

Shoreline Assessment Ground Survey: An operational component of the Monitoring Plan for the Montara Well Release Timor Sea

October 2009

Post-Survey Report

Shoreline Assessment survey team

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Executive Summary

As part of the Operational Monitoring Plan for the Montara Well Release Timor Sea, a five day Shoreline Assessment was completed on the 25th October. The survey was carried out on behalf of the Incident Management Team for the Australian Maritime Safety Authority (AMSA) to determine if any hydrocarbons were present within the intertidal sediments of the reserves and to provide a baseline of the environments for future surveys that may be required within the longer term monitoring plan.

The survey team included a representative from PTTEPAA, a representative from the Department of the Environment, Water, Heritage and the Arts, and a seconded government scientist.

Sixty six sediment samples were acquired (Attachments A and B), as well as seventy seven environmental descriptions along with the positions of sea surface anomalies and wildlife occurrences (see Attachment C). Sea surface observations were undertaken and recorded while transiting to each assessment location as well as to and from Darwin. The sediment samples are being analysed by Leeder Laboratories in Melbourne Australia and the imagery is being collated by PTTEPAA.

All islands surveyed are dish shaped with wash over deposits in the interior. Any sea surface phenomena arriving on a high tide or during high winds may be deposited on the reef flats, sand sheets, and over the fore dunes towards the interior of the vegetated islands.

The results from this survey will provide baseline information that will feed into the relevant operational response and long-term monitoring procedures that have been initiated since the Montara well release began.

1. Introduction

This work is in support of the Monitoring Plan for the Montara well Release Timor Sea, as agreed between PTTEP Australasia (Ashmore Cartier) Pty Ltd (PTTEPAA), AMSA and the Department of the Environment, Water, Heritage and the Arts on 9 October 2009.

This shoreline survey was undertaken as a component of the operational response to the Montara well release, which began on 21 August 2009. The survey was carried out on behalf of the Incident Management Team (IMT) to determine if any hydrocarbons were present within the reserves and to provide a baseline of the environments for future surveys that may be required within the longer term monitoring plan. The initial five day shoreline survey was completed on 25 October 2009.

This report contains the preliminary results of the intertidal zone survey on the islands of Ashmore Reef, Cartier Islet and Hibernia Reef (Attachments B and C) in the Indian Ocean off the North West Shelf of Australia, along with sea surface observations along the transits from Darwin - Ashmore Reef - Hibernia reef - Cartier Islet - Darwin (Attachment D).

Primary regions of interest were agreed to by the assessment team and were sampled using the protocols as taught by John Wardrop of Wardrop Consulting.

The shoreline assessment was led by Ms Rosie Maughan, representing PTTEPAA, and accompanied by government representatives, Mr Glen Ewers from the Department of Environment, Water, Heritage and the Arts, and Dr Kriton Glenn seconded from Geoscience Australia. Survey results were provided to John Wardrop (Wardrop Consulting) and samples were provided to Leeder Consulting with a final shoreline assessment report to be provided to AMSA.

1.1. BACKGROUND

1.1.1. Study Area

The survey was carried out across the Marine Protected Areas of Ashmore Reef and Cartier islet and Hibernia Reef to the east-north east of Ashmore Reef (Figure 1.1). This is located within the survey box of 122 - 125 degrees East and 11 – 13 degrees South. The region is monsoonal, experiences cyclones and has a semi diurnal tidal regime with a 4.7 metre tidal range and evaporation potential is almost twice that of the precipitation (Glenn 2005). The three vegetated islands of Ashmore Reef all contain fresh water lenses.

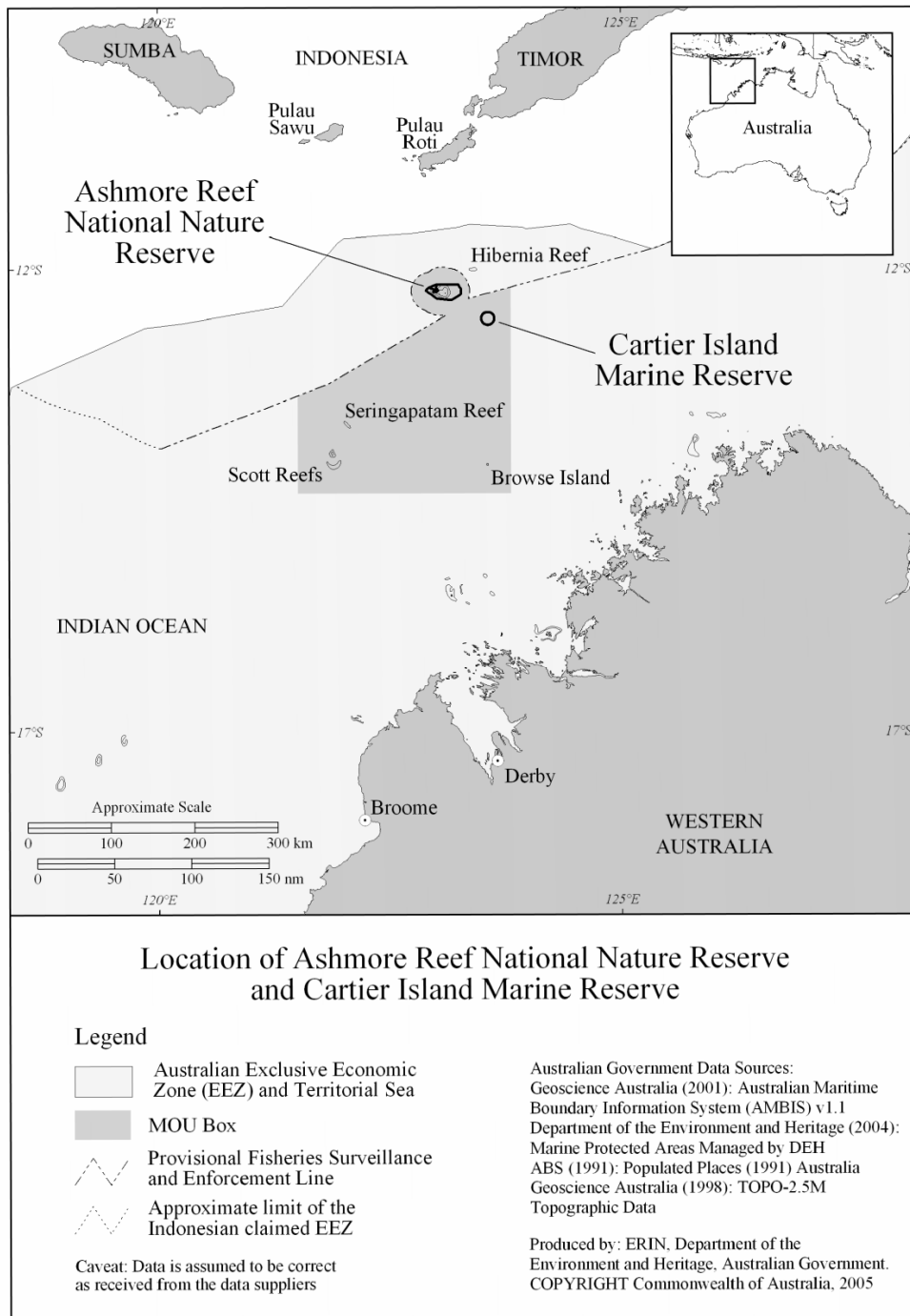


Figure 1.1 Regional map of assessment locations and Commonwealth marine reserve boundaries

1.1.2. Survey Objectives

The scientific survey objectives were to:

- Describe the shorelines of the reefs in order to facilitate response planning,
- Assess the current oiling status of the shorelines, and to
- Acquire samples of intertidal sediments, so they may be processed to yield baseline data regarding the oil / wax content of intertidal sediments on islands in the region of the Montara well release.

1.1.3. Survey time line

Date	Description
18/10/09	Team arrives in Darwin and prepares for the survey
19/10/09	All survey team members attend the training day with John Wardrop of Wardrop Consulting to ensure that the sampling protocols are as per industry requirements.
20/10/09	Some Assessment Team members met with AMSA representatives for latest updates whilst other team members were obtaining final briefs from PTTEPAA prior to departing Darwin for Ashmore Reef.
20/10/09	Assessment team travels to Ashmore Reef
21/10/09	Recording environmental observations en-route to Ashmore Reef
22/10/09	West island orientation transect and sample both East and Middle islands at Ashmore Reef.
23/10/09	Depart for Hibernia Reef for a visual survey and return to Ashmore Reef.
24/10/09	Depart for Cartier Islet, and sample the intertidal sands, depart for Darwin making biota and sea surface observations on route.
24/10/09	Recording environmental observations en-route to Darwin
25/10/09	Arrive in Darwin. Meet and debrief with PTTEPAA and DEWHA representatives.

1.2. SURVEY PARTICIPANTS AND VESSEL

1.2.1. Vessel Description

The survey team travelled on the MV Sea Sprint, a 72 foot charter boat with 2 x Scania V8 DSI 14 – 575Hp main engine specifications.

1.2.2. Shoreline Assessment Team and Crew Personnel

Mr Glen Ewers from the Department of Environment, Water, Heritage and the Arts, Dr Kriton Glenn from Geoscience Australia seconded to Department of Environment, Water, Heritage and the Arts for this survey, accompanied Ms Rosie Maughan from PTTEPAA to carry out the assessment. Mr Simon Akkerman from Solutions Australia took video documentation of proceedings.

The crew of the MV Sea Sprint included Mark Farris, Neville Gill & Sally Wheeler.

2. Methods

Equipment and processing were conducted according to pre-assessment training based on, 'The Assessment of Shorelines a Simplified Approach', by John Wardrop.

2.1 OCEANOGRAPHY AND METEOROLOGY

Conditions were most favourable throughout the survey, with light winds up to 10 knots and sea state was calm with up to 0.5 metre swell.

2.2 SAFETY

2.2.1 Daily reporting

Throughout the survey a scheduled daily report was made by Ms Maughan to the PTTEPAA Emergency Response Group (ERG) to ensure that up to date information was conveyed both from the survey to the ERG and from the ERG to the survey team. This daily report included the location of work accomplished that day and the forward plan for the next phase of work as well as any issues encountered.

2.2.2 Survey safety

2.2.2.a On site Communication

While on transfer to the islands and while onshore, the Shoreline survey party was able to contact Sea Sprint at all times via VHF radio.

2.2.2.b First aid

A first aid officer was designated prior to undertaking the assessment (Dr Glenn certified in advanced first aid) and a first aid kit was carried at all times.

2.2.2.c Boat transfer

Throughout all small boat transfers, all staff wore the regulated personal floatation devices (PFDs), small boat and shore party also carried signalling flares.

2.2.2.d Personnel protective equipment

Appropriate personnel protective equipment (PPE) was worn (including hats & sun screen). Due to the reef environment, team members wore appropriate footwear (neoprene dive booties).

2.2.2.e Hydration

Hot, humid conditions were also encountered throughout the survey. To ensure proper hydration, the shoreline assessment team maintained a minimum store of six litres of fresh water at each survey location. Hydration was scheduled at a minimum of every 30 minutes.

2.3 SURVEY PLANNING

The planning was multi phase and was constantly refined as more information was received. Shoreline assessment programme constraints included an unfavourable tidal regime which necessitated extensive reef transects on foot to the island shoreline on several occasions (East Island & Cartier Islet). Consequently, the shoreline assessment schedule was frequently reviewed refined and agreed to by the survey members during transit.

3. Sedimentology

3.1. SAMPLE ACQUISITION AND PREPARATION

As per the protocols from the publication, 'The Assessment of Shorelines a Simplified Approach', by John Wardrop, Wardrop Consulting, Sixty six samples were acquired (Attachment B).

3.2. DIGITAL IMAGERY

Digital imagery was taken by Simon Akkerman from Solutions Australia. He took video documentation of proceedings. The video coverage will be delivered separately to this report. Other still imagery was taken by the participants of the survey team.

4. Observations

4.1. ENVIRONMENTAL OBSERVATIONS

Sea surface observations were undertaken and recorded while transiting to each assessment location as well as from Darwin. A total of seventy-seven environmental observations, were obtained including both sea surface anomalies as well as wildlife sightings. All observations were documented and are at Attachment C.

Upon arriving at Ashmore Reef, the team began their assessment of the reef environment (a detailed sampling methodology, Attachment B). Island trips were made to East, Middle and West Islands on the first day. Each sampling location was logged using a Global Positioning System (Figures 4.1 and 4.2)

All islands at Ashmore and Cartier had seabirds and evidence of sediment bioturbation by turtle nests and tracks from both laying turtles and the hatchlings.

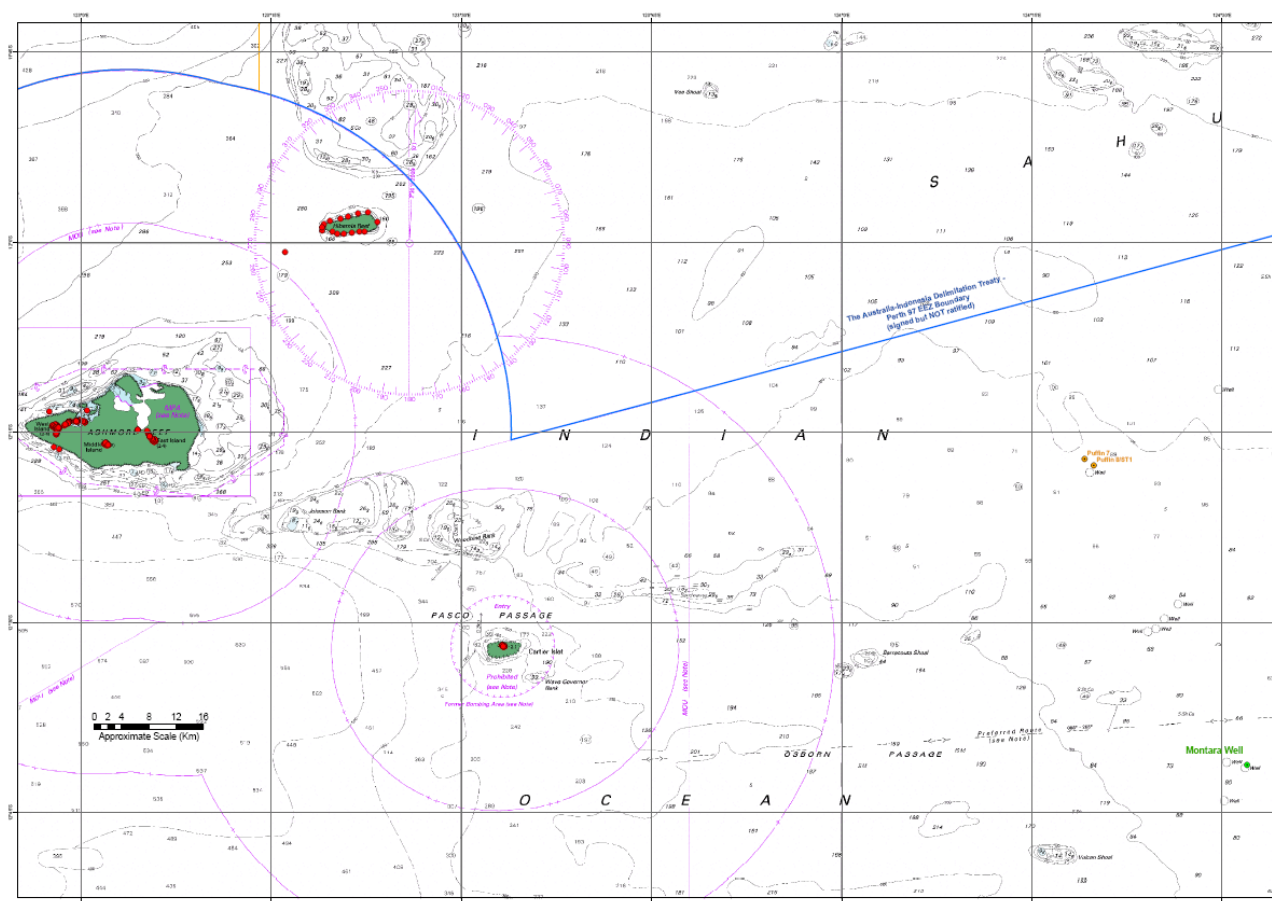


Figure 4.1. Waypoints (GPS locations) for the observations and sampling locations

4.1.1 West Island

West Island is the largest of the three vegetated islands at Ashmore Reef. It is also the most vegetated, with succulents, argusia bushes and several grass species growing within the centre of the Island. The West Island fore-dune is up to 4 metres high from the surrounding sand flats and is heavily bioturbated by turtles. Several burnt ship wrecks were found on the eastern tip of the islands.

The internal features are gently basinal with some wash over deposits up to 10 metres inland (Glenn and Collins 2005).

The multiple crests within the beach rock skirt of about approximately 30 metres in width in places indicates that it is a generally stable island with a history of 4 previous shorelines.

Loss of vegetation and exposure of Argusia bushes along parts of the coast line is noted and may be part of seasonal or a cyclical rhythm (Glenn 1997 unpublished thesis). The island is surrounded by many square kilometres of extensive intertidal mobile bioturbated sand flats.

There was no visual evidence of oil or wax seen on West Island.

Twenty sediment samples were collected from West Island.

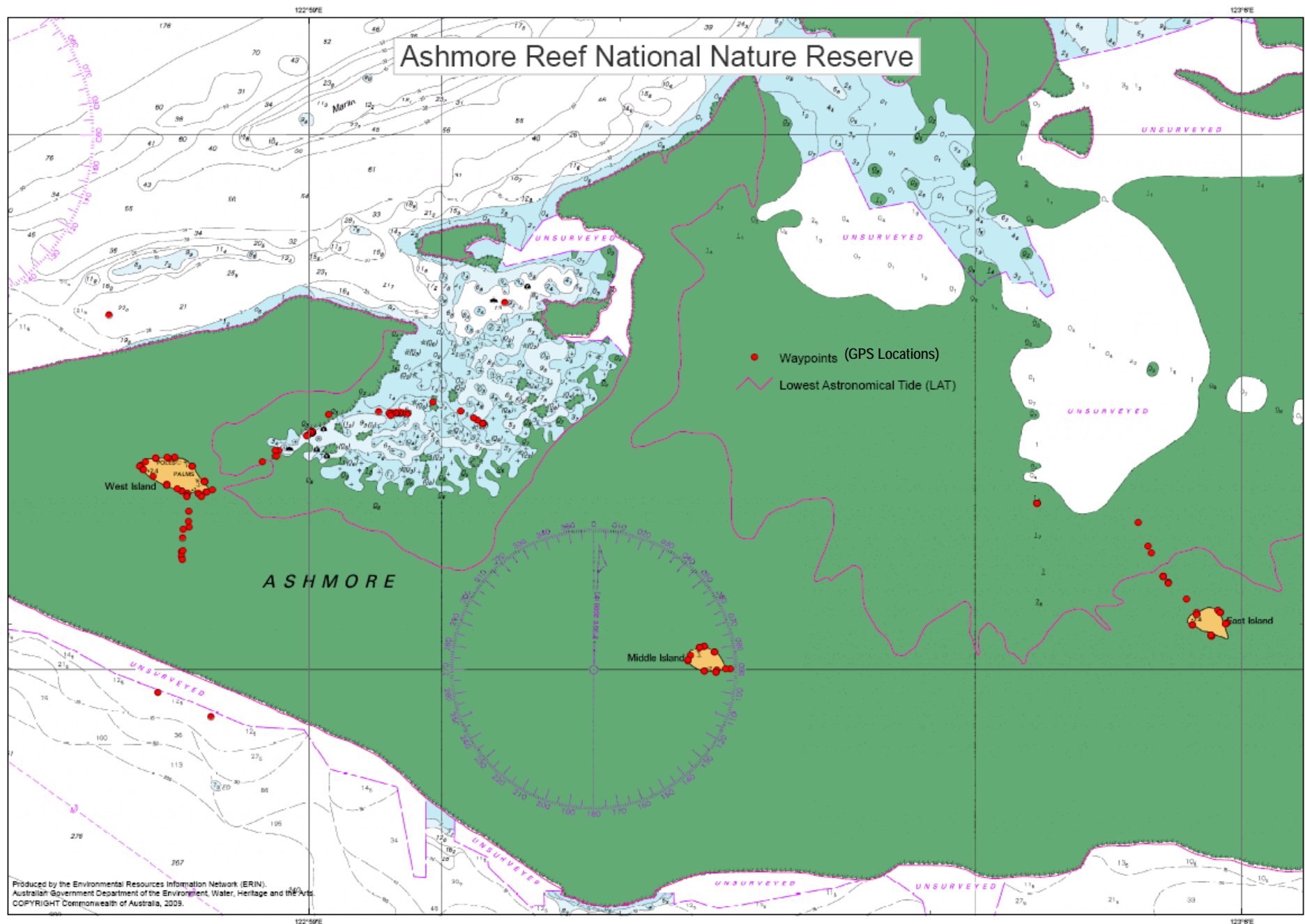


Figure 4.2 Data for sampling and observation locations at Ashmore Reef

4.1.2 Middle Island

This elliptical shaped island has several a prominent beach rock exposures parallel to the shore face.

The dish shaped interior is well defined and there is evidence of wash over deposits of coralline algae, pumice, wood and anthropogenic waste. This shrub-ringed, grass covered island has high bird densities. Rookeries are noted across all vegetated areas of the interior and turtle nesting sites located near the fore dune.

There was no visual evidence of oil or wax seen on Middle Island

Fourteen sediment samples were acquired on Middle Island.

4.1.3 East Island

East Island is almost entirely covered by grasses and other ground cover.

There is a high density of bird life and the vegetated ground is littered with nests in close proximity to each other. There was a high density of nesting sites on the sand on the eastern tip of this island just above the high tide mark. The northern shore line has a sand cliff at 1.4 metres high and soil horizons can be seen in the cliff exposure with several well defined humic layers.

There was no visual evidence of oil or wax seen on East Island.

Fourteen sediment samples were acquired on East Island.

4.1.4 Hibernia Reef

Working in a high tidal regime the work flow had to accommodate the variation in tidal variations. Using the low tide windows to advantage, a visual assessment of Hibernia reef took place on the 23 October.

Hibernia reef is a semi-emergent reef system with line of coralline boulders 10-20 metres in from the reef front. Some of these boulders are larger than two metres in height and width and appear to be above Mean high water. These large boulders sit and in some cases cemented to the low profile rise of encrusting coralline algae.

Further back towards the centre of the reef there is a shallow depression in the centre of the reef. This centralised shallow basin is almost entirely surrounded by a low rise reef rim yet appears to fill initially from the east indicating that this is lower in height and in the lee of the prevailing wind / wave energy.

Photos, visual observations and GPS locations of the reef features and sea surface were noted with particular attention paid to any suspected anomalies.

There was no visual evidence of oil or wax seen on Hibernia Reef.

No sediment samples were acquired on Hibernia Reef.

4.1.5 Cartier Islet

On 24 October, the assessment team surveyed Cartier Islet. It has a well defined reef flat and a semi mobile sand cay near its centre. The reef flat is ringed by line of coralline boulders, approximately 1-2 metres in diameter. The reef flat was characterised by patch reef morphology dominated by massive coral growing to the sea surface, encrusting algae and multiple interconnected sand gutters towards the reef front. The reef appeared to be a typical coral reef ecosystem with high biodiversity including: molluscs; fish; coral; and algae. Further detailed description of all shore visits can be found in Attachment B.

The sand that makes up this sand cay is biogenic mainly mollusc, coralline algae and coral. The upper strand line of this cay is marked by line of coralline debris with wash over deposits of coralline/mollusc debris with some anthropogenic debris. The interior of the Islet was heavily bioturbated by turtle and hatchling activity, particularly on the elevated rim of the sand cay. The centre of the cay appears to have a small deflation surface. There is a grave site in the southern side of the sand cay and scattered metal military debris. An abandoned bird nesting site with unhatched eggs atop a semi-lithified guano pavement was observed in southeastern interior of the island and photographed.

There was no visual evidence of oil or wax seen on Cartier Islet.

Eighteen samples were acquired on Cartier Islet.

4.1.6 Marine Debris

Dr Glenn and Mr Ewers agreed that they observed much lower levels of marine debris deposited on the intertidal and fore-dune areas of the emergent islands than they had previously experienced. In the past, a range of empty plastic bottles, footwear and other anthropogenic debris was found alongside timber logs and bamboo. Observations during this survey revealed little debris. This may be due in part to the Wildlife Response and Customs Officers cleaning the beaches during daily inspections of the islands and also the seasonal influences of oceanic currents.

5. Acknowledgements

Thank you to the master of vessel & crew – Mark Farris (master), Neville Gill & Sally Wheeler (crew) – for the safe survey. Thank you also to Barbara Ross (DEWHA) and Ed Fletcher (PTTEPAA) for their assistance in Darwin.

6. References

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<http://www.environment.gov.au/coasts/oilspill.html>

7. Appendices

- 7.1 Appendix A: Field Notes
- 7.2. Appendix B: Ashmore Cartier Sample Meta Data
- 7.3. Appendix C: Environmental Observations

Attachment A – Field Notes

Sampling methods and labelling protocol:

Each island was systematically sampled in a clockwise direction. The island morphology was classified into various segments and a sequential number was allocated to each of these segments (1 through 6). Each segment, represented by a distinct change in environment type (i.e. from a “course grain beach with no bedrock skirt” to “beach with bedrock lower intertidal zone”), was sampled to ensure that all habitats were represented by the assessment.

Once a sample site was selected, two parallel incisions were made in the sediment using a square edged spade. Digging parallel between the spade incisions, the sediment between these incisions was then removed creating an untouched cross section at depth. Sediment samples were then acquired using a new bricklayers trowel and transferred to a glass sampling jar.

At least two samples were acquired at each sampling station: usually one at 0-½ cm depth and a second at 5 cm depth. Although not encountered during this survey, as per instruction from John Wardrop, if heterogeneous sediments were revealed in sediment cross sections then further samples would have been taken at each location.

Each individual sample was labelled using a distinct numbering system, where: East Island = E, Middle Island = M, West Island = W and Cartier Islet = C. Samples were labelled based on the island, the segment and the sample number. For example, the first sample at West island, located in Segment 1 was labelled “1 W1” and the 12th sample on Middle island in Segment 6 was “12 M6”.

Each Sample was labelled in three ways to assist sample analysis as much as possible. A sticky label with complete meta-data (including time, date, sample and location identification, GPS location, sample depth) was attached to sample jar at time of acquisition. This was supplemented with an abbreviated numbering system written in water proof ink on the top of each jar. An additional aluminium label with basic data was adhered to the sample jar. All sample meta data was collated in a spreadsheet to accompany samples to laboratory (Attachment B).

Attachment B – Ashmore-Cartier Sample Record

Sample number	Time	Date	Description	Location	Latitude	Longitude
1 E1	11:08	22/10/2009	Intertidal Zone, - Fine sand	East Island	12 deg. 15.354 S	123 deg. 05.447 E
2 E1	11:27	22/10/2009	1/2 cm Sand UITZ	East Island	12 deg. 15.588 S	123 deg. 05.660 E
3 E1	11:27	22/10/2009	5cm Sand UITZ	East Island	12 deg. 15.588 S	123 deg. 05.660 E
4 E2	11:50	22/10/2009	1/2 cm Sand	East Island	12 deg. 25.960 S	123 deg. 09.731 E
5 E2	11:50	22/10/2009	10cm sand sample	East Island	12 deg. 25.960 S	123 deg. 09.731 E
6 E3	12:06	22/10/2009	1/2 cm sand	East Island	12 deg. 26.102 S	123 deg. 09.796 E
7 E3	12:06	22/10/2009	6cm sand	East Island	12 deg. 26.102 S	123 deg. 09.796 E
8 E3	12:08	22/10/2009	Water foam on incoming tide	East Island	12 deg. 26.102 S	123 deg. 09.796 E
9 E4	12:30	22/10/2009	1/2 cm Sand	East Island	12 deg. 26.240 S	123 deg. 09.613 E
10 E4	12:30	22/10/2009	5 cm Sand	East Island	12 deg. 26.240 S	123 deg. 09.613 E
11 E4	12:35	22/10/2009	1/2 cm sand	East Island	12 deg. 26.251 S	123 deg. 09.618 E
12 E4	12:35	22/10/2009	5cm Sand MITZ	East Island	12 deg. 26.251 S	123 deg. 09.618 E
13 E4	12:53	22/10/2009	1/2 cm course grained sand	East Island	12 deg. 26.112 S	123 deg. 09.383 E
14 E4	12:53	22/10/2009	5cm Course grained sand	East Island	12 deg. 26.112 S	123 deg. 29.383 E
1 M1	13:55	22/10/2009	1/2 cm well sorted sand	Middle Island	12 deg. 26.399 S	123 deg. 03.221 E
2 M1	13:55	22/10/2009	5cm well sorted sand	Middle Island	12 deg. 26.399 S	123 deg. 03.221 E
3 M2	14:17	22/10/2009	1/2 cm Sand	Middle Island	12 deg. 26.381 S	123 deg. 03.278 E
4 M2	14:17	22/10/2009	5cm sand	Middle Island	12 deg. 26.381 S	123 deg. 03.278 E
5 M3	14:30	22/10/2009	1/2 cm med / course sand	Middle Island	12 deg. 26.454 S	123 deg. 03.405 E
6 M3	14:30	22/10/2009	5cm Course / med sand	Middle Island	12 deg. 26.454 S	123 deg. 03.405 E
7 M4	15:07	22/10/2009	1/2 cm med sand	Middle Island	12 deg. 26.700 S	123 deg. 03.426 E
8 M4	15:07	22/10/2009	5cm med sand	Middle Island	12 deg. 26.700 S	123 deg. 03.426 E
9 M5	15:19	22/10/2009	1/2 well sorted sand	Middle Island	12 deg. 26.684 S	123 deg. 03.276 E
10 M5	15:20	22/10/2009	5cm well sorted sand	Middle Island	12 deg. 26.684 S	123 deg. 03.276 E
11 M6	15:35	22/10/2009	1/2 Cm med well sorted sand	Middle Island	12 deg. 26.560 S	123 deg. 03.073 E
12 M6	15:35	22/10/2009	5cm Med well sorted sand	Middle Island	12 deg. 26.560 S	123 deg. 03.073 E
13 M6	15:45	22/10/2009	1/2 cm sand	Middle Island	12 deg. 26.487 S	123 deg. 05.106 E
14 M6	15:45	22/10/2009	5cm Sand	Middle Island	12 deg. 26.487 S	123 deg. 05.106 E
1 W1	12:43	23/10/2009	1/2 cm well sorted sand	West Island	12 deg. 24.323 S	122 deg. 97.028 E
2 W1	12:43	23/10/2009	5 cm well sorted sand	West Island	12 deg. 24.323 S	122 deg. 97.028 E
3 W2	13:02	23/10/2009	1/2 cm Sand UITZ	West Island	12 deg. 24.406 S	122 deg. 97.048 E

4 W2	13:02	23/10/2009	5cm Sand UITZ	West Island	12 deg. 24.406 S	122 deg. 97.048 E
5 W3	13:08	23/10/2009	1/2cm course / med sand UITZ	West Island	12 deg. 24.447 S	122 deg. 96.962 E
6 W3	13:08	23/10/2009	5cm course / med sand UITZ	West Island	12 deg. 24.447 S	122 deg. 96.962 E
7 W3	13:19	23/10/2009	1/2 cm Sand UITZ	West Island	12 deg. 24.438 S	122 deg. 96.747 E
8 W3	13:19	23/10/2009	5 cm Sand UITZ	West Island	12 deg. 24.438 S	122 deg. 96.747 E
9 W3	13:34	23/10/2009	1/2 cm Sand UITZ	West Island	12 deg. 24.363 S	122 deg. 96.558 E
10 W3	13:34	23/10/2009	5cm Sand UITZ	West Island	12 deg. 24.363 S	122 deg. 96.558 E
11 W3	13:50	23/10/2009	1/2 cm Sand UITZ	West Island	12 deg. 24.180 S	122 deg. 96.262 E
12 W3	13:50	23/10/2009	5 cm Sand UITZ	West Island	12 deg. 24.180 S	122 deg. 96.262 E
13 W4	13:56	23/10/2009	1/2 cm Sand	West Island	12 deg. 26.124 S	122 deg. 96.238 E
14 W4	13:56	23/10/2009	5cm Sand UITZ	West Island	12 deg. 26.124 S	122 deg. 96.238 E
15 W5	14:15	23/10/2009	1/2 cm Course / med sands UITZ	West Island	12 deg. 24.632 S	122 deg. 96.424 E
16 W5	14:15	23/10/2009	5 cm Course / med sands UITZ	West Island	12 deg. 24.632 S	122 deg. 96.424 E
17 W5	14:29	23/10/2009	1/2 cm med Sand UITZ	West Island	12 deg. 24.042 S	122 deg. 96.657 E
18 W5	14:29	23/10/2009	5cm Med Sand UITZ	West Island	12 deg. 24.042 S	122 deg. 96.657 E
19 W5	14:42	23/10/2009	1/2 cm Med Sand	West Island	12 deg. 24 133 S	122 deg. 96.874 E
20 W5	14:42	23/10/2009	5cm Med sand	West Island	12 deg. 24 133 S	122 deg. 96.874 E
1 C1	8:14	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.109 S	123 deg. 55.362 E
2 C1	8:14	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.109 S	123 deg. 55.362 E
3 C1	8:20	24/10/2009	1/2 cm Sand (strand line)	Cartier	12 deg. 52.999 S	123 deg. 55.362 E
4 C1	8:20	24/10/2009	5 cm Sand (strand line)	Cartier	12 deg. 52.999 S	123 deg. 55.362 E
5 C1	9:34	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.026 S	123 deg. 55.552 E
6 C1	8:34	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.026 S	123 deg. 55.552 E
7 C1	8:44	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.075 S	123 deg. 55.664 E
8 C1	8:44	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.075 S	123 deg. 55.664 E
9 C1	8:49	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.096 S	123 deg. 55.673 E
10 C1	8:49	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.096 S	123 deg. 55.673 E
11 C2	9:15	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.115 S	123 deg. 55.460 E
12 C2	9:15	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.115 S	123 deg. 55.460 E
13 C2	9:19	24/10/2009	1/2 cm Sand	Cartier	12 deg. 53.167 S	123 deg. 55.447 E
14 C2	9:19	24/10/2009	5cm Sand	Cartier	12 deg. 53.167 S	123 deg. 55.447 E
15 C1	9:30	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.108 S	123 deg. 55.524 E
16 C1	9:30	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.108 S	123 deg. 55.524 E
17 C1	9:35	24/10/2009	1/2 cm Course Sand	Cartier	12 deg. 53.040 S	123 deg. 55.336 E
18 C1	9:35	24/10/2009	5cm Course Sand	Cartier	12 deg. 53.040 S	123 deg. 55.336 E

Attachment C – Marine Environmental Observations

Date	Time CST	Type	Latitude	Longitude	Description	Wind speed	Wind Dir	Sea State
21/10/2009	09:30	Sea Surface Anomaly Sighting	12 deg 17.551 S	127deg 03.51 E	Calmer water along anomaly, no change in sea colour, approx 4m wide, more than 2km long. Sea sprint travelled straight through anomaly	12 knots	NE	Light Chop on 1/2 metre swell
21/10/2009	16:09	Sea Surface Anomaly Sighting	12 deg 15.039 S	125 deg 31.618 E	Sections of fawn to khaki substance within calmer water. Long line (several km undisturbed, 10m wide in a EW Direction			Light Chop on < 1/2 metre swell
21/10/2009	16:20	Sea Surface Anomaly Sighting	12 deg 15.005 S & 12 deg 14.978 S	125 deg 30.779 E & 125 deg 28.770 E	Orangey / fawn discontinuous, buoyant substance (not continuous). A small white buoyant substance / solid were also seen in wind rows (approx 1cm - 5cm in size). No further discolouration of water. - 60NM from West Atlas 65 Deg True			light chop < 1/2 sea swell
21/10/2009	16:40	Banded sea Snake	12 deg 14.939 S	125 deg 25.952 E	Approx 2m in length, fawn & brown bands. Not in proximity of oil, travelling towards the south			
22/10/2009	17:00	Banded sea Snake	13 deg 14.939 S	126 deg 25.952 E	Approx 2m in length, fawn & brown bands			
23/10/2009	07:43	No anomaly observed	12 deg 07.340 S	123 deg 06.688 E	Normal Sea Conditions	7 knots	NE	1/2 m swell
23/10/2009	08:00	No anomaly observed	12 deg 04.857 S	123 deg 10.250 E	Normal Sea Conditions	7 knots	NE	3/4 m swell
23/10/2009	08:15	No anomaly observed	12 deg 03.328 S	123 deg 12.550 E	Normal Sea Conditions	7 knots	NE	1/2 m swell
23/10/2009	08:30	No anomaly observed	12 deg 00.973 S	123 deg 16.220 E	Normal Sea Conditions	10 knots	NE	1/2 m swell
23/10/2009	08:33	Sea Surface Anomaly (potential oil)	12 deg 00.653 S	123 deg 16.731 E	10m wide by >1.5km long change in sea surface with other patches of similar phenomena. Orientation = SE-NW	10 knots	NE	1/2 m swell
23/10/2009	08:37	Sea Surface Anomaly (potential oil)	12 deg 00.039 S	123 deg 17.771 E	Extensive patches of sea surface anomaly with white / orange solids < 4cm in diameter through out	10 knots	NE	1/2 m swell

23/10/2009	08:39	Sea Surface Anomaly (potential oil)	11 deg 59.755 S	123 deg 18.249 E	Sea Surface Anomaly (potential oil)	10 knots	NE	1/2 m swell
23/10/2009	08:41	Sea Surface Anomaly (potential oil)	11 deg 59.280 S	123 deg 18.640 E	Sea Surface Anomaly (potential oil)	10 knots	NE	1/2 m swell
23/10/2009	08:50	Suspected sheen at Hibernia Reef	12 deg 00.039 S	123 deg 17.771 E	Suspected sheen at Hibernia Reef - heading north west past western tip of reef. Approx 250m from reef front	10 knots	NE	1/2 m swell
23/10/2009	08:51	Western tip of Hibernia Island			Emergent reef system with line of boulders 10-20m in from reef front. Low profile coralline Algae present, coral platform; travelling at 6-8m water depth & can clearly see sea floor. Southern edge, coralline boulders on reef front, spur & grove morphology with scattered larger boulders further up reef towards centre. Boulders up to 1.2m in diameter- greenish hue in centre of island, more orange at edge.			1/2 m swell
23/10/2009	08:56	Sea Surface Anomaly (potential oil)			Sea Surface Anomaly within 150m of southern reef edge. 10m by minimum 1km length			
23/10/2009	08:59	Sea Surface Anomaly (potential oil)			10m x 300m No well defined reef flats, reef consists of hard substrate			
23/10/2009	09:03	Sea Surface Anomaly (potential oil)	11 deg 59.319 S	123 deg 20.244 E	30m x 50m had bubbles in middle of it			
23/10/2009	09:09	Hibernia Description	11 deg 59.295 S	123 deg 20.872 E	Near shore boulders 1.5m in height, 2-2.5 metres in width. Scattered coralline boulders along middle southern edge of reef. Higher relative energy. Internal part of reef is a basin which leads to reef rim; boat 120m from reef front in 8-10m water			
23/10/2009	09:15	Sea Surface Anomaly (potential oil)			5m wide- 800m long, 100m from southern side of the reef			
		sea snake observed			sea snake observed			
23/10/2009		Sea Surface Anomaly (potential oil)	11 deg 59.129 S	123 deg 22.420 E	2-3m wide x 800m long			
23/10/2009		Sea Surface Anomaly (potential oil)	11 deg 58.374 S	123 deg 23.366 E	Southern eastern tip of Hibernia Coral rubble flat, rubble of boulders & Cobbles, adjacent to lagoon entry.			

23/10/2009		lagoon entry	11 deg 95.982 S	123 deg 37.749 E	patch reef; spur and groove morphology			
23/10/2009		Sea Surface Anomaly (potential oil)	11 deg 57.742 S	123 deg 21.778 E	3m x >1km in north east a third of the way down the northern side of the reef			
23/10/2009		coralline algae bioherm	11 deg 57.947 S	123 deg. 21.148 E	bioherm is 1.5m height and laterally extensive. Along the reef is scattered coralline boulders <50cm in diameter. 8 seabirds spotted along the reef front.			
23/10/2009		Sea Surface Anomaly (potential oil)	11 deg. 96.871 S	123 deg. 34.113 E	5m wide, >2km long; NW of Hibernia			
23/10/2009		transition in environment	11 deg. 97.183 S	123 deg. 32.726 E	Transition in environment at the northern point of Hibernia. High density coralline boulders up to 2m diameter. More emergent and a high profile rim. No well formed reef flats, goes straight up to reef platform; boat in 24 meters water; island tip progrades			
23/10/2009		several sea surface anomalies coalescing at reef edge	11 deg, 97.547 S	123 deg. 31.924 E	patchy coalescence to the W. three birds spotted flying along reef edge			
23/10/2009		spur and groove morphology	11 deg. 97.937 S	123 deg. 31.816 E	well developed spur and groove morphology on reef edge from 18-32m			
23/10/2009	10:22	Sea Surface Anomaly (potential oil)	11 deg. 59.559 S	123 deg. 18.162 E	7m wide; discontinuous over several kilometres; multiple occurrences of the same streaking; from NE to SW. Also flying fish observed.			
23/10/2009	10:30	Sea Surface Anomaly (potential oil)	12 deg. 00.686 S	123 deg. 60.168 E	7m wide by >1km; SW to NE trends with multiple lines of anomaly in parallel			
23/10/2009	10:35	Sea Surface Anomaly (potential oil)	12 deg. 01.031 S	123 deg. 15.603 E	>100m wide, >2km long; white/orange chunks; E to W			
23/10/2009	10:50	Normal sea conditions	12 deg. 02.977 S	123 deg. 12.410 E	Normal Sea Conditions	7 knots		half metres swell
23/10/2009	10:53	Sea Surface Anomaly (potential oil)	12 deg. 03.284 S	123 deg. 11.939 E	>2km long, 5m wide			
23/10/2009	10:55	Sea Surface Anomaly (potential oil)	12 deg. 03.658 S	123 deg. 11.440 E	multiple anomalies >2km long, 5m wide			
23/10/2009	11:15	Sea Surface Anomaly (potential oil)	12 deg. 06.416 S	123 deg. 07.900 E	Travelling SE to NW; 7-10m wide, >1km long, white foam observed; patches approximately 150m wide nearby to sea surface anomaly			
23/10/2009	11:20	Sea Surface Anomaly (potential oil)	12 deg. 07.197 S	123 deg. 06.865 E	Dark orange biogenic solids observed			

23/10/2009	11:25	Sea Surface Anomaly (potential oil)	12 deg.07.820 S	123 deg.06.001 E	Dark orange biogenic solids observed; 100-200m long, 3-4m			
23/10/2009	11:30	Sea Surface Anomaly (potential oil)	12 deg. 08.045 S	123 deg. 05.074 E	Dark orange sea surface anomaly; white solids on the surface; hundreds of brown boobies feeding			
23/10/2009	11:35	Sea Surface Anomaly (potential oil)	12 deg. 08.978 S	123 deg. 04.312 E	25m wide, >1km long; orange and white solids			
23/10/2009	11:37	Sea Surface Anomaly (potential oil)	12 deg. 09.217 S	123 deg. 03.950 E	patches of transparent white/orange solids; multiple anomalies 3-4 long coalescing; 25m wide, >2km long			
23/10/2009	11:40	Sea Surface Anomaly (potential oil)	12 deg. 09.627 S	123 deg. 63.243 E	several long anomalies and patches with white flakes throughout; 5-30m wide, >1-2km long			
23/10/2009	11:45	Sea Surface Anomaly (potential oil)	12 deg. 10.140 S	123 deg.02.314E	Sea surface anomalies with white foam; 15m wide, >1-2km long			
23/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 13.304 S	122 deg. 57.655 E	Linea Sea Surface anomaly 5-7m in width in same direction as wind - off NW tip of Western Edge of Ashmore Reef	5 knots		1/2 m swell
23/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 14.550 S	122 deg. 55.519 E	Patchy sea surface anomaly, no wind ripples (still spots)			
23/10/2009		Ashmore - Southern Reef Description			Western Tip of Ashmore proper, water clear to 16m; extensive reef flat, waves breaking on reef front, devoid of coral boulders. - Localised up welling & confused currents - linear features running semi parallel to reef front - reef flat is unremarkable & consistent - small wave break zone - Sea grasses & algae apparent in water			
23/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 15.127 S	122 deg. 55.694 E	Small particulates on surface. Fawn in colour			
23/10/2009		Ashmore - Southern Reef Description			Southern edge of Ashmore- Wave break zone occurs roughly at reef edge- 50m swash zone after breaking- Feeding terns were seen and aggregation of boobies were seen along reef front.			
23/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 15.756 S	122 deg. 59.920 E	Running parallel from reef front ~ 100 m from break for length of reef front. Approx 4-5 m wide - Others run parallel to these ~ 100 m apart, but more broken up towards sea.			

23/10/2009		Ashmore - South of Eastern tip of West Island - Reef Description	12 deg. 26.960 S	122 deg. 96.447 E	Uniform reef front; haven't seen any morphological changes in reef front.			
23/10/2009		Ashmore - Southern Reef Turning point	12 deg. 27.258 S	122 deg. 97.112 E	Travelled 3.4 nautical miles along southern edge of reef.			
23/10/2009								
24/10/2009	06:45	Sea Surface Anomaly (potential oil)	12 deg. 27.980 S	123 deg. 24.682 E	Sea surface anomaly; N to S; 5 knots winds; half metre swell; 55nm from the rig			
24/10/2009	06:50	Sea Surface Anomaly (potential oil)	12 deg. 28.472 S	123 deg. 25.977 E	Sea surface anomaly - patchy and linear from SE to NW; 5 knot wind, SW to W winds; half metre swell.			
24/10/2009	07:04	Sea Surface Anomaly (potential oil)	12 deg. 29.756 S	123 deg. 29.670 E	patchy sea surface anomaly; 20m wide, 600m long; 5 knots, half metre swell			
24/10/2009			12 deg. 30.807 S	123 deg. 30.340 E	Approximately 8 dolphins, swimming W			
24/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 30.548 S	123 deg. 31.358 E	Sea surface anomaly - > 2km long & 100-200m wide. White bubbles in smaller patches, approx 1.3 nautical miles from Cartier.	5 knots		< 1/2m swell
24/10/2009		Cartier Reef Description	12 deg. 31.278 S	123 deg. 39.904 E	Boulders <2m just behind reef front, scattered. There are more boulders on north western tip. - beach rock outcrop on southern side of island - extensive reef flat			
24/10/2009	12:19	Patches of Sea Surface anomaly (potential sheen)	12 deg. 31.072 S	123 deg. 47.149 E	White globs in water (potential dispersant?) 40 NM from rig, 13NM from Cartier			Calm patches
24/10/2009		Sea Surface Anomaly (potential oil)	12 deg. 43.705 S	123 deg. 24.045 E	Sheen on water is wide spread. "Dispersant" seen as white gloss up to 3cm. Occasional occurrences of orange slime on sea surface. 3 x 5m2			
24/10/2009	15:20	School of Tuna	12 deg. 73.982 S	124 deg. 53.885 E	School of Tuna	2-3 knots	ENE	
24/10/2009	15:27	Sea Birds feeding	12 deg. 45.993 S	124 deg. 36.254 E	Approximately 10 birds observed feeding	2-3 knots	ENE	
24/10/2009	15:29	Jelly Fish	12 deg. 43.878 S	123 deg.26.820 E	Jelly Fish at approx 1m depth	2-3 knots	ENE	
24/10/2009	15:32	Dolphins	12 deg. 43.797 S	123 deg. 38.240 E	> 3 Dolphins sighted	2-3 knots	ENE	
24/10/2009	15:35	Pod of Dolphins	12 deg. 43.777 S	123 deg. 38.385 E	Approximately 20 dolphins and 1 bird sitting in water (flew 20m then back into water)	2-3 knots	ENE	

24/10/2009	15:37	Turtle	12 deg. 43.723 S	124 deg. 39.280 E		2-3 knots	ENE	
24/10/2009	15:39	Jelly Fish	12 deg. 43.691 S	124 deg. 39.589 E	Jelly Fish at approx 1m depth	2-3 knots	ENE	
24/10/2009	15:45	Jelly Fish	12 deg. 43.235 S	124 deg. 42.123 E	Jelly Fish at approx 1m depth	2-3 knots	ENE	
24/10/2009	15:48	Jelly Fish & Sea Snake	12 deg. 43.522 S	124 deg. 42.320 E	Jelly Fish at approx 1m depth Sea Snake on surface	2-3 knots	ENE	
24/10/2009	15:58	Sea Surface Anomaly (potential oil)	12 deg. 43.420 S	124 deg. 43.899 E	Ocean predominantly covered in suspected oil, but separating into patches of normal sea state.	2-3 knots	ENE	
24/10/2009	16:00	Birds, Fish & sea surface anomaly	12 deg. 43.386 S	124 deg. 44.598 E	50-100 Birds feeding (suspected sooty Terns), fish shoals (suspected Tuna); Sea Surface anomalies in patches (suspected sheen) 100 - 200 m wide > 3-4km in length			1/2 m swell
24/10/2009	16:05	Birds, Fish & sea surface anomaly	12 deg. 43.352 S	124 deg. 45.656 E	25-50 birds feeding; fish shoals; Sea Surface anomalies in patches (suspected sheen) 50 - 100 m wide > 1-2km in length			1/2 m swell
24/10/2009	16:08	Bird	12 deg. 43.328 S	124 deg. 46.329 E	Unidentified flying bird			
24/10/2009	16:12	Sea Surface Anomaly (potential oil)	12 deg. 43.294 S	124 deg. 47.475 E	Sea Surface anomalies in patches (suspected sheen) 100 - 200 m wide > 3-4km in length			
24/10/2009	16:15	Pod of Dolphins, Birds & Sea Surface Anomaly	12 deg. 43.272 S	124 deg. 48.356 E	> 3 Dolphins sighted in patches of Sea surface anomaly (suspected sheen) 100 - 200 m wide > 3-4km in length. > 4 Birds (Sooty Terns)			
24/10/2009	16:32	Sea Surface Anomaly (potential oil)	12 deg. 43.141 S	124 deg. 53.521 E	Sea Surface anomalies in patches (suspected sheen) 50 - 100 m wide > 3-4 km in length			
24/10/2009	17:58	Sea Surface Anomaly (potential oil)	12 deg. 41.779 S	125 deg. 17.541 E	70% anomaly (potential sheen) cover with white chunks on sea surface. 50nm from the Montara rig. Two sea snakes and flying fish observed.			
24/10/2009	19:05	Sea Surface Anomaly (potential oil)	12 deg.40.818 S	125 deg. 33.566 E	20% anomaly (potential sheen) cover.	5 knots		1/2m swell