert
SMP6 - Hydrocarbon Fate and Effects Assessment	
• 1 x Environmental Consultant for fieldwork / reporting	
SMP7 - Subtidal habitat assessment	
• 2 x Environmental Consultants for fieldwork • 1 x Environmental consultant for reporting	• Field monitoring equipment, including towed/drop camera units, sediment grabs • 1 x subject matter expert

1. AUV, UAV and operators are available through OSRL master service agreement held by Eni
2. Traditional Owner involvement will be facilitated by Eni
3. Vessels, ROV and divers are available through Eni logistics contracts.

An annual audit of ENI's Environmental Panel contract capability will be completed against the capability listed in Table 1.7 to ensure capability is maintained over the period of the Environment Plan.

1.5.2 Contract timeframes

Eni have OSRL and AMOSC contracts in place with guaranteed response timeframes and availability for OMP1 and OMP 3.

The environmental panel will be available and engaged based on 'best endeavours' and typical contracting/procurement timeframes. Typically Eni are able to raise a Purchase Order within the environmental panel within 2-3 days. In emergency situations, the turnaround time for a Purchase Order can be within 1 day. Once a PO is raised mobilisation of the resource is likely to be within 2-3 days.

Eni have the ability to contract third party scientific monitoring specialists, through the environmental panel contractors. Subcontracts through the environmental panel will be executed on a best endeavours basis. Typically a PO can be raised by an environmental panel contractor within one week when an existing contract exists with the third party contractor.

Eni or the environmental panel would contract third party scientific monitoring specialists as identified in Section 1.5.3.

1.5.3 Third party scientific monitoring support

Eni have also identified third party scientific monitoring specialists, as identified in Table 1.8. Where required, Eni may engage them directly or through a contractor.

Table 1.8 Third party scientific monitoring specialists

Study	Study Title	Supplementary capability	Company and Contact Details	Names of specialists and Demonstrated Experience
SMP1	Wildlife Impact Monitoring and Sampling	Marine Fauna Observation Studies and studies into the death of marine fauna	[redacted]	[redacted]
SMP2	Shoreline Ecological Assessment Aerial Surveys	Drone providers capable of surveying, including NDVI assessments	[redacted]	[redacted]
SMP3	Assessment of fish for the presence of hydrocarbons	Analysis to determine the presence of hydrocarbons in fish, including species caught by commercial and	[redacted]	[redacted]

Study	Study Title	Supplementary capability	Company and Contact Details	Names of specialists and Demonstrated Experience
		subsistence fishermen. This will include in-field collection of fish species and lab analysis of the fish caught	[redacted]	[redacted]
SMP4	Fisheries Assessment	Subject matter experts to collect data to assess the effects on fish and fisheries in the Joseph Bonaparte Gulf arising from the hydrocarbon spill. This will involve desktop and in-field studies.	[redacted]	[redacted]
SMP5	Shoreline Ecological Surveys	**Capability available within environmental panel.** Additional providers identified to provide supplementary expertise and personnel where required.	[redacted]	[redacted]

Study	Study Title	Supplementary capability	Company and Contact Details	Names of specialists and Demonstrated Experience
SMP6	Hydrocarbon Fate and Effects Assessment	The study will obtain data to better understand the physical and chemical weathering of the hydrocarbon. This will be used to understand and inform the assessment of impacts on the environment and will follow on from OMP2.	[redacted]	[redacted]
SMP7	Assessment of subtidal benthic communities	**Capability available within environmental panel.** Additional providers identified to provide supplementary expertise and personnel where required.	[redacted]	[redacted]

2. RISK ASSESSMENT AND DATA MANAGEMENT

Risk assessment, data management and quality assurance and control must be considered for **ALL** operational and scientific monitoring programs.

These considerations are described below.

2.1 Risk Assessment, Occupational Health and Safety Considerations

It is essential that the appropriate personal protective equipment (PPE) always be worn during a response. The PPE requirements may vary with work location and the type of survey work undertaken. A minimum requirement will be the use of appropriate sun protection (including head gear) and long sleeves and pants.

2.1.1 Vessel Surveys

Vessel fieldwork must consider health and safety risks associated with marine activities. Eni's safety management processes should be followed in a spill response situation, including aspects of:

- risk management (permit to work, Job Safety Analysis [JSA]);
- marine safety;
- occupational hygiene (PPE).

All personnel should be aware of the limitations and safe operating procedures of all equipment used in the response operation. This should, where necessary, involve a risk assessment and the development of a site-specific health and safety plan, including details for induction and briefing procedures. Examples of hazards to be considered are:

- access, e.g. to and from location;
- exposure, e.g. ingestion of hydrocarbons;
- inhalation of toxic components;
- heat stress;
- manual handling;
- ignition sources and fuel source;
- skin contact with oil and other chemicals – resulting in a possible degreasing effect on skin tissue and inflammation of skin. Prolonged or repeated skin contact may result in dermatitis as well as increased body uptake of some crude oil components. Increased sensitivity to oils can also occur as a result of repeated exposures.

2.1.2 Aerial Surveys

Aerial survey work must consider health and safety risks associated with monitoring activities. Eni's safety management processes should be followed in a spill response situation, including aspects of:

- risk management (permit to work, JSA);

- aerial safety;
- occupational hygiene (Material Safety Data Sheet [MSDS], PPE).

All personnel should be aware of the limitations and safe operating procedures of all equipment used in the response operation. This should, where necessary, involve a risk assessment and the development of a site-specific health and safety plan, including details for induction and briefing procedures. Examples of hazards to be considered are:

- access, e.g. weather forecast;
- heat stress;
- manual handling.

2.2 Data Management and QA/QC

Monitoring is likely to result in data generated from a number of sources in a number of different formats:

- logs and forms;
- photographs and video recordings (digital);
- annotated maps;
- portable GPS/GIS units.

Management of the generated data requires extensive data storage, analysis, backup and archiving. Samples should be treated as legal evidence and secured against loss or tampering. Data records and results of analysis should be delivered to info@eniaustralia.com.au and HSE.Mailbox@eniaustralia.com.au. Copies of data sheets and analysis should be archived by Eni Document Control (documentcontrol@eniaustralia.com.au).

3. LOGISTICS

3.1 Vessel Mobilisation

The IMT Leader has authorisation to request the mobilisation of AMSA and AMOSC resources, including vessels and aircraft.

Eni may also engage vessel operators and owners in WA, NT and Singapore to charter suitable vessels through [redacted].

The vessel specifications should allow for the coverage of the required sampling area, safe access to water for sampling and sufficient deck space for storage of field equipment and samples.

Table 3.1: Vessel contracts contact details

Company	Function	Contact Details
[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]
	[redacted]	[redacted]

3.2 Aircraft Mobilisation

The IMT Leader has authorisation to request the mobilisation of AMSA and AMOSC resources, including vessels and aircraft.

Eni also has contracts in place to charter helicopters from [redacted] and aircraft from [redacted]. Contact details are listed in Table 3.2. Aerial surveillance can be mobilised within 24 hours.

Table 3.2: Aerial contracts contact details

Company	Contact Details
[redacted]	[redacted]
[redacted]	[redacted]

3.3 Permit requirements

OSMP field sampling and monitoring activities may be undertaken in Commonwealth waters (>3NM from shore), WA state waters (<3NM from WA coast) and Northern Territory waters (<3NM from NT coast).

Permits that may be required for field monitoring activities are outlined in Table 3.3.

Table 3.3: Commonwealth and state permit requirements for field monitoring activities

Permit	Relevance	Legislation and Agency	Remarks
Commonwealth			
General Permit Application for: • Threatened species and ecological communities • Migratory species • Whales and dolphins • Listed marine species	Required for scientific sampling of matters listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	EPBC Act Department of the Environment and Energy	It would also be beneficial to apply for an exemption from Part 13 permitting requirements under section 303A of the EPBC Act. The Minister would then consider whether it is in the national interest to grant an exemption. The EPBC Act provides that certain actions are not offences and, therefore, would not require a permit. However, the survey(s) (i.e. 'the action') would need to satisfy one of the criteria set out at section 197 and it is not immediately apparent that it would do so. If it did, there would still be a requirement to notify the Secretary if the action was taken.
Access to Biological Resources in a Commonwealth Area for Non-commercial Purposes	An applicant must obtain written permission from each Access Provider. The Access Provider must state permission for the applicant to: • enter the Commonwealth area • take samples from the biological resources of the area • remove samples from the area.		

Permit	Relevance	Legislation and Agency	Remarks
Western Australia			
Application for an exemption to collect aquatic organisms (alive or dead) for commercial purposes, including: • the eggs, spat, spawn, seeds, spores, fry, larvae or other source of reproduction or offspring of an aquatic organism (including plants and algae), and • a part only of an aquatic organism, including the shell or tail. Exclusions from permit requirements include aquatic mammals, aquatic reptiles, aquatic birds, amphibians or (except in relation to Part 3 and Division 1 of Part 11) pearl oysters	Exemption under Section 7(2)(b) of the Fish Resources Management Act 1994	Fish Resources Management Act 1994 Department of Primary Industries and Regional Development (DPIRD)	Required anywhere in WA State waters and out to 200 nautical miles (NM). In the event that OSMP sampling was required within WA state waters, DPIRD may either consider expediting the application process or providing a ministerial exemption
• Application for a licence to take (i.e. capture, collect, disturb or study) fauna for scientific purposes (Regulation 17), and/or	Fauna means: • any animal indigenous to any State or Territory of the Commonwealth or the territorial waters of the Commonwealth	Wildlife Conservation Act 1950	Required in WA State waters to three nm, and for collection of biological resources in Commonwealth waters requiring transit through WA state waters. Permits require nomination of a person in charge who must be on site during sampling. Due to the potential for shift rotations during the permitted period, it is recommended that

Permit	Relevance	Legislation and Agency	Remarks
• application form for a Scientific or Other Prescribed Purposes Licence to take protected flora from Crown Land for noncommercial purposes (CLM59)	• any animal that periodically migrates to and lives in any State or Territory of the Commonwealth or the territorial waters of the Commonwealth. The Act specifically refers to licensing the taking of protected fauna. However, it is recommended to have this in place for collection of any fauna should any protected fauna be inadvertently collected	Department of Biodiversity, Conservation and Attraction (DBCA)	separate permits be obtained for party chiefs/Field leads involved (where multiple names cannot be included in a single permit). In the event that OSMP sampling was required within WA state waters, DBCA may either consider expediting the application process or providing a ministerial exemption
Entry Permits for access to Aboriginal Land, and requirements for disturbance or relocation of Aboriginal Heritage sites	Legally required for transit through an Aboriginal Reserve, under Part II of the Aboriginal Affairs Planning Authority Act 1972 Natural Heritage Listed places are protected under the EPBC Act. Assessment under this Act may be required for any disturbance to the values for which these areas were listed (e.g. Aboriginal Heritage). Removal, relocation or	• Aboriginal Affairs Planning Authority Act 1972 • EPBC Act • Aboriginal Heritage Act 1972 Department of Planning, Lands and Heritage (DPLH)	A Section 18 permit may take in excess of 18 months to obtain under normal conditions

Permit	Relevance	Legislation and Agency	Remarks
	interference with Aboriginal Heritage objects or sites requires Ministerial approval under Section 18 of the Aboriginal Heritage Act 1972 (via DPLH) The DPLH maintains a register of Aboriginal sites, which can be accessed via the enquiry system at www.daa.wa.gov.au		
Northern Territory			
Application for a permit to undertake scientific research on wildlife	A permit is required for taking or interfering with wildlife for scientific purposes.	Territory Parks and Wildlife Conservation Act 2006 NT Department of Primary Industry and Resources	https://nt.gov.au/environment/animals/wildlife-permits/permits-take-interfere-with-wildlife
Application for a special permit under Section 17 of the Fisheries Act	A permit is required to take fish or aquatic life or be in the possession of fishing gear that is other not permitted, for research.	Fisheries Act NT Department of Primary Industry and Resources – Fisheries Division	$725 application fee

Permit	Relevance	Legislation and Agency	Remarks
Land access permit	A permit is a written document authorised by NLC on advice of the Traditional Owners that sets out permission, terms and conditions to enter the private land and/or intertidal waters of a group of Aboriginal people.	Aboriginal Land (Northern Territory) Act 1978 Northern Territory Aboriginal Sacred Sites Act Administering agency: Department of Planning, Lands and Heritage Permit issuer: Relevant Land Council	Land access must be organised with the relevant Land Council for landowner approval, typically via the Northern Land Council If an application is successful, the permit holder is advised to contact the Aboriginal Areas Protection Authority (phone numbers 8981 4700 / 8952 6366) before commencing any activities. A permit holder undertaking scientific research is required to credit intellectual property rights appropriately and agree that nothing in the permit is intended to affect or derogate from any rights, title or interest in indigenous cultural expression or intellectual property.
Aboriginal Affairs Planning Authority (AAPA) Lands Permit (ALPS)	People passing through or visiting communities on Aboriginal Lands Trust reserves proclaimed under Part III of the Aboriginal Affairs Planning Authority Act 1972 (the Act) must obtain an Aboriginal Affairs Planning Authority (AAPA) Lands Permit (ALPS) to comply with the Act.	Aboriginal Affairs Planning Authority Act 1972 Administering agency: Department of Planning, Lands and Heritage Permit issuer: Aboriginal Affairs Planning Authority	The permit type will depend on the purpose and mode of travel. https://www.dplh.wa.gov.au/information-and-services/online-services/entry-permits-for-access-to-aboriginal-lands

Permit	Relevance	Legislation and Agency	Remarks
Equipment-specific exemptions (all states and Commonwealth waters)			
Fisheries exemption for use of sub-legal mesh sizes	For demersal fish populations studies (including juveniles) as part of scientific monitoring	Local regulations (e.g. the Fisheries Management (South East Trawl Fishery) Regulations) made under the Fisheries Management Act 1991 Relevant Fisheries Departments	

4. OMP1 – MONITORING OF SURFACE HYDROCARBON DISTRIBUTION AT SEA AND VISUAL OBSERVATION OF MEGAFAUNA

4.1 Monitoring Rationale

The spatial and temporal extent of hydrocarbon distribution in the marine environment will be determined after a hydrocarbon spill. Information on the distribution of hydrocarbons provides the details necessary to assist in selecting appropriate response strategies and determining resource requirements. Additionally, wildlife resources present in the area will be determined to assess what resources are likely to be affected during a spill. The distribution of hydrocarbons simulated in models can further assist with the selection of appropriate response strategies and the required resources through predicting the spill trajectory pathway.

The purpose of OMP1 is to locate and confirm a reported hydrocarbon spill and record any opportunistic observations of marine mammals, large cartilaginous fish or marine reptiles. Monitoring during the operations phase will focus on identifying and qualifying the marine wildlife at risk and identify if strategies to manage and mitigate this risk are required. If confirmed, monitoring should focus on the movement of the spill to determine what resources/receptors are likely to be affected (at risk) and may require protection or clean-up, and to guide response and recovery operations. This will be achieved by assessing hydrocarbon spill trajectory using modelling tools and rapidly collecting data to verify the actual distribution of the hydrocarbon spill (size and movement) in real time, including satellite imagery, vessel and aerial based surveys where appropriate.

4.1.1 Objectives

The objectives of this OMP are to:

- evaluate the spatial extent of a hydrocarbon spill (spatially and temporally) via satellite imagery;
- track the movement of the hydrocarbon spill;
- if necessary, identify areas of potential shoreline contact and sensitive resources/ environmental receptors at risk to enable timely prioritisation of protection priorities to guide the management and execution of hydrocarbon spill response operations.
- record any observations of marine mammals, large cartilaginous fish or marine reptiles.

4.2 Resources Available

See Table 4.1 for available resources. Contracts are summarised in Section 1.5.

The IMT Leader has authorisation to request the mobilisation of AMSA, AMOSC or OSRL resources if required or requested by the Control Agency.

Environmental Consultants from ENIs Environmental Panel Contracts may also be mobilised to support the identification of environmental resources at risk during an ongoing response.

Visual observation will be sought from vessels of opportunity within 24 hours of mobilisation.

Table 4.1 Resources available for OMP1

Resource	Provider	Timeframe
OSTM	APASA, via AMOSC – Oil Spill Modelling Eni HQ OSRL	24 hours (available 24/7)
	National Plan resources through AMSA	As per National Plan
Satellite monitoring	KSAT AMOSC OSRL Eni HQ	24 hours (available 24/7)
Unmanned aerial vehicle (UAV)	Various UAV providers via OSRL	Best endeavours
Vessels	[redacted]	Visual observations from chartered vessels occur within 72 hours of mobilisation.
Aircraft	[redacted]	Visual observation – from aircraft/ helicopter within 24 hours of mobilisation.
Aerial surveillance trained observer	AMOSC OSRL	24 hours (personnel)
	National Plan resources through AMSA	As per National Plan

4.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency.

4.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- The source of the spill is contained, i.e. no more hydrocarbons entering the environment.

- Oil is no longer observed (as described by the Bonn Agreement Oil Appearance Code-BAOAC) at rainbow or metallic sheen or discontinuous or continuous true oil colour. Hydrocarbon thicknesses below these thresholds indicate that the thickness is less than 0.3 microns and poses little threat of harm to environmental receptors.
- OSTM indicates entrained hydrocarbons are below the 100 ppb threshold and that sensitive receptors are not under threat.
- Relevant stakeholders (e.g. WA DoT, NT DoT) agree that no further impacts to shorelines or marine megafauna are likely to be observed.

4.5 Predictive Modelling to Assess Resources at Risk

Accurate and timely detection of hydrocarbon impacts will depend on a good understanding of the actual and predicted slick trajectory and fate estimates (weathering) of the hydrocarbon.

Data input on the various parameters in the model are to assume a 'worst-case' so as to overestimate the possible locations of the hydrocarbon spill. Spill trajectories can be updated and re-analysed with Metocean forecasts.

Manual input data to be provided for modelling includes:

1. spill release point (latitude and longitude or easting and northing)
2. spill start date and time
3. manual wind speed/direction and sea temperature
4. hydrocarbon type and grade (hydrocarbon name; American Petroleum Institute [API]; specific gravity; pour point; wax content; sulfur content) – this information is available in the EP
5. estimated spill release rate and volume (instantaneous or total; continuous release).

Geo-referenced surveillance information and observations from the spill scene should be used to update the model daily. This will include details from satellite imagery on the spatial extent and forecast meteorological data.

4.5.1 Metocean Data

Information on weather conditions – i.e. prevailing winds and currents from Metocean office; relevant tidal and current station data; sea state; temperature; visibility/precipitation, etc. – will be provided to Eni's modelling contractor and can be obtained from:

- Metocean data
  - http://imos.aodn.org.au/imos/.
- real-time meteorological data:
  - www.bom.gov.au/wa/observation
  - www.eldersweather.com.au/wa

- www.transport.wa.gov.au/imarine/19138.asp.

4.5.2 Mobilisation of Predictive Modelling

OSTM will be undertaken on an initial and daily basis through AMOSC by a third-party contractor (i.e. APASA). Eni Headquarters in Milan, Italy, also has capability to undertake oil spill trajectory modelling.

Oil weathering modelling can be undertaken using the Automated Data Inquiry for Oil Spills (ADIOS) model developed by the US National Oceanographic and Atmospheric Administration. ADIOS can be operated by Eni's Environmental Advisor. To run the model, inputs are required about oil type, volume, weather conditions, water properties and release type (e.g. instantaneous or continuous). Further information on ADIOS can be found at:

<http://response.restoration.noaa.gov/oil-and-chemical-spills/oilspills/responsetools/adios.html>

4.6 Satellite Monitoring to Detect Resources at Risk

Eni has contracted KSAT to provide satellite monitoring for its operations.

KSAT provide high fidelity photographs using different spectrums to identify the trajectory of the oil. In case of a spill reported to KSAT by Eni, KSAT will activate its Emergency Response Team that is targeted to be assembled within 24 hours. Contact details are outlined in Table 4.2.

Table 4.2: Satellite monitoring contact details

Company	Contact Details
KSAT	Direct phone: +47 77 60 02 51 Switchboard: +47 77 60 02 50 Fax: +47 77 60 02 99

4.7 Vessel Survey

Prior to the arrival of aircraft for aerial surveillance, vessels at the scene or vessels of opportunity will be used to provide initial observational data.

If required, the IMT Leader has authorisation to request the mobilisation of AMSA resources, including vessels. A field vessel will be deployed within 72 hours. Refer to Section 3 for deployment of vessels.

Vessels will be instructed to follow the leading edge of the hydrocarbon slick.

4.8 Unmanned Aerial Vehicle (UAV)

UAVs can utilise multiple sensors including Visual (HD), Infrared, and Ultraviolet to support a response and can provide real-time monitoring of the spill.

UAVs can be mobilised through contacting OSRL and are available on a best endeavours basis and dependent upon obtaining permission to fly and availability of the UAV suppliers to respond.

4.9 Aerial Survey

Aerial reconnaissance surveys will use either a rotary or fixed wing aircraft to track and monitor the spill movement. Eni has contracts in place to charter helicopters from Babcock Helicopters Australia and aircraft from FCM. Contact details are outlined in Section 3. Aerial surveillance will be mobilised within 24 hours.

Flight paths will be confirmed prior to each flight and will be planned to start and finish within daylight hours for clear observation of the sea surface. A flight plan will be prepared in advance and agreed with the pilot and relevant authorities and take account of any information that will reduce the search area (i.e. last known sighting and expected trajectory of the oil). The search altitude is likely to be determined by the prevailing visibility, but as a guide from ITOPF (2011):

- clear conditions over the open ocean should set altitude at 300–450 m;
- clear conditions close to shore, 120–150 m assuming no restrictions.

The surveys will continue until the termination criteria are reached. The control agencies IMT will be responsible for flight timetabling and flight paths.

Trained aerial observers can be mobilised through AMOSC. A trained AMOSC aerial observer should:

- confirm the location of the spill using ladder or spiral search paths (see Figure 4.1);
- quantify the amount of oil on the water and verify the results from modelling.

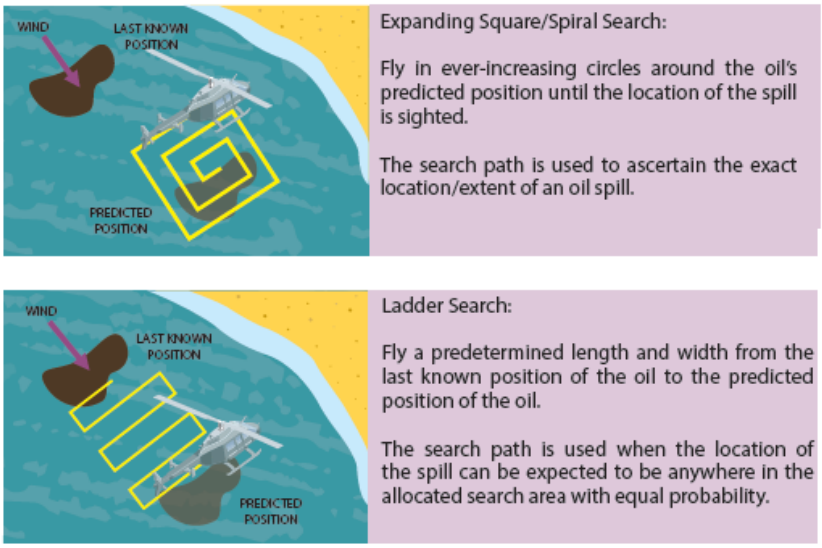

Figure 4.1: Flight search patterns (OSRL, 2011)

Photographs or video should be taken during the aerial survey to record the hydrocarbon spill. Where possible, features such as ships and the coastline should be included to provide an estimate of scale. The photographer should follow these guidelines:

- take photograph as vertically as possible (53°);
- use the shortest exposure time (1/250 or faster);
- overlap photographs by about 20%;
- use a polarised filter to reduce the brilliance of the surface of the water.

Figure 4.2 provides a visual representation of the spill quantification procedures.

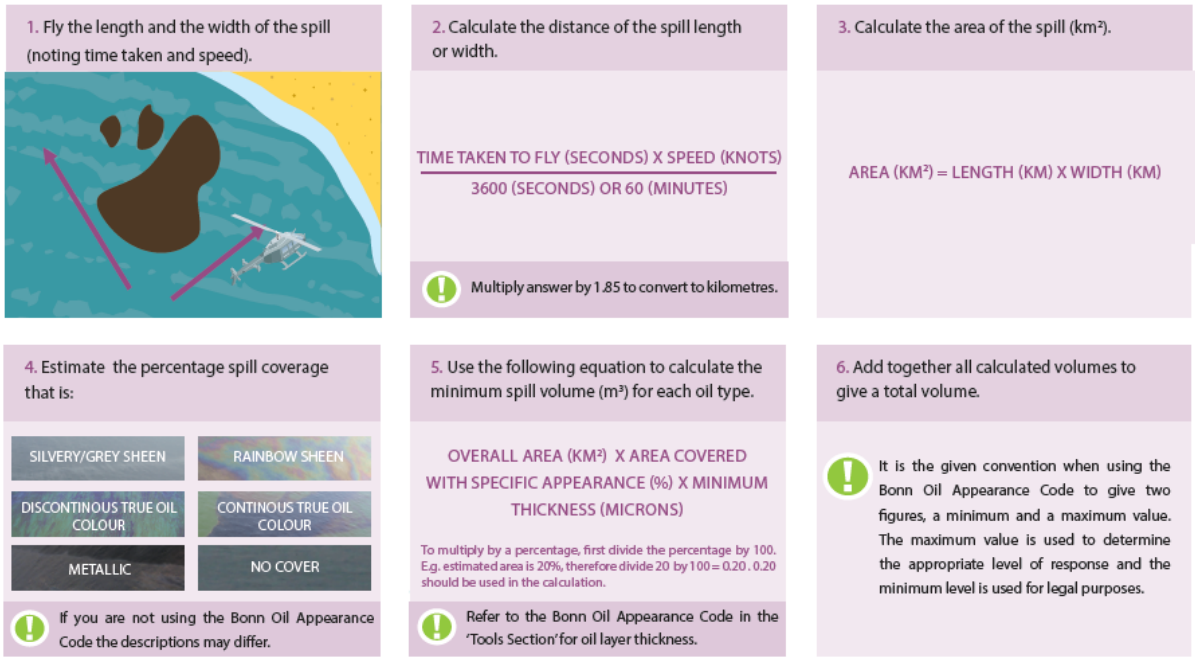

Figure 4.2: Spill quantification procedure (OSRL, 2016)

Observations will be recorded via a standard aerial surveillance observer log (Figure 4.3) and include:

- day, time, observer name, altitude, visibility;
- location and extent, latitude and longitude using a global positioning system (GPS) for location;
- colour of oil slick or sheen: using Bonn Agreement Oil Appearance Code (see Figure 4.4);
- character: i.e. windrow, slick, patch, streak (use consistent descriptive phrases throughout);
- features, e.g. leading edge;
- coverage, percent coverage description (see Figure 4.5).

REPORTING AUTHORITY	AIRCRAFT REG	MISSION No	CAPTAIN	CO PILOT	OPERATOR	OBSERVER	DAY	DATE	MONTH	YEAR

FLIGHT TYPE	ROUTE / AREA				TIME OVER THE SEA DAY		TIME OVER THE SEA NIGHT		TOTAL TIME OVER THE SEA	
					hrs	mins	hrs	mins	hrs	mins

No	AREA CODE	TIME UTC	POSITION		DIMENSIONS		AREA COVER	OILED AREA	OIL APPEARANCE COVERAGE (PERCENTAGE - %)						MINIMUM VOLUME	MAXIMUM VOLUME	COMBAT
			LATITUDE 'NORTH'	LONGITUDE 'EAST/WEST'	LENGTH Km	WIDTH Km	%	Km^2	1	2	3	4	5	Oth	m^3	m^3	Y / N

No	POLL TYPE	DETECTION						PHOTO	VIDEO	FLIR	WEATHER					REMARKS
		SLAR	IR	UV	VIS	MW	LF	Y / N	Y / N	Y / N	WIND	CLOUD	VIS	SEA	Wx	
											°	FT				
											°	FT				
											°	FT				
											°	FT				
											°	FT				

No	REMARKS	OIL APPEARANCE TABLE			
		No	OIL APPEARANCE DESCRIPTION	MINIMUM VOLUME m^3 / km^2	MAXIMUM VOLUME m^3 / km^2
		1	SHEEN	0.04	0.30
		2	RAINBOW	0.30	5.00
		3	METALLIC	5.00	50.0
		4	DISCONTINUOUS TRUE COLOUR	50.0	200
		5	TRUE COLOUR	200	>200

Figure 4.3: Standard pollution observation/detection log example (OSRL, 2017)

Code	Description/ Appearance	Layer Thicknesss Interval (Microns)	Litres per km²	Typical Appearance
1	Sheen (silver/grey)	0.04 - 0.30	40 - 300	
2	Rainbow	0.30 - 5.0	300 - 5000	
3	Metallic	5.0 - 50	5000 - 50.000	
4	Discontinuous True Oil Colour	50 - 200	50.000 - 200.000	
5	ContinuousTrue Oil Colour	>200	>200.000	

Figure 4.4: The BAOAC for categorising slick thickness and colour (OSRL, 2018)

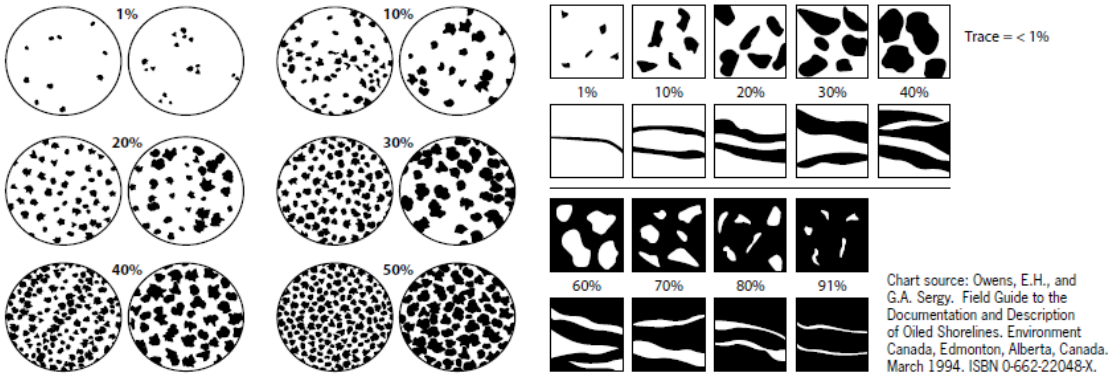

Figure 4.5: Percent coverage chart (AMSA, 2016)

4.10 Visual Observation of Megafauna

The purpose of this survey is to record and collate observations of any marine megafauna during the implementation of OMP1 Given the low precision of data/knowledge on the distribution and abundances of most marine fauna in the area, quantification of abundance is unlikely. Qualitative data on numbers of marine fauna recorded, presence and any behavioural impacts will be recorded. Methods are principally designed to collect information on presence/absence, mortality and the status of those individuals encountered (i.e. behaviour, oiling, etc.).

Aerial Survey

Aerial surveillance for marine fauna should ideally be undertaken daily in conjunction with the aerial survey OMP1. As such the survey will only detect visible animals without confidence of estimates of abundance. Visual and photographic/video data should be collected and information on sea state and flight path as outlined below. Ideally the following should apply if possible:

- Information is to be recorded about sea state (using Beaufort Sea state scale), cloud cover (in octaves), glare (strength and area affected) and overall sighting conditions (good; moderate; poor) at the beginning of each survey and when conditions change.
- Line-transect, extending 400 m either side of the flight path, for a flight time of approximately ten minutes are to be completed with observers recording numbers and identification to the lowest taxonomic level possible (see AMSA 2016).
- Flight paths should be confirmed prior to each flight, but strip transects should be based on a grid or ladder approach to capture both the area affected by the slick, and the unaffected area immediately around the slick.
- All sightings are to be marked with location coordinates (GPS).
- Data is to be collected in standardised observation logbook records. For each cetacean sighting, data collated should include: location; species; group size; group composition (adults and calves); behaviour (directional swimming; non-directional swimming; feeding; resting), cue (underwater; body at surface; splash; blow); swimming direction and reaction to the survey craft.
- Video (high definition) and photographic (still image) data is to be collected to provide a permanent record (if possible).
- 500 ft is the preferred flight height for identification purposes but will be dependent on the flight height utilised for the aerial surveys.

Vessel Surveys

A vessel-based survey for presence of marine mammals is likely to occur opportunistically. If required, the IMT leader has authorisation to request vessel resources. Refer to Section 3.

Gathering observational data on any marine mammals in close proximity to the surface slicks and documenting any unusual behaviour or ill health will be undertaken in addition to details on species, location, etc.

Standardised survey methods can however still be applied by a trained observer and include the following:

- Position the observer at the highest accessible point.
- At the beginning and end of each observation period record time, ship's location, course and speed. Record information on sea state (using Beaufort Sea state scale), cloud cover (in octaves), glare (strength and area affected) and overall sighting conditions (good, moderate, poor) at the beginning of each survey and when conditions change.

- Collect effort data every 30 minutes, or more frequently if there are marked changes in ship course or speed, or sighting conditions change.

Aerial observations will be made concurrent with vessel and/or ground-based surveillance where required.

4.11 Personnel Resource Requirements

Given the small area with any surface expression of floating oil, a single aircraft and observer are considered appropriate for mapping the floating oil distribution. Opportunistic observations of Marine Megafauna would be recorded during each aerial survey.

The monitoring team would be required to consist of at least:

- 1 x trained observer
- 1 x person with oil spill assessment training
- Vessel and aircraft operators

Additional shoreline assessment teams would be mobilised as required.

5. OMP2 – MONITORING OF HYDROCARBONS: WEATHERING AND BEHAVIOUR IN MARINE WATERS

5.1 Monitoring Rationale

Each spill will have unique physical and chemical properties and behaviours when released to the environment. This will be dependent on the type of oil, sea temperatures and weather conditions as well as how the oil is released (e.g. a subsurface or surface release). Hence it is necessary to establish a fingerprint of the freshly released oil. Once hydrocarbons have been released to the environment, weathering and/or attenuation processes such as evaporation, dispersion, dissolution and sedimentation will lead to the degradation or removal of hydrocarbons from the water column, while emulsification can result in its persistence. The speed and importance of these processes will depend on the components within the hydrocarbon involved in the spill and the oceanographic conditions present at the time of the spill. Therefore, the fate (where it goes) and its persistence (how long it remains in the system) can vary considerably in time and space. While laboratory analysis has been undertaken to determine the chemical and physical properties of Woollybutt crude, monitoring the changes to the oil properties during a spill is still required to verify the laboratory results and to feed back into the current and planned spill response operations. Various spill response actions will depend on the physical properties of oil (e.g. viscosity can affect skimming operations) and the information will inform what strategies will be most effective.

Sampling of hydrocarbons in the water column will provide data on the behaviour of the hydrocarbon, its dispersal, and the chemical properties and toxicity of compounds as it weathers (which will be used to predict effects on the identified resources and receptors at risk).

5.1.1 Objectives

The objectives of this OMP are to:

- provide field-based information on the presence, type, quantity, properties, behaviour and weathering of the spilled oil to assist in spill response operations;
- provide information on the temporal and spatial extent of the hydrocarbon plume
- determine the distribution and concentrations of hydrocarbons in the water column during the spill event

The information collected under this OMP will be used to feedback into OMP1 for input into the forecast modelling and verification of the surveillance observations.

5.2 Resources Available

See Table 5.1 for available resources. Contracts are summarised in Section 1.5.

Eni through OSRL have access to an Autonomous Underwater Vehicle (AUV). OSRL have partnered with Blue Ocean Monitoring Limited and an agreement provides OSRL access to Blue Oceans Riptide and Slocum Glider for preparedness and response operations. The AUV capability is provided on a best endeavours basis.

Eni also have access to Turner C3 Fluorometers through OSRL which can be attached to the AUV or deployed separately in a towed configuration. To monitor for the presence/absence of hydrocarbons in the water column, water samples would be analysed under an existing agreement with Intertek laboratory.

Table 5.1 Resources available for OMP2

Resource	Provider	Timeframe
1 x Turner C3 Fluorometer (submersible) 1 x OSRL fluorometry unit operator	[redacted]	24 hours (OSRL personnel)
1 x Autonomous underwater vehicle (AUV) with fluorometry sensor 1 x AUV engineer	[redacted]	Best endeavours basis
Vessels	[redacted]	Vessels within 24 hours of mobilisation.
Laboratory analysis services and sample containers	[redacted]	Typically 48 hours – 5 days to raise a PO

5.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency.

5.4 Termination of this Plan

This plan can be terminated by the Control Agency when:

- it can be demonstrated that no further environmental improvement outcomes can be achieved through continued implementation of this OMP;
- physical response options are no longer being considered and/or implemented;
- it is determined that there is no risk of shoreline impacts from the spill;
- Monitoring objectives have been met.

5.5 Survey Methodology

Sampling design will be confirmed with the ENI IMT prior to mobilisation of the vessel to the spill location. Sample design will be depend on the location of the spill (surface/subsurface).

It has been estimated that in a first strike response a field team using a single vessel will be capable of covering 27 nm / day per (12 hour) day during towed sampling activities. This figure is calculated with the following equation;

Max sample speed = 2 knots = 2.3 nm/h

12 hour day x 2.3 nm = 27.6 nm a day / vessel

This sampling range is considered appropriate to cover an advancing spill front in the early phases of a response.

5.5.1 Water sampling

Water samples will be collected as part of this program to verify chemical, hydrocarbon and nutrient concentrations. Water samples would be collected during fluorometry tows.

5.5.2 Laboratory Analytical Methods

Water samples will be analysed by Intertek laboratory for the following analytes:

- Total recoverable hydrocarbons (TRHs);
- Polycyclic Aromatic Hydrocarbons (PAHs); and
- BTEX.

Water sampling laboratory analyses, in particular TRH, will be used to better interpret field fluorescence data. Eni has a contract with Intertek for laboratory services, including the above analysis. Unless otherwise advised by ENIs IMT Leader, samples will be sent to Intertek's Darwin laboratory for analysis.

5.6 Equipment

Several specialised pieces of equipment will be used to undertake OMP2 in the event of a spill. The equipment is specified below:

- ***fluorometers*** and backscatter sensors to detect hydrocarbon presence and estimate oil concentrations in the marine environment.
- ***water sampler*** to undertake water sampling alongside the fluorometry tows to allow for the potential to calibrate the fluorometry unit.

5.7 Data and Information Requirements

This OMP will rely on the outputs from the OMP1 and on the extent of the oil spill from both the predictions of the oil spill distribution and oil spill surveillance.

Table 5.2: Data and information requirements for OMP2

Information	Details
OMP1	Distribution of oil.
Metocean data	Integrated Marine Observing System (IMOS): http://imos.aodn.org.au/imos/
Real-time meteorological data	www.bom.gov.au/wa/observation
	www.eldersweather.com.au/wa
	www.transport.wa.gov.au/imarine/19138.asp
Satellite imagery	https://asset.joubeh.com/

5.8 Logistics

Monitoring equipment will be sourced locally where available, otherwise typically transported to Darwin by commercial flight.

BOM personnel and AUV (through OSRL) are based in Perth and BOM will organise transport to Darwin via commercial flight. The AUV will be mobilised to the spill location by vessel and deployed into the water by a davit arm or crane.

Implementation of this OMP will require a field deployment vessel. The vessel specifications should allow for;

- covering the required sampling area
- vessel class and service category
- safe access to water for sampling; and
- davit arm or crane for AUV deployment, if required.

It is expected to be no larger than the project vessel used for the Woollybutt activities.

Table 5.3: Logistics for OMP2

	Location	Mobilisation/deployment
Sampling and analysis equipment	Darwin and interstate	Mobilisation to Darwin by commercial flight Deployment to spill location by vessel (Eni)
OSRL fluorometer	Singapore	
BOM AUV	Perth	Mobilisation to Darwin by commercial flight (organised by BOM) Deployment to spill location by vessel (Eni) and into water by davit arm or crane
Charter vessels	Darwin	Mobilise from Darwin Harbour and arrive at spill location within 72 hours.

Refer to Section 3 for deployment of vessels.

5.9 Personnel Resource Requirements

A single monitoring unit (Autonomous Underwater Vehicle (AUV) equipped with fluorometer or towed fluorometry unit) is considered suitable to monitor the progressing spill front.

The monitoring team would be required to consist of at least:

- 1 x AUV engineer to operate the AUV and support data integration into a response (the engineer would be sourced from the AUV provider); and
- 1 x vessel and crew for AUV deployment.

OR

- 1 x OSRL personnel to operate the OSRL fluorometry unit; and
- 1 x vessel and crew for towing the fluorometry unit.

6. OMP3 – SHORELINE ASSESSMENT SURVEYS

6.1 Monitoring Rationale and Objectives

Understanding the extent and nature of shoreline predicted to be, or actually contacted by a hydrocarbon spill, is critical to developing an effective spill response. The collection of data on the shoreline condition should be undertaken in a rapid and systematic way, taking account of spill conditions and hydrocarbon type.

The scope of OMP3 is to provide a rapid assessment of shoreline areas to determine the scale of hydrocarbon contamination and to inform treatment/cleanup response options, constraints or limitations. Geographical and spatial results of the shoreline and/or oiling conditions will be used by the IMT for response planning. Information obtained in OMP3 may also inform long-term scientific monitoring of shoreline habitats under SMP2 and SMP5.

6.1.1 Objectives

The objectives of this OMP are to:

- undertake a preliminary assessment of the shoreline and coastal habitats to assist in making decisions on appropriate management and response actions and inform scientific monitoring;
- provide a high-level determination of potential effects on shoreline communities in order to inform clean up, deflection or containment operations; and
- identify post-spill physical characteristics of the shoreline in terms of access constraints and substrate.

The priority for gathering rapid shoreline data is for enabling the operational response. Consideration should be given to scientific data needs but not at the expense of the operational requirement for rapid access to data to inform the planning of an appropriate response.

6.2 Resources available

See Table 6.1 for available resources. Contracts are summarised in Section 1.5.

The IMT Leader has authorisation to request the mobilisation of OSRL, AMSA or AMOSC resources if required or requested by the Control Agency.

Table 6.1 Resources available for OMP3

Resource	Provider	Timeframes
Shoreline assessment team Shoreline surveyors	[redacted]	Onsite within 5 days, or 24 hours prior to shoreline contact (if prolonged time to shoreline contact).
Unmanned aerial vehicle (UAV)	[redacted]	Best endeavours

Resource	Provider	Timeframes
Vessels	[redacted]	Visual observations from chartered vessels occur within 72 hours of mobilisation.
Aircraft	[redacted]	Visual observation – from aircraft/ helicopter within 24 hours of mobilisation.

6.2.1 Shoreline Assessment Teams

Shoreline Assessment Teams will be deployed initially with the specialist skills to make an assessment of the actual and potential impact to the shoreline sensitivities and the resources that are required to implement a clean-up operation.

Shoreline assessment team onsite within 5 days, or 24 hours prior to shoreline contact (if prolonged time to shoreline contact). Initial assessment of shoreline areas predicted for impact would take initially 1-2 days post spill.

6.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency.

6.4 Termination of this Plan

This plan can be terminated by the Control Agency when:

- it can be demonstrated that no further environmental improvement outcomes can be achieved through continued implementation of this OMP;
- physical response options are no longer being considered and/or implemented;
- it is determined that there is no risk of shoreline impacts from the spill;
- Monitoring objectives have been met.

6.5 Survey Methodology

The shoreline assessment is intended to document and quantify hydrocarbon spill extent at the shoreline to determine condition and to assess potential impact. This information will be used by the IMT to determine the most appropriate response. Execution of sampling and communication of results are required quickly, with initial information typically necessary for approval to implement response activities by regulatory agencies.

Following a hydrocarbon spill, a judgment must be made about whether monitoring is "necessary", and whether the scope of the monitoring is "reasonable", to reach appropriate spill response decisions in an appropriate time frame, and with an acceptable level of accuracy. This OMP outlines a range of methods to allow flexibility for planning a monitoring program that will account for individual spill conditions, the nature of the hydrocarbon released, and the emergency response implemented.

The approach outlined includes elements of published guidelines for a Shoreline Clean-up Assessment Technique termed SCAT (e.g. NOAA 2000, Maritime and Coastguard Agency 2007) to collect data on shoreline oiling conditions and support decision-making for shoreline cleanup. The SCAT process continues past the initial assessment to verify clean-up effectiveness and conduct final evaluations.

Detailed methods have been divided into the following components:

1. Pre-survey Planning.
2. Field Survey.
3. Monitoring Design.
4. Reporting.

Table 6.2 identifies the processes, rationale and monitoring methods that will be applied to pre-survey planning and field surveys in OMP3.

Table 6.2: Objectives, rationale and monitoring methods that will be applied to pre-survey planning and field surveys in OMP3. Guideline refers to those listed in AMSA (2016)

Primary Objective	Rationale	Secondary Objectives	Monitoring Method
Shoreline Assessment	Geographical distribution influences monitoring design	Collect qualitative information on the presence/absence of environmental receptors at affected shorelines. Verify aerial surveys and existing data.	Video/photographic records
			Determine sector segment boundaries
			Characterise substrate
			Determine beach profile
			Determine surface oil
			Determine subsurface oil
			Field detection of petroleum hydrocarbons

6.5.1 Pre-survey Planning

A rapid review of the extent and condition of habitat types will be conducted on impacted and at risk of being impacted shorelines as determined by the monitoring of hydrocarbon distribution (OMP1) and the fate and effects of hydrocarbons (OMP2). The shorelines will be assessed with regards to their sensitivity to impacts from the hydrocarbon spill and accessibility for clean-up operations. Pre-survey planning includes:

- identification of shoreline segments;
- determination of the survey requirements; and
- preparation for field survey.

A guideline for designing a monitoring program is provided (see AMSA 2016). This guideline forms the basis of the following pre-survey planning considerations.

Identification of Shoreline Segments

A guideline for selecting shoreline segments is provided (see AMSA 2016). Shoreline segments will be defined using the following considerations:

- Likelihood of hydrocarbon contact on shorelines as determined in OMP1.
- Homogeneity of habitats, physical features and sediment type to define shoreline segments and assign location identifier.
- Determine segment length considering resolution needs to detail the distribution of hydrocarbon. As a guide, segments should be in the range of 0.2–2 km in length.
- Practical aspects that can be used by the IMT for deployment of response (i.e. access and staging locations).

Determination of Survey Requirements

The scale of the spill will determine the level of effort required for the shoreline assessment study. Planning of the survey method should take into account the following questions to specify if the proposed survey is "reasonable" and "appropriate" in scope, design and subsequent cost:

- Are results of significant value in the design, execution or assessment of response actions?
- Is the scope of the programme, and speed of obtaining results, the minimum necessary to fulfil the stated objectives?

To execute the OMP, decisions are required by the IMT for each of the four monitoring components which include:

- Ground Surveys: What physical, biological and chemical variables do we need to consider in the shoreline cleanup? At what scale will the information be collected:
  - Broad-scale: Information required over multiple segments which would include combined aerial and/or remote sensing surveys with ground surveys.
  - Medium-scale: A small number of segments required for sampling using broad scale ground survey methods.
  - Fine-scale: Data required from targeted segments.
- Develop clean-up guidelines: What is the required communication timeframe? What clean-up methods are inappropriate and can be removed from consideration before monitoring?

Preparation for Field Survey

The IMT will need to plan for shoreline assessments prior to mobilising the field team. A typical field plan may incorporate the following considerations:

- Identify and acquire shoreline assessment survey equipment, create checklist before mobilising to field.
- Identify requirement for aircraft, vessels, or special vehicles for remote locations.

- Development of the types of communications needed (e.g. radios, cellular phones) between field team and IMT.
- For each shoreline type, identify clean-up methods that will not be suitable for the habitat. This will limit the field evaluation to only those methods which may be approved.
- Identify other OMPs which may operate simultaneously with the rapid shoreline assessment study.

6.5.2 Field Survey

Aerial Surveillance

A guideline for undertaking aerial surveillance of shorelines is provided (see AMSA 2016). Aerial surveillance provides a reliable and rapid method for defining the overall extent of a spill area, and identifying oiled shorelines and those at threat from the spill. A guideline for identifying extent and distribution of oiled shorelines is provided (see AMSA 2016). Photos, video, mapping and verbal feedback all provide basic information that can be used to define information needs and response priorities. Helicopters can be useful in combining aerial surveillance with ground surveys.

Ground Surveys

Ground surveys allow more detailed observations of shoreline conditions including the physical structure, ecological character, and human use of shorelines. This monitoring approach can provide comprehensive detail on the resources and activities likely to be affected by a spill, the potential extent of oiling and logistical considerations for different response methods.

Rapid shoreline survey methods will be agreed by the IMT to ensure the priorities relating to the spill response activities are the primary objective of the ground survey. Ground surveys for operational monitoring will target potential impact areas.

Physical Monitoring

Physical monitoring will determine how oil will behave over time, how the shoreline can most effectively be cleaned and the likelihood that it can be damaged by oil and clean-up activities. The physical character of the shoreline segment will be described in terms of:

- Verification of the extent of shoreline habitat and segment boundaries.
- Surface and sub-surface oil observations (see AMSA 2016).
- Substrate type (see AMSA 2016).
- Form: geomorphological type, dimensions, profile or gradient (see AMSA 2016).
- Energy: winds, waves (see AMSA 2016)
- Provide photographic evidence and observation of access restrictions.

6.5.3 Reporting

Shoreline assessment should be entered into established forms and communicated to the shoreline assessment coordinator on a daily basis. Communications will include recommended clean-up methods, with consideration of NEBA to inform response strategies (Efroymson et al. 2003; IPIECA 2000). Shoreline clean-up methods must:

- specify generic and site-specific constraints for clean-up activities;
- determine the need for follow-up surveys if sensitive resource values are present;
- establish clean-up priorities for shoreline resources; and
- identify safety concerns for clean-up operations.

A final report for OMP3 will be prepared post the rapid shoreline assessment study. It is essential survey reports include detailed information on the methods used and the level of search effort adopted. This includes who was involved, what work was done, where the work took place, when the survey occurred and how the survey was carried out. The final report should follow the standard aims, methods, results and discussion format common to all scientific research.

6.6 Data and Information Requirements

Information on the hydrocarbon distribution (OMP1 and OMP2) will be essential for development of an appropriate assessment design and to define the overall scope of this OMP. In addition, the following existing data and information will be reviewed as part of OMP3:

- mapping of sensitive resources and key receptors;
- review available previous shoreline survey data;
- review ongoing monitoring data of shorelines; and
- knowledge of current survey designs implemented for other OMP activities, and if available any proposed designs for SMP activities.

Key data related to the above categories can initially be acquired from the Australian Ocean Data Network (AODN), which is a publically funded data repository.

6.7 Field Equipment

Typical monitoring equipment:

- tide tables;
- clipboards and data sheets;
- radio;
- compass;
- ruler;
- tape measure;
- flags and stakes (to mark the location of buried oil);

- camera and video equipment; and
- GPS.

6.8 Logistics

Implementation of this OMP will require a field deployment vessel or aircraft. The vessel or aircraft specifications should allow for covering the required sampling area and safe access to water for sampling. The vessel that would be used is expected to be no larger than the project vessel used for the Woollybutt Operations.

A field vessel or aircraft will be deployed within 72 hours from Darwin.

Shoreline assessment teams will be deployed from Perth and Darwin (AMOSC) and Singapore (OSRL).

Refer to Section 3 for deployment of vessels.

6.9 Personnel Resource Requirements

Shoreline impact is only predicted in the event of an extended spill (365 days), which would result in low shoreline loadings at a number of coastlines. A single response team with (1 x shoreline assessment team lead and 2 x shoreline surveyors) may cover approximately 2km per day. Additional shoreline assessment teams would be mobilised as required

Field teams will use individuals who are trained in techniques, procedures, and terminology of shoreline assessment. Team members are required to have a thorough understanding of the response goals and objectives and will consider safety concerns in cleanup recommendations. Shoreline assessments should be carried out by teams assigned to individual, pre-defined coastline segments. It is recommended that an assessment team comprises of individuals with the following skills:

- Hydrocarbon spill experience and SCAT training – to identify and document hydrocarbon distribution (from air or ground).
- Emergency response representative – to identify logistical and other feasibility issues and evaluate likely resources required and level of effort where cleanup/treatment is required.

Where more than one survey team is deployed, a Shoreline Assessment Coordinator experienced in hydrocarbon spill assessment and coordination may be required and will act as a communication point between the field teams and the IMT. This coordinator will be providing the following information to the IMT:

- prioritisation of shoreline segments;
- consideration of access and staging issues;
- potential clean up options; and
- report and map-generation.

Support staff includes office-based personnel, vessel aircraft crews and IMT communications support will be required to support rapid shoreline assessment field teams.

7. SMP1 – WILDLIFE IMPACT MONITORING AND SAMPLING

7.1 Monitoring Rationale

During the operational phase of the response data would be collected as part of the Oiled Wildlife Response (Section 8.4 of the Woollybutt Oil Pollution Emergency Plan). Following the cessation of the oiled wildlife response this program would be mobilised to assess and quantify impacts and to provide ongoing support should oiled wildlife be observed that were not detected as part of the Oiled Wildlife Response.

In the event of a hydrocarbon spill a number of OMPs will be initiated. Monitoring of wildlife will be continued throughout the response activities, including opportunistic observations from aircraft, vessels and the shoreline during the implementation of OMP1, OMP2 and OMP3. This data would be used when assessing the impact to wildlife.

7.1.1 Resources at Risk

The key sensitive receptors that may be affected from an accidental oil spill including that will be assessed under SMP1 are:

- marine mammals;
- marine reptiles;
- fish and sharks;
- avifauna.

7.1.2 Objectives

The objectives of this SMP are to:

- undertake wildlife impact monitoring and sampling to determine the cause of death for wildlife carcasses (i.e. tissue analysis) following the cessation of the oiled wildlife response.
- Determine the potential impact to wildlife populations.

7.2 Resources Available

See Table 7.1 for available resources. Contracts are summarised in Section 1.5.

Table 7.1 Resources available for OMP1

Resources	Provider	Timeframes
Wildlife monitoring team (2 x MFOs)	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2
Vessels	[redacted]	Visual observations from chartered vessels occur within 72 hours of mobilisation.

Resources	Provider	Timeframes
Aircraft	[redacted]	Visual observation – from aircraft/ helicopter within 24 hours of mobilisation.

During the operational response phase impacts to wildlife would be recorded as part of the Oiled Wildlife Response. Following the cessation of this response SMP1 would be mobilised to determine whether any wildlife deaths may be attributable to the spill through tissue analysis.

As this response would be mobilised following the operational phase of the response, sufficient time would be available to contract the require resources for this program, which may include:

- Marine megafauna observers
- Marine avifauna specialists
- Vets for the collection of tissue samples following the death of wildlife
- Aircraft to complete marine megafauna and avifauna surveys
- Laboratory to complete tissue analysis

Eni also maintains an Environmental and Social Impact Consultancy Services Panel. The panel includes Marine Scientists and Consultants with the ability to assess the data from the operational and post response phase and assess the impacts to wildlife. Eni Headquarters also may provide specialists to assist.

7.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency in response to a Level 2 or Level 3 spill if impacts to wildlife are observed in the Oiled Wildlife Response or during the implementation of OMP1, OMP2 or OMP3.

7.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- Measures have been taken to assess the effects or impact of the spill on marine wildlife.
- Restoration of key biological processes (e.g. abundance, distribution, breeding) necessary to ensure post-impact recovery is demonstrated and/or can be predicted.
- Spill impacts on marine wildlife are no longer detectable.
- Consultation with relevant stakeholders has determined that no further monitoring is required. For example, consultation with the DNP for termination of monitoring within the JBG AMP.

- Monitoring objectives have been met.

7.5 Survey Methodology

Vessel and Aerial reconnaissance surveys may be used to record and collate observations of any marine mammals within the area of interest using reconnaissance aerial or boat based surveys. Rapid and systematic identification is required using standardised survey protocols. Given the low precision of data/knowledge on the distribution and abundances of most marine fauna in the Joseph Bonaparte Gulf area, quantification of abundance is unlikely. Qualitative assessment, and assessment of numbers, presence and any impacts to individuals, where observed, is however possible. Methods are principally designed to collect information on presence/absence; mortality and the status of those individuals encountered (i.e. behaviour, oiling etc.).

Methods have been divided into the following components:

- pre-survey planning (see Section 7.5.1); and
- field survey assessment (see Section 7.5.2).

It is important to note that the priority of resources and receptors and the sites themselves will change under different spill or weather conditions, the seasonal presence of key species, or the life stage of the species present. It is likely that a judgment will need to be made at the time of the survey about the relative value of different sites and sampling design.

A degree of flexibility is therefore required in the implementation of the SMP. Details of methods provided below outline a number of potential approaches to the collection of the necessary information. The actual methods to be used should be selected at the time of the survey.

7.5.1 Pre-survey Planning

Given the impracticalities of monitoring all potential receptors under the marine megafauna grouping, the use of indicator species will be used to provide a method to track the potential impact.

Depending on location of the spill and its predicted extent, potential indicator species for assessing impact to marine mammals have been identified. The selection of indicator species has been based on:

- currently available information/data on abundance/distribution/migration patterns within the region;
- ability to observe/detect and correctly identify the species;
- likelihood of exposure to hydrocarbons;
- sensitivity to hydrocarbon spills;
- regulatory protection status (i.e. EPBC listed species).

Based on these considerations, the recommended indicator species includes:

- flatback turtles;

- olive ridley turtles;
- Irrawaddy dolphin;
- Snubfin dolphin;
- Indo-Pacific humpback dolphin; and
- avifauna.

7.5.2 Field Survey Assessment

Aircraft can survey large areas and inaccessible areas in a short space of time. Aerial surveys also reduce the risk of double counting that can potentially occur from boat-based surveys. This platform works well for larger marine mammals and where waters have good light penetration and visibility. Aerial survey methods however do not provide robust counts for inshore dolphin populations where shallow waters are turbid. Visual assessments using this approach will include the potential for under-reporting. In such instances where the ZPI includes shallow coastal waters, vessel based surveys are likely to be more suitable (taking into account safety considerations). Consideration of the environmental conditions at the time of survey will influence what survey platform is most appropriate.

Aerial Survey

Aerial surveillance for marine fauna should ideally be undertaken weekly. The survey will only detect visible animals without confidence of estimates of abundance. Visual and photographic/video data should be collected and information on sea state and flight path as outlined below. Ideally the following should apply if possible:

- Record information on sea state (using Beaufort Sea state scale); cloud cover (in octaves); glare (strength and area affected) and overall sighting conditions (good; moderate; poor) at the beginning of each survey and when conditions change.
- Line-transect, extending 400 m either side of the flight path, for a flight time of approximately 10 minutes are completed with observers recording numbers and identification to the lowest taxonomic level possible (see AMSA 2016).
- Flight paths should be confirmed prior to each flight, but strip transects should be based on a grid or ladder approach to capture both the area affected by the slick, and the unaffected area immediately around the slick.
- All sightings to be marked with location coordinates (GPS).
- Data to be collected in standardised observation logbook records. For each cetacean sighting, data collated should include: location; species; group size; group composition (adults and calves); behaviour (directional swimming; non-directional swimming; feeding; resting), cue (underwater; body at surface; splash; blow); swimming direction and reaction to the survey craft.
- Video (high definition) and photographic (still image) data is collected to provide a permanent record (if possible).
- 500 ft is the preferred flight height for identification purposes.

Vessel Surveys

A vessel-based survey for presence of marine mammals is likely to be required if the slick has contacted nearshore environments with high turbidity. Gathering observational data on any marine mammals in close proximity to the surface slicks and documenting any unusual behaviour or ill health will be undertaken in addition to details on species, location etc.

Standardised survey methods can however still be applied by a trained observer and include the following:

- Observer should be positioned at the highest accessible point.
- At the beginning and end of each observation period record time; ship's location, course and speed. Record information on sea state (using Beaufort Sea state scale); cloud cover (in octaves); glare (strength and area affected) and overall sighting conditions (good; moderate; poor) at the beginning of each survey and when conditions change.
- Collection of effort data each 30 minutes, or more frequently if there are marked changes in ship course or speed, or sighting conditions change.

An example data record sheet is shown in Table 7.2. This provides an example of the type of information that should be recorded during the survey.

Table 7.2 Example marine fauna data record sheet

Resource	Type/Species	Number	Location	Behaviour/Comment
Turtles	Species Age/size	Adult _____ Juvenile _____	Lat _____ Long _____	Nesting activity. Proximity of oil to nests. (surface and subsurface). Observed oiling of turtles. Observed behaviour/fitness of turtles if present. Carcases.
Dolphins	Age/size	Adult _____ Juvenile _____ Calf _____	Lat _____ Long _____	Proximity of oil. Observed oiling of dolphins. Observed behaviour/fitness. Carcases.
Sea snakes	Species Size		Lat _____ Long _____	Breeding or other activity. Observed oiling of snakes. Observed behaviour/fitness of snakes. Carcases.
Birds	Species Age/size	Nesting Roosting	Lat _____ Long _____	Proximity to oil to nests and roosting areas. Location of roosting/ nesting activity Observed oiling. Observed behaviour/fitness of birds. Presence of oil on eggs (if present). Carcases. Hatching or fledging rates.

Resource	Type/Species	Number	Location	Behaviour/Comment
Other Details for each Observation Location				
Ambient Conditions at Each Location	Date:		**Photographic/ Video Record**	Date and Time of Each:
	Time:			Video/Photo Clip Number:
	Weather Conditions:			Brief Description:
	Visibility:			GPS Link:

7.5.3 Live Stranding and Carcass Recording

Any live strandings or carcass recordings within the area affected by the spill should be recorded as follows. Trained professionals will need to be involved in the handling of any marine mammal strandings encountered. In Western Australia, Wildcare (08 9474 9055) is the lead stranding network organisation. In Northern Territory, Marine Wildwatch (1800 453 941) is the lead stranding network organisation.

During the operational phase, recording of strandings information will be required. Where carcasses are observed physical details (species, length, sex, condition, etc.) will be documented and photographs taken.

It may be appropriate to collect tissue samples which will be analysed. The state of decomposition of any carcasses will need to be evaluated to determine the viability of the collection of samples for specific analysis, with some analysis unlikely on severely decomposed carcasses.

Standardised protocols are available for carcass handling with the following to be adopted:

- DoEE 2006, *Standardised protocols for the collection of biological samples from stranded cetaceans*, Department of Environmental and Heritage. View at <https://www.environment.gov.au/resource/standardised-protocols-collection-biological-samples-stranded-cetacean>.
- Eros C, Marsh H, Bonde R, O'Shea T, Beck C, Recchia C, Dobbs K, Turner M, Lemm S, Pears R and Bowater R, 2007, *Procedures for the Salvage and Necropsy of the Dugong* (*Dugong dugon*). Second Edition. Great Barrier Reef Marine Park Authority. View at <http://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/403/1/Procedures-for-the-salvage-and-necropsy-of-the-Dugong-Dugong-Dugon.pdf>.
- Flint M, Patterson-Kane JC, Mills PC, Limpus CJ, 2009, *A veterinarian's guide for sea turtle post mortem examination and histological investigation*. View at <https://veterinary-science.uq.edu.au/filething/get/4226/pm-guide-msf.pdf>.

In most instances the cause of death will not be determined until tissue is analysed.

Trained professionals will need to be involved in handling any strandings encountered. Where carcasses are observed, physical details (species, length, sex, condition, etc.) will be documented and photographs taken. There will also be a need to collect basic biological information and where appropriate tissue samples for laboratory analysis. Where appropriate, a necropsy should be undertaken by a pathologist to determine cause of death. Careful and consistent documentation of strandings is needed and clinical pathology is required to determine whether the cause of the mortality can be attributed to the oil spill event.

Table 7.3: Wildlife data capture for every individual captured

Date and time of capture:		
Location of capture:		
Species:		
Degree of oiling: %	Cover of oil:	Oil distribution on body:
Condition of animal:		
Any field treatments:		

7.5.4 Laboratory

Carcasses of oil-affected wildlife should be retained and tested to determine their cause of death, including tissue sampling and/or external examination. The samples will be analysed for an agreed set of parameters which may include determining the concentrations of:

- polynuclear aromatic hydrocarbons (PAH) and the standard EPA list of 16 priority pollutants via normal phase silica chromatography and gas chromatography mass spectrometry (GCMS);
- saturated hydrocarbons in the C_{10} to C_{36} range via by flame ionisation gas chromatography (GC);
- volatile hydrocarbons via purge and trap into a GCMS.

As well as reporting on tissue levels of hydrocarbons, other diagnostic chemical characteristics relevant to the spilled oil (such as various ratios) will be screened to confirm contaminant source.

7.6 Data and Information Requirements

The information in Table 7.4 will be used to assist in collecting data for SMP1.

Table 7.4: Data and information requirements for SMP1

Information	Details
Standard Forms for Field Survey	See section 7.5.
Sensitive Resources and Receptors	i.e. Draft EIAs, EPs existing environment, etc.
OMP1, OMP2 and OM3	Observations and findings.

7.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used:

- survey platform: marine vessels;
- hand-held video camera;
- digital camera (with GPS where possible);

- GPS;
- a pair of binoculars;
- nautical charts;
- log book/observation sheets (see section 7.5).

7.8 Logistics

Implementation of this SMP may require aircraft or vessels. The vessel specifications should allow for storage of field equipment and samples.

A field vessel will be deployed within 72 hours from Darwin. Refer to Section 3 for deployment of vessels.

7.9 Personnel Resource Requirements

See Table 1.6 for the capability / personnel resourcing requirements for this program.

Table 7.5 Resources available for OMP1

Personnel	Duration	Required skills
2 x Marine Fauna Observers (MFOs)	Minimum one month	Marine mammal expert knowledge and field skills to identify and quantify abundance (essential). Experience in marine mammal surveys from aerial surveys (desirable).
1 x vet	As required	Veterinary and pathology expertise on call for diagnosis of cause of death with experience in record keeping (chain-of command procedures), and advising on diagnosis of death.

8. SMP2 – SHORELINE ECOLOGICAL ASSESSMENT AERIAL SURVEYS

8.1 Monitoring Rationale

SMP 2 helps to provide qualitative information on the presence/absence of species along the potentially affected shorelines. This study considers the seasonality of some species and habitats present on the shorelines of the Joseph Bonaparte Gulf including:

- Turtle Nesting
- Shorebirds
- Mangroves

The study would be used to inform the design of the shoreline ecological surveys (SMP5) which aim to quantify any potential impacts. Data from the aerial surveys may also be used when defining impact and reference locations.

8.1.1 Objectives

The objectives of this SMP are to:

- identify the presence and extent of environmental receptors pre-impact, including any existing damage;
- understand the spatial extent of the impact from the hydrocarbon spill on the environmental receptors;
- provide data to identify suitable impact and reference sites.

8.2 Resources Available

See Table 8.1 for available resources. Contracts are summarised in Section 1.5.

Data from OMP1 may be used to determine areas that are likely to have been impacted and data collected (aerial observation imagery overlapping shorelines, satellite imagery overlapping shorelines) may be used to support the targeted aerial surveys completed as part of the SMP2 program.

This monitoring program would be completed following shoreline contact from hydrocarbons and completion of the response. Eni maintains an Environmental and Social Impact Consultancy Services Panel. The panel includes Marine Scientists and Consultants with the ability to assess the data from the operational and post response phase for the presence/absence of receptors and to identify suitable impact and reference sites for the study design.

Table 8.1 Resources available for SMP2

Resources	Provider	Timeframes
Shoreline Ecological Assessment Team – fieldwork, reporting and GIS	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2

Resources	Provider	Timeframes
Unmanned Aerial Vehicle (UAV) drone and operators	OSRL Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	Best endeavours
Aircraft	[redacted]	Visual observation – from aircraft/ helicopter within 24 hours of mobilisation.

8.3 Activation of this Plan

OMP1 and/or OMP3 indicate shorelines have been impacted by hydrocarbons.

8.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- it can be demonstrated that no further environmental improvement outcomes can be achieved through continued implementation of this SMP;
- physical response options are no longer being considered and/or implemented;
- it is determined that there is no risk of shoreline impacts from the spill;
- Monitoring objectives have been met.

8.5 Survey Methodology

Georeferenced aerial imagery would be collected as part of OMP1. Data collected as part of OMP3 may also be used to supplement the data collected as part of OMP1.

Data would be interpreted in the IMT to determine whether the following is present/absent along the potentially affected shorelines:

- Turtle activity including nesting
- Aggregations of shorebirds at potentially contacted shorelines
- Mangrove stands and the inferred health of any mangroves from the aerial imagery.

8.5.1 Pre-survey Planning

It should be noted that SMP2 would not be used to assess impact, but that information collected as part of this program would be used to assist with planning more detailed quantitative assessments of shoreline impact as part of SMP5. Flight paths would be determined based on the shorelines that are potentially impacted/impacted by hydrocarbons.

8.5.2 Field Survey

Georeferenced imagery should be collected along the shorelines that may be impacted. The imagery should be of sufficient resolution to determine the presence/absence of hydrocarbons, shorebirds and evidence of turtle nesting activity (tracks).

The use of infra-red and false colour aerial surveillance techniques may be used to monitor environmental receptors, such as mangroves. Other remote sensing options may be explored depending on the environmental receptors impacted by the hydrocarbon spill.

Records of aerial photography and video footage can be used to aid scientists in determining the impact to shorelines from the spill and the rate of recovery post spill clean-up.

Aerial observations will be made concurrent with vessel and/or ground-based surveillance where required (see SMP5). Observations will be recorded using a data record sheet, for example the information listed in Table 8.2 and georeferenced imagery will be sent to the IMT for further analysis.

Table 8.2: Example aerial data record sheet

Resource	Form	Location	Description
Seagrass	Species Intertidal Emergent Subtidal	Start and stop: Lat _____ Long _____	Length along shore Distance from shore to seaward edge Percentage cover Percentage dead/discoloured (location if isolated)
Corals	Form Emergent Subtidal	Start and stop: Lat _____ Long _____	Length along shore Distance from shore to seaward edge Percentage cover Percentage dead/bleached (location if isolated)
Mangroves (wetlands)	Species Form	Start and stop: Lat _____ Long _____	Length along shore Distance from seaward edge to inner edge. Zonation if evident Percentage cover Percentage dead/discoloured (location if isolated)

Other Details for each Observation Location			
Ambient Conditions at Each Location	Date:	**Photographic/ Video Record**	Date and Time of Each:
	Time:		Video/Photo Clip Number:
	Weather Conditions:		Brief Description:
	Visibility:		GPS Link:

8.6 Data and Information Requirements

The following existing data and information will be reviewed as part of the SMP2 and used to assist in the assessment of the presence/absence of receptors.

Table 8.3: Data and information requirements for SMP2

Information	Details
Standard Forms for Field Survey	See Table 8.2.

Information	Details
Sensitive Resources and Receptors	i.e. Draft EIAs, EPs existing environment etc.
OMP1	Georeferenced imagery

8.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used:

- tide tables;
- clipboards and data sheets;
- radio;
- compass;
- camera and video equipment; and
- GPS.

8.8 Logistics

Implementation of this SMP will require suitable aircraft and aerial observers as required under OMP1.

8.9 Personnel Resource Requirements

Field teams will use aerial observers as outlined in OMP1. An Environmental Scientist (e.g. from the Environmental and Social Impact Consultancy Services Panel) will be used to interpret the aerial imagery data and provide an assessment on the presence/absence of environmental receptors.

Shoreline impact is only predicted in the event of an extended spill (365 days), which would result in low shoreline loadings at a number of coastlines. The initial shoreline monitoring team would be required consisting of:

- 1 x Drone operator (where the drone is soured through the Environmental Panel Contracts);
- 1 x Environmental Consultant for fieldwork;
- 1 x Environmental Consultant for reporting; and
- 1 X GIS specialist.
- 1 x subject matter expert selected from Table 1.10 or other suitable provider

Additional shoreline assessment teams would be mobilised as required

The OSRL unmanned aerial vehicle (UAV) team would consist of the following additional personnel

- 1 x experienced UAV pilot;
- 1 x Sensor operator; and
- 1 x OSRL response specialist.

9. SMP3 –ASSESSMENT OF FISH FOR THE PRESENCE OF HYDROCARBONS

9.1 Monitoring Rationale

The Operational Area is located approximately 40km west of Barrow Island. Commercial fisheries that operate in the waters of the NWS are centred in Onslow, 65 km to the south of the field; Exmouth, 120 km to the southwest, and Dampier, approximately 180 km to the east. This study focuses on the potential impacts to fish health.

9.1.1 Objective

The objective of this SMP is to monitor for any hydrocarbons in representative commercial and recreational fish species to assess impacts and recovery.

9.2 Resources Available

See Table 9.1 for available resources. Contracts are summarised in Section 1.5.

Personnel will use the recommended methods to collect, store and transport tissue and organ samples for analysis at NATA-accredited laboratories.

ENI can commission Lab analysis through Intertek. Eni has also identified alternative providers in Table 1.8.

Table 9.1: Resources available for SMP3

Resource	Provider	Timeframe
Fish assessment team and subject matter experts	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2
Laboratory analysis services	[redacted]	Typically 48 hours – 5 days (Intertek access)
Vessels	[redacted]	Vessels within 24 hours of mobilisation.

Table 9.2: Laboratory services contractor contact details

Company	Contact Details	Address
[redacted]	[redacted]	[redacted]

9.3 Activation of this Plan

This plan will be activated if:

- The IMT Leader requests to activate this plan if requested by the Control Agency in response to a Level 2 or Level 3 spill, as defined in Table 3.1 of the OPEP
- It is suspected (e.g. through public reports) that significant levels of hydrocarbons have contaminated commercial or subsistence fishing areas.
- Fishing vessels fish stocks, fishing equipment and/or by-catch have been exposed to hydrocarbons.

9.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- Physiological and biochemical parameters in the studied fish species are comparable with fish sampled from reference sites unaffected by the spill.
- Contamination in the edible portion or in the stomach/intestinal contents of fish attributable to the spill is no longer detected.
- Monitoring objectives have been met

9.5 Survey Methodology

9.5.1 Field Sampling

The most commercially important species in the area will be targeted as part of this SMP:

- Albacore Tuna (*Thunnus alalunga*); and
- Bigeye tuna (*Thunnus obesus*); and
- Yellowfin tuna (*Thunnus albacares*); and
- Broadbill sword fish (*Xiphius gladius*).

Of the targeted species, twenty fish will be collected within the oil-impacted area and the same number of samples from the control area.

Fish will be collected using long-lines from within a vessel at both impacted and control sites. The number of sites within each area will be determined at the time of the spill in accordance to the scale and nature of the spill.

Upon capture all fish will be identified, observed for any outwardly visible signs of abnormality or physical stress, and measured. The sex and reproductive stage will also be recorded. Approximately 100g of muscle tissue will be taken per sample for hydrocarbon analysis. The remaining muscle tissue will be kept for later taste or olfactory testing analysis if required. Two gut samples per species from each site will be kept for hydrocarbon analysis.

Water samples will be collected at each site using a weighted 1 L glass bottle which will be suspended 1 m below the sea surface. Each sample will be collected from an area ahead of the vessel (i.e. not disturbed by the passage of the hull). Two 1 L samples and one smaller 40 ml sample will be collected from each site. One 1 L sample will be immediately frozen, while the other 1 L and 40 ml sample will be refrigerated.

9.5.2 Sampling Protocol

To avoid hydrocarbon contamination from other sources, fish samples will be collected using the following protocol:

- Fish for analysis will be placed on a clean oil-free surface for examination and dissection. These surfaces will be cleaned with methanol prior to fish contact.
- All instruments will be cleaned with detergent and water and then rinsed with methanol.
- Tissues for hydrocarbon analysis will be placed in glass jars with Teflon-lined lids. A replicate sample will be wrapped in methanol-treated aluminium foil, then placed in a zip lock plastic bag.
- The jars and plastic bags will be labelled with all relevant information including: species, location, identification number and date.
- The sample number will be related to a record containing species name, size, type of tissue, handling details, capture location, capture depth and all observations of health, presence of visible oil, etc.
- All samples will be immediately placed in a freezer and transported frozen. The shipping container will have a "chain of custody tag" attached. This ensures samples can be tracked to ensure validity until they reach the analytical lab.

9.5.3 Laboratory Chemical Analysis

Fish samples will be defrosted and then prepared in a mechanical blender. Hydrocarbons will be extracted with dichloromethane. Internal standards will be added to extracts to track recovery. Extracts will then have interfering lipids removed by gel permeation chromatography. Half of the extract will be further cleaned by normal phase silica chromatography and analysed by selected ion monitoring for PAH by GC/MS. Samples will be analysed for the standard EPA list of 16 priority pollutants. A high ratio of phenanthrene to pyrene in samples would indicate unburned oil content.

The other half of the extract will be cleaned by acidified silica gel chromatography (Muijs and Jonker 2009) and analysed for saturated hydrocarbons in the C10 to C36 range by flame ionization GC.

Volatile hydrocarbons (C6 to C9) will be analysed by purge and trap into a GC/MS. An aliquot of methanol will be added to a water filled Purge & Trap vial and analysed by Purge & Trap GC/MS. This method is suitable for the determination of BTEX and hydrocarbons in the TPH C6 to C9 range.

The analysis will be done using GC/MS set to SIM/SCAN mode. All chromatograms will be checked for trace PAHs down to the detection limit i.e. the LOR is 0.01 mg/kg which equates to approximately 0.003 mg/kg detection limit. The GC/MS will also set up to analyse selected oil markers (tetramethyl naphthalenes and dibenzothiophene, SIM mode) which are good indicators (if used).

Eni has a contract with Intertek for laboratory services, including the above analysis. Unless otherwise advised, samples will be sent to Intertek's Darwin laboratory for analysis.

9.6 Data and Information Requirements

The information in Table 10.2 will be used to assist in collecting data for SMP3.

Table 9.3: Data and information requirements for SMP3

Information	Details
Sensitive Resources and Receptors	i.e. Draft EIAs, EPs existing environment, etc.
Fisheries Data	Effort and catch rate data from fisheries, location and number of fishing vessels, etc.
OMP1 and OMP2	Results and findings.
Knowledge of current survey designs implemented for other SMP activities	-

9.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used for sampling:

- survey platform: marine vessels
- digital camera (with GPS where possible)
- GPS
- a pair of binoculars
- nautical charts
- fishing equipment (long-line rods, knives)
- dissection kits, whirlpaks for fish samples
- freezer and refrigerator space
- water quality testing equipment (1 litre bottles, 40 ml vials, niskin bottle).

Implementation of this SMP will require a field vessel. The vessel specifications should allow for storage of field equipment and samples. It is expected to be similar in size and no larger than the project vessel used for field management activities.

Refer to Section 3 for deployment of vessels.

9.8 Personnel Resource Requirements

The team for SMP3 would consist of the following personnel. The field team would require experience in the handling of samples for analysis of environmental impacts:

- 2 x Environmental Consultants for fieldwork
- 1 x Environmental Consultant for reporting
- 1 x laboratory for analysis
- 1 x subject matter expert selected from Table 1.10 or other suitable provider.

Specific skill sets required to complete the SMP:

- Experience in the catching of fish (local knowledge of their habitats).
- Experience in the correct dissection of fishes for analysis, including correct storage and transfer of samples

10. SMP4 –FISHERIES ASSESSMENT

10.1 Monitoring Rationale

A hydrocarbon spill has the potential to impact on commercial fisheries and other limited recreational fishery areas.

10.1.1 Objective

The objective of this SMP is to:

- Collect relevant data to assess the short-term and/or long-term effects on fish and fisheries from the hydrocarbon spill.
- Understand the geographic extent of exposure of fish to hydrocarbons from the spill.
- Assessing the impacts to fish health, including reproductive health associated with hydrocarbons from the spill.

10.2 Resources Available

See Table 10.1 for available resources. Contracts are summarised in Section 1.5.

Eni maintains blanket contracts with a panel of HSE consultants with the capabilities in designing and implementing fish surveys using both dedicated and opportunistic vessels, including working with recreational and commercial fishers.

Table 10.1 Resources available for SMP4

Resources	Provider	Timeframes
Fisheries Assessment Team and subject matter experts	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2
Vessels	[redacted]	Vessels within 24 hours of mobilisation.
Laboratory analytical services	[redacted]	Typically 48 hours – 5 days
	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2

10.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency in response to a Level 2 or Level 3 spill, as defined in Table 3.1. of the OPEP

- It is suspected (e.g. through public reports) that significant levels of hydrocarbons have contaminated commercial or subsistence fishing areas.
- Fishing vessels fish stocks, fishing equipment and/or by-catch have been exposed to hydrocarbons.

10.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- evidence that catch rates, species composition, community abundance, distribution and age structure of commercial fisheries and their by-catches have returned to pre-spill levels; and
- agreement with relevant stakeholders (e.g. fishing organisations, Government authorities) that fish stocks are no longer impacted or damaged as a result of the spill.
- Monitoring objectives have been met

10.5 Survey Methodology

The focus will be analysing the levels of biomarkers in the target species.

The study will collect commercial and subsistence fish and prawn species from impacted and non-impacted (i.e. control sites), in consultation with relevant stakeholders.

The target species will be determined prior to mobilisation based on the hydrocarbon spill characteristics. The samples collected from the control sites will be used to comparison purposes—i.e. the impacted specimens against the non-impacted specimens.

The following biomarkers will be measured in fish:

- Liver detoxification enzymes: The hydrocarbons absorbed by the fish are metabolised by the liver using detoxification enzymes. These are quantified in the liver.
- PAH Biliary Metabolites: Hydrocarbon compounds are directed to the bile for elimination out of the body. Biliary metabolites of petroleum compounds represent the most sensitive biomarker of exposure to crude oil, and can inform on the temporal and geographical extent of the exposure to very low levels.
- DNA Damage: Several contaminants, including petroleum compounds, can alter the integrity of the DNA molecule. This biomarker evaluates the damage done to the DNA molecules.
- Serum sorbitol dehydrogenase (SDH): Serum SDH provides an understanding of the liver integrity and liver functions, which might be affected if exposure to hydrocarbons is high.
- Other physiological biomarkers such as condition factor, liver somatic index and gonado-somatic index will be determined along with total weight, length, condition, parasites, egg development, testes development, etc. All abnormalities, if any, will be photographed.

Biomarkers to be measured in prawns, include:

- DNA Damage: Several contaminants, including petroleum compounds, can alter the integrity of the DNA molecule. This biomarker evaluates the damage done to the DNA molecules.
- Lipid ratios: amphipods exposed to the water-accommodated fraction of hydrocarbons have altered lipid ratios (Olsen et al. 2007). These changes may affect the health of the exposed benthic invertebrates but also the benthic invertebrates may not as good a food item for higher trophic level organisms.
- Other physiological biomarkers such as parasites, total weight, length and condition will be determined. All abnormalities, if any, will be photographed.

Fecundity, time between molts, embryo development, hatching rates and larval survival may also be investigated to understand the impacts to prawns.

All reports of dead prawns, e.g. found washed up on beaches, will be investigated. Amphipods, filter-feeding bivalves and urchins are thought to be among the most sensitive organisms to oil contamination in subtidal communities. Thus the abundance of amphipods has been found to be a good indicator of oil exposure and recovery in soft-bottom subtidal communities (Gomez Gesteria and Dauvin 2005).

Recovery phase monitoring will therefore include quantifying abundance in the environment or through measuring catch volumes.

10.5.1 Field Sampling

Prawns will be collected using trawl at both impacted and control sites. The number of sites within each area will be determined at the time of the spill in accordance to the scale and nature of the spill. The fishing industry will be consulted during planning and field sampling.

Trawling will be conducted in accordance with the *Marine sampling Field Manual for Benthic Sleds and Bottom Trawls* (Przeslawski 2018). Sample collection and handling will be done in accordance with the Australian code for the care and use of animals for scientific purposes (NHMRC 2013).The fish/prawns captured at each site will be kept alive in live tanks equipped with flow through, as biopsies need to be collected on freshly scarified animals. Each specimen will be initially measured for length (using a mm scale ruler) and for weight using an electronic spring balance. Each specimen will be examined for external abnormalities including lesions or damage.

Fish captured for biopsy collection (approximately 20 of each target species from each site) will be sacrificed by iki jimi (spike through the brain) and a vacuutainer and needle were used to collect blood from the caudal vein. These blood samples will be allowed to coagulate at 4°C for up to 20 minutes and then centrifuged at 2400 x *g* for 10 mins and the serum supernatant divided into two samples: one of which is frozen at –20°C and the other placed in liquid nitrogen. The fish will be then dissected along the ventral line and inspected internally.

The following biopsies will be collected:

1. Serum samples (see above);

2. Bile will be collected from the gall bladder using a 1 ml syringe and frozen at – 20°C;

3. The liver will be removed, weighed and subsamples frozen in liquid nitrogen for analysis;

4. The gonads will be removed and weighed. Where available the gonads of 10 male and 10 female fish of each species from the impacted area and reference area were preserved in glutaraldehyde for histology;

5. Carcass (body less viscera) was weighed using the electronic spring balance.

Stomach and intestinal contents will also be collected from 10 of each species at each location where available.

10.5.2 Laboratory Analysis

Laboratory analysis will be undertaken by a NATA-approved Laboratory for the following analyses:

- Fish
  - liver detoxification enzymes (EROD activity);
  - biliary metabolites;
  - SDH activity;
  - oxidative DNA damage; and
  - gonad histology.
- Prawns
  - oxidative DNA damage; and
  - lipid ratios.

Biomarker analyses will be undertaken at government or academic laboratories with experience in the area.

Statistical analyses of these results will then be undertaken to assess the differences (if any) between the impacted and control site species.

10.5.3 Recovery monitoring

Recovery phase monitoring will include quantifying abundance in the environment or through measuring catch volumes. This will be undertaken by trawling, in consultation with and likely with assistance from the fishing industry.

In addition, indices of community health and resilience may also be considered in monitoring recovery, such as the index of biological integrity (King and Richardson 2003) and community structure analysis to quantify abundance, diversity and condition of different taxonomic groups in the area. Community structure analysis involves surveying the abundance of different organisms, recording the age, size class, sex and condition of organisms. It is recommended that this surveying be done to the level of species or taxa, to identify any changes in the community structure (e.g. .disappearance of sensitive taxa and or increase in hydrocarbon-degrading bacteria and fungi).

10.6 Data and Information Requirements

The information in Table 10.2 will be used to assist in collecting data for SMP3.

Table 10.2: Data and information requirements for SMP3

Information	Details
Sensitive Resources and Receptors	i.e. Draft EIAs, EPs existing environment, etc.
Fisheries Data	Effort and catch rate data from fisheries, location and number of fishing vessels, etc.
OMP1 and OMP2	Results and findings.
Knowledge of current survey designs implemented for other SMP activities	-

10.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used for sampling:

- survey platform: marine vessels
- trawl with spare(s)
- trawl box(es)
- digital camera (with GPS where possible)
- GPS
- a pair of binoculars
- nautical charts
- dissection kits, whirlpaks for samples
- 1 L and 10 L buckets with lids
- Sample labels, pre-printed on waterproof paper
- freezer and refrigerator space

10.8 Logistics

Implementation of this SMP will require a field vessel. The vessel specifications should allow for storage of field equipment and samples. It is expected to be similar in size and no larger than the project vessel used for field management activities.

Refer to Section 3 for deployment of vessels.

10.9 Personnel Resource Requirements

The team for SMP4 would consist of the following personnel:

- 2 x Environmental Consultants for fieldwork
- 1 x Environmental Consultant for reporting

- 1 x laboratory for analysis
- 1 x subject matter expert selected from Table 1.10 or other suitable provider.

Specific skill sets required to complete the SMP:

- Experience in the catching of fish (local knowledge of their habitats).
- Experience in the correct dissection of fishes for analysis, including correct storage and transfer of samples.

11. SMP5 – SHORELINE ECOLOGICAL SURVEYS

11.1 Monitoring Rationale

This study will aim to quantify impacts to receptors observed to be potentially impacted during SMP2.

11.1.1 Resources at Risk

SMP2 summarises the key sensitive receptors that may be affected from an accidental oil spill including:

1. turtle nesting beaches
2. mangroves

11.1.2 Objectives

The objectives of this SMP are:

- Quantify the impacts to shorelines species.
- Quantifying, where possible, exposure of environmental receptors to the hydrocarbon.
- Assessing the recovery of environmental receptors.

11.2 Resources Available

See Table 11.1 for available resources. Contracts are summarised in Section 1.5.

Eni maintains blanket contracts with a panel of HSE consultants that would be used to complete the surveys for SMP5.

Specifics and further details on the personnel resource requirements are detailed in Section 11.9

For further information on equipment requirements refer to Section 11.7 Refer to Section 11.8 for logistic required for this SMP. Vessels are accessed as per Section 3.

Table 11.1 Resources available for SMP5

Resources	Provider	Timeframes
Shoreline Ecological Survey team and subject matter experts	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2
Traditional Owner support, indigenous knowledge	tbc	Best endeavours
Vessels	[redacted]	Vessels within 24 hours of mobilisation.

11.3 Monitoring Initiation Criteria

It has been observed or is predicted (e.g. through the SMP2 program) that shorelines will be impacted by the hydrocarbon spill and sensitive receptors are present at the affected shorelines.

11.4 Monitoring Termination Criteria

This plan can be terminated by the Control Agency when the following are met:

- Monitoring objectives have been met.
- Biological monitoring demonstrates that the ecological components of the shoreline environment are returned to pre-spill state (as determined from baseline data and/or control sites).

11.5 Survey Methodology

11.5.1 Mangrove Monitoring

A guideline for monitoring the potential impact on coastal flora are provided (see AMSA 2016; Table 11.2). Methods suggested include combining remote sensing and ground surveys using quadrats or transects. Sub-lethal effects such as foliage density, chlorosis (bleaching), canopy height can be detected using ground surveys. Much of this information can be collected without much additional effort and provides valuable baseline data of the health of the ecosystem and is useful for the scientific program design. Suitable coastal flora found within shoreline habitats of the ZPI that may be used as bio-indicators may include mangroves, and microalgae on tidal flats, and macroalgae species on intertidal flats and rocky shores.

Table 11.2: Example of coastal flora data parameters and methods (AMSA 2016)

Resource	Form	Comments
Number of abundance of plants	% cover of the sediment	Ground and aerial survey (large areas only) (see SMP2).
	Numbers	May occur in days/weeks.
	Biomass: mass of plants per m^2	Intrusive. Detailed study based on sampling in affected and control sites.
Distribution of plants or damage	Tidal zone/elevation	Ground survey - using transects or beach gradient.
Distribution of oil on plant mat	% of plant area oiled	Ground survey – suitable for algaes and seagrasses.
Distribution of oil on plant	Maximum and minimum height of oil	Ground survey – suitable for macrophytes such as mangroves.
	% cover of whole plant	
	% cover of foliage	
	Position on plant	Ground survey – roots, leaves and truck.
Mortality	Number or area of dead plants	Ground surveys - using quadrats or transects.
	Area or %loss	Aerial survey (see SMP2).

Resource	Form	Comments
Other possible effects	Chlorosis	Ground surveys – leaves or fronds go yellow, lose colour.
	Black/curled leaves (dead)	Ground surveys – sometimes called 'burning'.
	Leaf/frond loss	Ground surveys – may occur within days, weeks or even months in the case of mangroves.
	Loss of plants	Ground surveys – may occur within days/weeks.
	Changes in level of fungal or insect damage	Ground surveys – may occur with weeks/months.

Epifauna Sampling

A guideline for monitoring the potential impact on invertebrate shoreline fauna are provided (Table 11.3). The suitable method suggested is ground surveys using quadrats or transects. Invertebrate fauna species found on the littoral fringe and upper eulittoral, the zone of highest impact, should be used as target indicators. Suitable indicator intertidal invertebrate epifauna for monitoring may include molluscs, barnacles and chitons on rocky shores, and burrowing crabs in tidal flats and mangrove and depositional shorelines.

Table 11.3: Example of invertebrate beach fauna data parameters and methods

Parameter		Comments
Number of organisms	% cover of the sediment	This can be done as an estimate (similar to oil cover). Photo documentation.
	Number of individuals per m^2	Use of quadrat frames. Count or photo-documentation to speed up field work.
Position of organisms		Record distance along a transect or height on rock.
Oil cover/impact on organisms	% of oil organisms	Use of quadrates or transects.
	% of area oiled	Suitable alternative to number of oiled/unoiled organisms.
Damage to 'sheet'. E.g. shellfish, barnacles, polychaetes	% are of sheet that is covered by dead animals/bare 'holes'	Indicated by presence of unattached individuals or holes in the sheet, particularly mussels and oysters. Damage to the sheet can result in additional future damage by wave action.
Mortality	Number/mass/area of dead organisms	Data from impacted sites needs to be checked against control areas. Seasonal mortalities occur with some species.
	Number/mass/area of live organisms	

Chemical Monitoring

Chemical monitoring provides a greater level of accuracy for determining the presence and concentration of hydrocarbons. If seafloor communities are to be monitored it is advisable to simultaneously monitor water and sediment contaminant levels. In this way

any relationships between contaminant levels and biological effects can be examined. Chemical fingerprinting of surface oils conducted in OMP2 form an important initial step for identifying the difference between natural and anthropogenic oil sources. Usually, operational monitoring will require information to be collected and processed rapidly with a low level of sampling and accuracy.

Water and Sediment Sampling

Sampling of water are described in OMP2. Chemical monitoring of water will include:

- In-situ tests conducted to validate of the presence hydrocarbons in water
- In-situ methods for determining the concentration of oil in water (e.g. fluorometer readings, hydrocarbon sensors on water quality units, see OMP2 for more detail).
- Physico-chemical sampling of the water using multi-parameter water quality instruments (see OMP2 for more detail).
- Obtaining a limited selection of water and sediment samples to be sent to the laboratory for chemical analysis (see OMP2 for methods for collection of water samples).

Biological chemical testing of indicator shoreline flora and fauna species may also be implemented if time permits.

Turtle Nesting Beaches and Avifauna

The shoreline monitoring of turtle nesting beaches and avifauna that may be potentially present during a hydrocarbon spill will include:

- Monitoring of damage to coastal birds including, number of individuals, type present, oil distribution on birds, activity of oil birds (see AMSA 2016).
- Monitoring of damage to coastal reptiles including, numbers of individuals, species present, oil distribution on organisms, mortality rates (see AMSA 2016).

11.6 Data and Information Requirements

This SMP will rely on the outputs from OMP1 and OMP3 on the extent of the oil spill from both the predictions of the oil spill distribution, oil spill surveillance and observational data from the field.

Table 11.4: Data and information requirements for SMP5

Information	Details
Standard Forms for Field Survey	See Table 11.2 and Table 11.3.
Sensitive Resources and Receptors	i.e. Draft EIS, EPs existing environment etc.
OMP3 and SMP2	Results and findings.
Knowledge of current survey designs implemented for other SMP activities	-

11.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used:

- survey platform: vessel to reach remote shoreline areas;
- tide tables;
- clipboards and data sheets;
- radio;
- compass;
- ruler;
- quadrant frames;
- sampling bags;
- sieves;
- spade;
- tape measure;
- flags and stakes (to mark the location of buried oil);
- camera and video equipment; and
- GPS.

11.8 Logistics

Implementation of this SMP will require a field vessel. The vessel specifications should allow for storage of field equipment and samples. It is expected to be similar in size and no larger than the project vessel used for field management activities.

Access to shoreline areas may require Indigenous Land Access Permits and permission from the relevant Traditional Owner and/or Traditional Owner participation.

Refer to Section 3 for deployment of vessels.

11.9 Personnel Resource Requirements

Specific skill sets required to complete the SMP are:

- Capable of conducting sampling (including quadrats, transects),
- Assessment of mangrove health
- Assessment of changes to turtle nesting over time

It is also recommended team members have experience in:

- Conducting field surveys in remote environments
- Understanding of field techniques for impact assessment

Given the potential scale of shoreline contact, one shoreline monitoring team would be required consisting of:

- 2 x Environmental Consultants for fieldwork
- 1 x Environmental Consultant for reporting
- 1 x small vessel for shoreline access
- 2 x Traditional Owners to facilitate site access (depending on impact area, consultation and availability).
- 1 x subject matter expert selected from Table 1.10

11.9.1 Coordination of field teams

Field teams will use individuals who are trained in techniques, procedures, and terminology of shoreline assessment. Team members are required to have a thorough understanding of the response goals and objectives and will consider safety concerns in cleanup recommendations. Shoreline assessments should be carried out by teams assigned to individual, pre-defined coastline segments.

Where more than one survey team are deployed, a Shoreline Assessment Coordinator experienced in hydrocarbon spill assessment and coordination may be required and will act as a communication point between the field teams and the IMT. This coordinator will be providing the following information to the IMT:

- prioritisation of shoreline segments;
- consideration of access and staging issues;
- potential clean up options; and
- report and map-generation.

Support staff includes office-based personnel, vessel aircraft crews and IMT communications support will be required to support rapid shoreline assessment field.

12. SMP6 – HYDROCARBON FATE AND EFFECTS ASSESSMENT

12.1 Monitoring Rationale

This SMP describes the level and type of hydrocarbon of exposure to sensitive receptors at risk as a function of time. This allows a relationship between hydrocarbon exposure and other values to be derived as part of long-term monitoring of the effects of hydrocarbon exposure.

Monitoring requires consistent repeat-measures to determine trends over time. The current SMP is reliant on baseline data; either from existing regional studies or monitoring programs for hydrocarbons in the environment, or from post-spill, pre-impact sampling conducted as part of OMP2. The data collected in response to the incident should be directly comparable to baseline data that results from monitoring results that have been collected as part of OMP2.

In particular, sampling and analysis methods should be consistent to ensure the post incident results are comparable.

12.1.1 Objective

Monitoring objectives are to:

- understand the distribution and fate of hydrocarbons attributable to the spill through time on the surface, water column and sediments
- determine the physical properties of the hydrocarbon as it weathers on the sea, on shorelines and in marine sediments
- determine the chemical properties of the hydrocarbon as it weathers at sea, on shorelines and in marine sediments
- assess water and sediment quality against accepted guidelines
- verify the source of identified hydrocarbons and attribute them to the spill, natural, pyrogenic or petrogenic sources.

12.2 Resources Available

See Section 5 OMP2 for resources available to conduct water quality monitoring. Contracts are summarised in Section 1.5.

12.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency in response to a Level 2 or Level 3 spill, as defined in Table 3.1 of the OPEP, or if OSTM and/or surveillance indicate there are:

- persistent hydrocarbons on or in the water at the end of the response
- persistent hydrocarbons in sediments at the end of the response, or
- actual or potential impacts on environmental receptors due to the hydrocarbon spill.

12.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- Monitoring objectives have been met.
- Consultation with relevant stakeholders has determined that no further monitoring is required. For example, consultation with the DNP has determined no further monitoring is required within the JBG AMP.

12.5 Survey Methodology

12.5.1 Hydrocarbon Properties

The extent of the sampling will be dependent on the scale and nature of the hydrocarbon spill. Samples will be taken from on the surface, water column and sediments (shoreline sediments will be collected under SMP5) so that the full geographic extent of the spill is captured.

Water Samples

- Water quality sampling is further detailed in OMP2 (Section 5).

Sediment Samples (shoreline sediments will be taken under SMP5)

- A number of samples should be collected (using a corer/grab) in impacted areas and reference sites.
- The collection of samples in impacted areas can be based on the outcomes of OMP2 and the modelling undertaken in OMP1.

12.5.2 Distribution and Fate of Hydrocarbons

To understand the spatial and temporal distribution of hydrocarbons on and in the sediments and in the water column samples will be collected either along a gradient from the source and/or randomly within target areas. If hydrocarbons are detected on the initial survey, samples will be collected on an ongoing basis to understand temporal extent of hydrocarbons on/in sediments and the water column. The geographic extent of sampling will be dependent on oil distribution and predicted movement (OMP1) and measured hydrocarbons in sediment and within the water column as determined through OMP2.

If specific natural resources are identified to be at risk and the individual scientific monitoring plan is triggered additional sampling locations will be added at relevant impact and reference sites to provide water quality and marine sediment data to assist in determining impacts for those resources.

Sediment Sampling Design

Two types of experimental design will be considered for sediment sampling:

1. Gradient approach.

2. Random sampling with in a target area.

The gradient approach will involve monitoring radially from around the source of the spill and collecting sediment samples along these transects. The exact number and length of transects will be determined based on spatial extent of spill. Samples will be collected on an ongoing basis (if detected during the initial survey and attributable to the spill) until the termination triggers are reached. The frequency will be dependent on the results from the initial survey and the extent and duration of the spill. Subsequent sampling, if required, will occur at fixed sampling sites.

The targeted sampling approach incorporates a BACI design (Before-After-Control-Impact). Outputs from OMP1 will identify potential impact areas which can be sampled which will allow sampling of sediment prior to impact (post-spill) under OMP2. These samples will allow an assessment of hydrocarbon presence and concentration and PSD prior to impact. Impact areas will be based on locations where there is a likelihood of hydrocarbons sinking and becoming entrained in sediments. These areas include:

1. Areas underlying burned or sinking hydrocarbons.

2. Areas which have high levels suspended sediments (generally nearshore areas).

3. Areas underlying convergence zones were hydrocarbons on water can potentially become concentrated.

Within these identified areas sediment samples will be collected from random sites, the number of sites sampled within each area will be dependent on the size of the area. Samples will also be taken from reference sites both prior to the impact (under OMP2) and post the spill response. Samples will be collected on an ongoing basis (if detected during the initial survey and attributable to the spill) until the termination triggers are reached. The frequency will be dependent on the results from the initial survey and the extent and duration of the spill. Subsequent sampling, if required, will occur at fixed sampling sites.

Sediment samples taken using a corer/grab either from a vessel or using an ROV.

Water Quality Sampling Design

Monitoring will be based on a gradient approach to determine both the spatial and temporal distribution of hydrocarbons on the water and entrained within the water column. The geographic extent of the area to be monitored will be based upon the oil distribution and predicted movement of the hydrocarbon spill as determined through OMP1 and measured hydrocarbons in sediment and within the water column as determined through OMP2.

The gradient approach will involve monitoring radially from around the source of the spill and collecting water samples along transects. The exact number and length of transects will be determined based on spatial extent of spill. Samples will be collected on an ongoing basis (if detected during the initial survey and attributable to the spill) until the termination triggers are reached. The frequency will be dependent on the results from the initial survey and the extent and duration of the spill. Subsequent sampling, if required, will occur at fixed sampling sites. Water quality sampling is further detailed in OMP2 (Section 5).

Marine Sediment Sampling

- Marine sediments can be sampled using a corer or grab
- Containers should to be as full as possible so there is no air to minimize volatilization of hydrocarbons
- Appropriate CoC must be maintained and samples secured.

12.6 Data and Information Requirements

This SMP will rely on the outputs from OMP1 on the extent of the oil spill from both the predictions of the oil spill distribution, oil spill surveillance and observational data from the field. Information required includes:

- spill type;
- spill volume and duration;
- spatial extent of the spill and movements; and
- all data collected during OMP2.

Baseline Information

In order to understand the changes in hydrocarbon content on the water, in the water column and within sediments it is necessary to understand the sediment and water quality in the predicted impact areas (and reference areas) prior to the spill event. However as the nature of the Woollybutt crude is that there are few persistence components it is likely that no significant volumes of hydrocarbons will remain within the water column once this SMP is triggered and it unlikely to reach the sediments. Baseline data will be largely comprise of pre-impact/post-spill monitoring or identification of suitable reference sites.

12.7 Field Equipment

Refer to Section 5.6.

12.8 Logistics

Implementation of this SMP will require a field vessel. The vessel specifications should allow for storage of field equipment and samples. It is expected to be similar in size and no larger than the project vessel used for field management activities.

See Section 5 OMP2 for logistics related to deployment of water quality monitoring equipment.

Refer to Section 3 for deployment of vessels.

12.9 Personnel Resource Requirements

See Section 5 OMP2 for capability / personnel resourcing requirements related to water quality monitoring.

13. SMP7 – INTERTIDAL AND SUBTIDAL BENTHIC HABITATS

13.1 Monitoring Rationale

This SMP is designed to monitor the potential impacts to subtidal benthic communities. The purpose is to determine whether any impacts observed at subtidal benthic habitats are attributable to hydrocarbons or whether they may be attributable to natural fluctuations in the physical environment.

13.1.1 Objective

Monitoring objectives are to:

- Collect quantitative data on subtidal habitats that have been exposed to hydrocarbons from the spill as determined by OMP 2
- Monitor recovery to baseline or reference levels.

13.2 Resources Available

See Table 13.1 for available resources. Contracts are summarised in Section 1.5.

Eni maintains blanket contracts with a panel of HSE consultants that would be used to complete the surveys for SMP7. Consultants on ENI's Environment Panel have demonstrated capability of completing surveys off the West Coast of Australia including dive surveys, drop and towed camera surveys to assess the health of benthic communities.

Specifics and further details on the personnel resource requirements are detailed in Section 13.9.

Table 13.1 Resources available for SMP7

Resources	Provider	Timeframes
Subtidal habitat assessment team	Environmental Panel Contracts and ability to contract third party specialists as detailed in Table 1.8	N/A. Contracting timeframe as per Section 1.5.2
Vessels	[redacted]	Visual observations from chartered vessels occur within 72 hours of mobilisation.
ROV Divers	[redacted]	Best endeavours

13.3 Activation of this Plan

The IMT Leader will activate this plan if requested by the Control Agency in response to a Level 2 or Level 3 spill, as defined in Table 3.1 of the OPEP, or if OMP1 shows that submerged benthic communities have been contacted by the spill.

13.4 Termination of this Plan

This plan can be terminated by the Control Agency when the following are met:

- Monitoring objectives have been met.

13.5 Survey Methodology

Survey methodology will be determined dependent on the receptor(s) contacted/potentially contacted. Where enough existing data is available a BACI study design may be considered. A BACI design may also be considered when there is enough time to collect baseline data prior to contact. Where there is no existing data/there isn't time to collect baseline data prior to contact control or reference sites may be used to infer pre-contact health of benthic communities.

Data of subtidal habitats would be collected using one of the below methods:

- ROV data
- Towed/drop camera data
- Diver surveys

Prior to mobilisation the survey design would be agreed in a sampling and analysis plan.

13.6 Data and Information Requirements

This SMP will rely on the outputs from OMP1 on the extent of the oil spill from both the predictions of the oil spill distribution, oil spill surveillance and observational data from the field to inform the survey design.

13.7 Field Equipment

The following list is not exhaustive, but includes common items that may be used:

- Vessel with A-Frame and Winch
- clipboards and data sheets;
- ROV, drop/towed camera system;
- GPS.

13.8 Logistics

Implementation of this SMP will require a field vessel. The vessel specifications should allow for safe deployment of field equipment, including ROV if required. It is expected to be similar in size and no larger than the project vessel used for field management activities.

Refer to Section 3 for deployment of vessels.

13.9 Personnel Resource Requirement

A single team is considered appropriate to implement a gradient monitoring design assessing potential impacts to the Carbonate Bank and Terrace System of the Sahul Shelf and other intertidal and subtidal benthic habitats. The team would consisting of:

- 2 x Environmental consultants for fieldwork;
- 1 x Environmental consultant for reporting;
- 1 x vessel with ROV and operators;
- 1 x commercially qualified diver team (if required);
- 2 x towed/drop camera unit;
- 2 x sediment grabs;
- 1 x subject matter expert selected from Table 1.10.

A team lead/party chief would be required on each vessel with experience in the assessment of subtidal habitats and the deployment of subsea video systems.

14. REFERENCES

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