ESTABLISHING BASELINE BENTHIC COMMUNITY MONITORING SITES IN THE MONTEBELLO/BARROW ISLANDS MARINE PROTECTED AREAS: 7-22 December 2006

Field Program Report: PIO/MBI-2006/05

A collaborative project between the Department of Environment and Conservation and the Department of Fisheries

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Summary

The Department of Environment and Conservation's Marine Science Program, in collaboration with the Pilbara Regional Office, is establishing a long-term monitoring program in the Montebello/Barrow Islands Marine Protected Areas. This program is a requirement of the management plan and will, ultimately, provide time-series data on the condition and pressure(s) on the ecological values and the effectiveness of management actions. This information is necessary for the conservation and maintenance of the ecological and social values of the reserves and the management of human use in the area.

The December 2006 field survey focuses primarily on establishing long-term monitoring sites within coral reef communities. Sites and monitoring methodologies have been selected to complement existing and future industry monitoring programs in the area. Future field surveys will focus on the other important benthic habitats, marine fauna, and water and sediment quality monitoring requirements of the management plan.

The primary objectives of the December 2006 survey are:

- to establish reference sites in the MBIMPA to assess the effects of natural disturbances;
- to establish sites in areas of existing/future human impact;
- to systematically collect further marine habitat data; and
- to collect human usage data on an opportunistic basis.

A suite of secondary activities, outlined in section 1.5, will be undertaken if time and conditions permit.

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1 Introduction

1.1 BACKGROUND

The Montebello/Barrow Islands marine protected areas (MBIMPA) which incorporates the Montebello Islands Marine Park, Barrow Island Marine Park and the Barrow Island Marine Management Area, were gazetted in 2005 and are vested in the Marine Parks and Reserves Authority (MPRA). The WA Department of Environment and Conservation (DEC), in collaboration with the Department of Fisheries (DoF), are responsible for the progressive implementation of the reserves' management plan on behalf of the MPRA.

The DEC's Marine Science Program, in collaboration with the Pilbara Region, is establishing a long-term monitoring program in the MBIMPA. This program is a requirement of the management plan (Department of Environment and Conservation and the Marine Parks and Reserves Authority 2004) and will, ultimately, provide time-series data on the condition and pressure(s) of the ecological values and the effectiveness of management actions. This information is necessary for the conservation and maintenance of the ecological and social values of the reserves and the management of human use in the area.

A scoping field trip was undertaken in August 2006 (Bancroft *et al.* 2006) which assessed the logistical and scientific issues relating to the establishment of monitoring programs. The outputs of this survey included the identification of potential coral reef monitoring sites, a subset of which will be utilised in the December field survey.

The December 2006 field survey focuses primarily on establishing long-term monitoring sites within coral reef communities. Sites and monitoring methodologies have been selected to complement existing and future industry monitoring programs in the area. Future field surveys will focus on other important benthic habitats, marine fauna, and water and sediment quality monitoring requirements.

1.2 MANAGEMENT ARRANGEMENTS

The management of the MBIMPA conforms to the Australian and New Zealand Environment and Conservation Council (Department of Natural Resources and Environment 1997) *Best Practice in Performance Reporting in Natural Resource Management.* This approach is reflected in the management plan, which specifies the ecological and social values. The current status, current major pressures, management objectives, management strategies (prioritised), generic performance measures and desired trends, and management targets are identified for each ecological and passive social values (eg. seascapes and wilderness).

The management plan identifies the performance assessment-reporting requirements, which requires the MPRA/DEC to conduct annual performance assessment reviews and the MPRA to undertake formal triennial audits of the management plan. The outcomes of the reviews provide feedback into the development of annual operational work plans (i.e. complementing the adaptive management cycle.

Key performance indicators (KPIs) are a key element of performance assessment reporting, as a measure of the overall effectiveness of management in relation to the strategic objectives of the reserves. KPIs relate specifically to the management targets for key ecological and social values and reflect the highest conservation (from biodiversity and ecosystem integrity perspectives) and management (social) priorities.

The KPIs for the MBIMPA are:

- water quality;
- coral reef (intertidal & subtidal) communities;
- mangrove communities;
- macroalgae and seagrass communities;
- marine turtles; and
- finfish.

Monitoring and research are integral components of the performance assessment framework. They provide data required firstly to understand the cause-effect pathways between the resource condition, pressure and response components of the model and secondly to provide the time series data that is used during annual assessments and triennial audits. The assessments and audits are essential to determine and report on whether management targets are being met and the level of effectiveness of the management strategies being implemented.

This project will provide some of the necessary data to meet the requirements for performance assessment reporting on coral reef communities.

This field report outlines the objectives, work program and expected outputs for the December 2006 field survey.

1.3 INDUSTRY COLLABORATIONS

The oil and gas industry has been active in the Montebello/Barrow Islands region for over 40 years. Barrow Island Project owned by Chevron Australia Pty Ltd is the State's largest oil producing project, with 34% of the total State production. Apache Energy Ltd operates the Harriet and East Spar projects on Varanus Island that produce gas condensate and oil. The two projects produce approximately 6% of the State's oil production and 25% of domestic gas production.

Associated with their activities on and around Varanus Island, Apache Energy Ltd has over the last ten years, established various monitoring programs of ecological values such as coral reef communities, macroalgal communities, mangroves, seabirds, turtles and intertidal communities (Astron Environmental Services 2005; Ecology Lab Pty Ltd 1997; International Risk Consultants 2001; 2002; 2005; 2006a; 2006b).

Chevron Australia Pty Ltd, a major stakeholder in the Gorgon Joint Venturers, proposes to develop the Gorgon gas field that lies north west of Barrow Island. The environmental assessment of this project is currently under consideration. The proposed Gorgon Development includes the installation of a subsea gathering system and a 70 km pipeline to Barrow Island. An associated processing plant that is proposed to be located in the northeast of the island, includes a loading facility, a jetty and a shipping channel. In particular, the dredging activities associated with the development are predicted to have impacts on the marine environment and as such, Chevron Australia Pty Ltd has undertaken environmental studies to characterise background water and sediment quality and benthic habitats.

The DEC, Apache Energy Ltd and Chevron Australia Pty Ltd have been collaborating to coordinate monitoring programs, to establish arrangements to exchange data, and to ensure consistency and compatibility of methods used.

1.4 STUDY AREA

The study area is within the boundaries of the MBIMPA (Figure 1), which is located in the Pilbara Offshore Bioregion (ANZECC 1998) of the northwest coast of Western Australia, approximately 1700 km north of Perth. The reserves cover an area of 2,122.4 km^2 and encompass the waters surrounding the Montebello, Lowendal and Barrow islands. The islands are located north of Onslow and northwest of Karratha, and range from 50-90 km in distance off the mainland coast.

1.5 OBJECTIVES

The overall goal of the field survey is to undertake the first phase of establishing a network of long-term monitoring sites in the MBIMPA to assess the status of the major benthic communities. The primary focus of this survey will be the coral reef communities.

The primary objectives of the December 2006 survey are:

- to establish long-term reference monitoring sites to assess the effects of natural disturbances on coral reef communities;
- to establish monitoring sites in areas of existing/future human impact on coral reef communities;
- to collect marine habitat data around the Montebello Islands, the Lowendal Shelf, Barrow Shoals, and Barrow Island; and
- to collect human use data on an opportunistic basis.

The following secondary activities will be undertaken, providing there is adequate time and appropriate conditions:

- to determine semi-quantitative relative estimates of finfish diversity and abundance. These data will be used to assist in the selection of future finfish monitoring sites;
- to determine relative abundances for two corallivorous invertebrates, the crown-of-thorns starfish (*Acanthaster planci*) and *Drupella* spp. gastropods;
- to obtain still and video footage of benthic communities at representative sites on an opportunistic basis to assist with future education and science communication programs; and
- to assess the extent and condition of the coral reefs in the Cape Preston area.

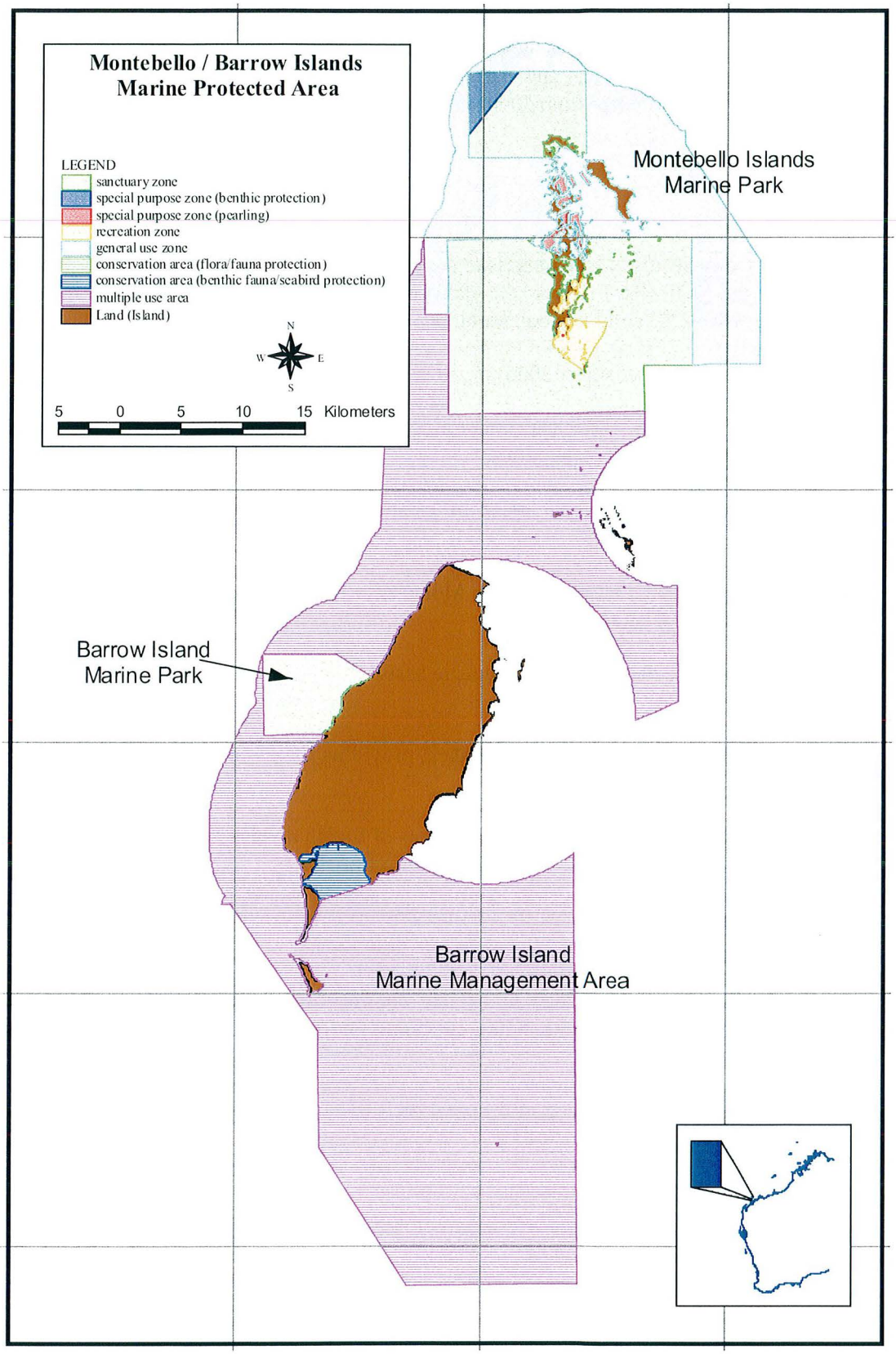

Figure 1. The survey study area: The Montebello Marine Park, the Barrow Islands Marine Park and the Barrow Islands Marine Management Area.

2 Methods

2.1 BENTHIC COMMUNITY MONITORING

Long-term monitoring sites for coral reef communities will be established in the MBIMPA as part of the implementation of long-term benthic community monitoring in all Conservation and Land Management Act (1984) marine protected areas (Cary 1997; Cary and Grubba 1998; Daly and Cary 1999; Cary *et al.* 2001; Grubba 2002). Quantitative and video surveys will be carried out along three replicate 50 m transects at each monitoring site. Routinely, the transects will be located in parallel, 20 m apart and the latitude and longitude will be determined at the end of each transect with a GPS. Care will be taken to ensure transects are located within a single community/zone type (e.g. upper reef slope) to avoid the confounding effects of depth, zone changes etc. An adaptation of the above method will be used if a site has insufficient area for three parallel 50 m transects (e.g. transects may be positioned serially) or if the rugosity (i.e. seabed roughness) of the coral community is high (e.g. longer transects may be used).

2.1.1 Data analysis

The Australian Institute of Marine Science's (AIMS) AVTAS method (English *et al.* 1997; Page *et al.* 2001) will be used to analyse the video transect footage. In this method, benthic features observed in 40 sub-sampled fields of view along each transect will be examined, and substrate type at five points per frame are recorded.

Data will be classified into seven major benthic groups:

- hard coral (Order Scleractinia);
- soft corals (Order Alcyonaria);
- algae (macroalgae, turf algae, coralline algae);
- sponge;
- abiotic (rock, sand, rubble);
- other (other identifiable organisms); and
- indeterminate (not able to confidently identify what is under a point).

These seven groups are subsequently divided into subcategories as outlined in Page *et al.* (2001). Benthic cover expressed as a percentage, will be calculated using the total 200 observations recorded for each transect.

2.1.2 Site selection

A network of sites will be established across the reserve, in relation to natural disturbances such as exposure to cyclonic and swell wave action, turbidity and currents. Other sites will be established in areas that are/may be impacted by future human activities. As mentioned previously (Section 1.3), data that has been or will be collected by oil and gas companies will be available for use by DEC under an informal data sharing agreement. The location of sites to be established during this survey has considered the location of existing and future industry monitoring and historical WA Museum survey sites. Some of the industry monitoring sites are located in areas of interest for the MBLTMP (Figures 2 & 3).

Some sites were identified during the scoping field trip undertaken in August 2006 (Bancroft *et al.* 2006) (Table 1; Figures 2 & 3). Other potential monitoring sites will be selected in the areas of interest identified using 1997 aerial photographs (1:20,000) and digital ortho-rectified aerial photographic mosaic captured in 2002 at 1:40,000) (Figure 2). Areas of interest were determined with limited benthic habitat information. Actual site coordinates within the area of interest will be determined in the field.

The areas of interest have been identified as below:

- **Area A** appears to be an exposed, low turbidity, back reef flat area. A northern site would complement sites MBI_0076, MBI_0079, C11 and C15;
- **Area B** appears to be a sheltered, high turbidity, high current area. Central sites would complement sites MBI_0083, G_01, C18, MBI_0071, MBI_0067 and G_02;
- **Area C** appears to be a sheltered, high turbidity, low current area along the eastern margin of Montebello and Lowendal islands. Northern sites would complement sites C22, C20, C11 and C23;
- **Area D** appears to be a sheltered, moderate turbidity, low current area along the margin of the Lowendal Shelf and Barrow Island. Another northern site would complement sites G_03, MBI_0087, G_04, MBI_0091, G_05 and G_06;
- **Area E** is the Dugong Reef which area experienced an anoxia event in 1991 and is an area of high diversity. Several sites would complement sites MBI_0089 and G_10;
- **Area F** is the Batman Reef, an area where our current understanding is limited. Sites would complement G_09;
- **Area G** appears to be sheltered, high turbidity, low current area along the eastern margin of the Barrow Shoals. It is another area where our current understanding is limited and sites would complement G_07 and G_08;
- **Area H** appears to be a highly exposed, low turbidity, low current area along the western margin of the Montebello Islands. Several sites would be required to provide spatial representation; and
- **Area I** appears to be an exposed, low turbidity, low current area along the northern margin of the Montebello Islands. Several sites would be required to provide spatial representation.

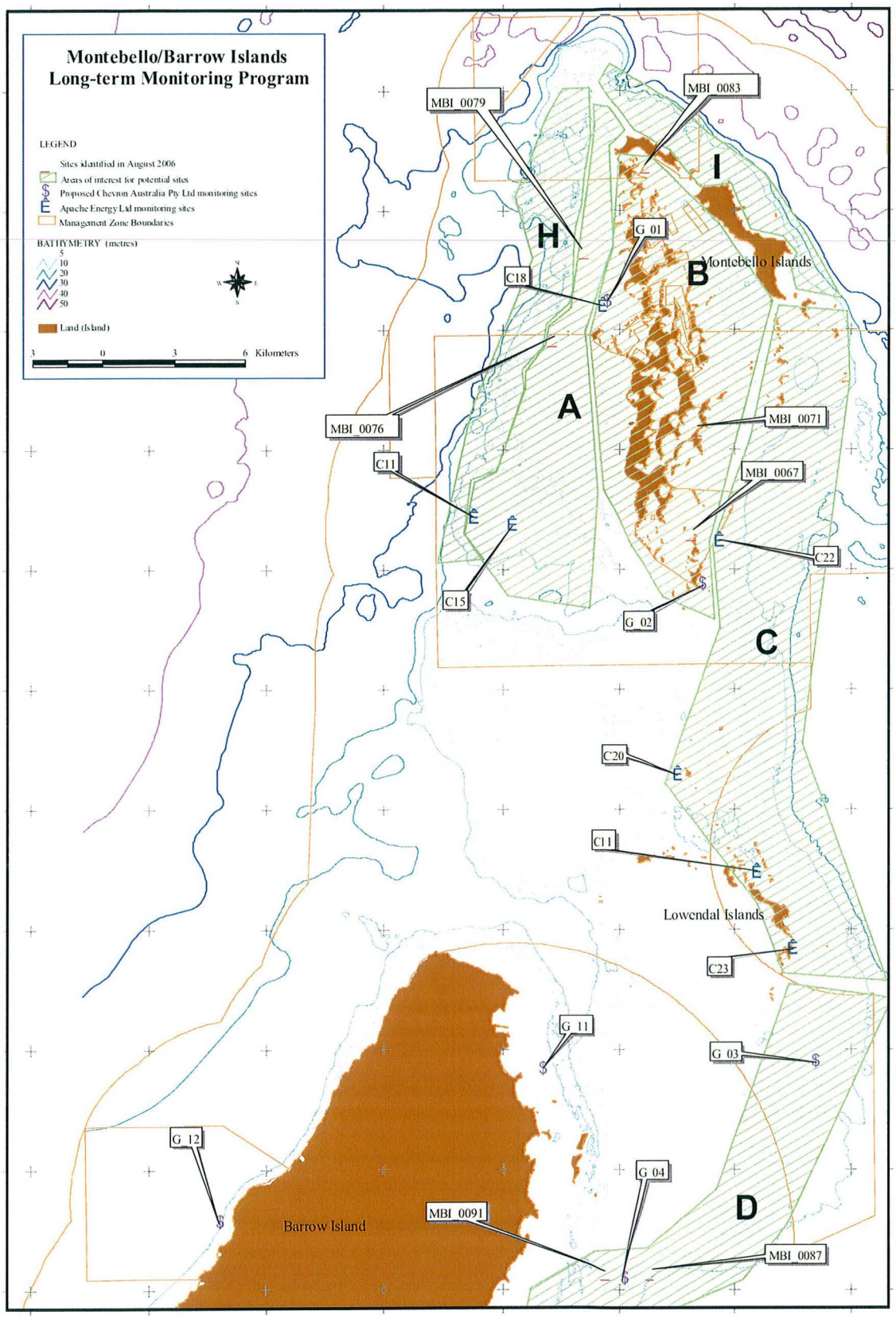

Figure 2. Potential coral reef community long-term monitoring sites in the Montebello Islands: identified during the August 2006 survey (red dots), to be determined in the field (green polygons) and provided by Apache Energy Ltd (blue stars) and Chevron Australia Pty Ltd (magenta triangles).

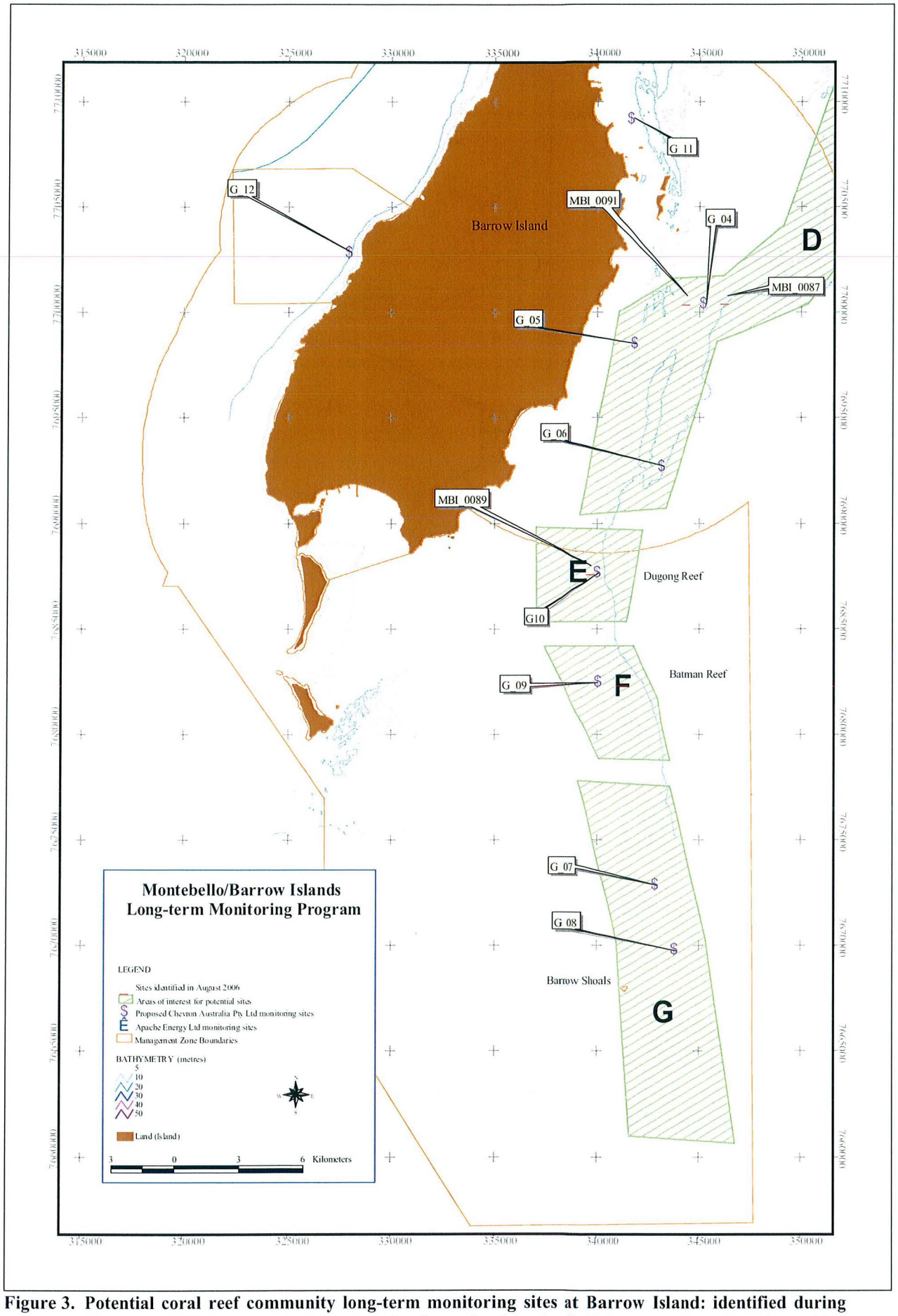

Figure 3. Potential coral reef community long-term monitoring sites at Barrow Island: identified during the August 2006 survey (red dots), to be determined in the field (green polygons) and provided by Apache Energy Ltd (blue stars) and Chevron Australia Pty Ltd (magenta triangles).

Table 1. Latitude and longitude of nominal long-term coral reef community monitoring sites identified in August 2006.

Site no	Location name	Latitude (decimal degrees GDA94)	Longitude (decimal degrees GDA94)
MBI_0067	Ah Chong Is	-20.50812	115.54384
MBI_0071	Stephenson Channel	-20.46861	115.54699
MBI_0076	W of Brooke Is	-20.43402	115.4867
MBI_0079	W of Bluebell Is	-20.40088	115.49984
MBI_0083	Northwest Is lagoon	-20.36921	115.52597
MBI_0087	Lowendal shelf	-20.78611	115.52388
MBI_0089	Dugong Reef	-20.90153	115.45906
MBI_0091	Lowendal shelf	-20.78613	115.50575

2.2 OTHER OBSERVATIONS

2.2.1 Finfish

The relative diversity and abundance of selective finfish groups will be measured at the coral community long-term monitoring sites. This information will inform future selection of sites for long-term finfish community monitoring within the MBIMPA.

Method: underwater visual census of selected finfish

A modified version of the method (Halford and Thompson 1994) used in long-term monitoring of finfish populations in the Great Barrier Reef Marine Park will be used to make an assessment of relative finfish diversity and abundance. An observer will record the the relative abundance of the fish groups occurring within a 5 x 50 m belt transect (2.5 m on either side of each replicate transect tape). Relative abundance per transect will be determined as *low* (0-5), *medium* (6-10), *high* (>10).

The following selected finfish taxa will be noted:

- *Lutjanus* spp. (sea perch);
- *Lethrinus* spp. (snapper);
- *Plectropomus* spp. (coral trout);
- *Epinephelus* spp. and *Cephalopholis* spp. (cod);
- Carangids (trevally);
- Scombrids (mackerel); and
- Sharks.

The following iconic finfish species will be noted:

- *Epinephelus tukula* (potato cod); and
- *Cheilinus undulatus* (humphead maori wrasse)

Quality control

Potential observer effects will be minimised by ensuring regular quality control procedures are implemented during the field survey .

2.2.2 Crown of Thorns Starfish, *Drupella* and other invertebrate observations

The corallivores *Acanthaster planci* (crown-of-thorns starfish, or COTS) and *Drupella* spp., a muricid gastropod, have caused significant reductions in live coral cover on reefs, and are the subjects of reef monitoring programs elsewhere in Western Australia and internationally.

Method:* Drupella *and COTS survey

The abundance of both COTS and *Drupella* spp. will be assessed by a visual search within a 5x 50 m belt transect for each replicate transect established for coral community monitoring. The maximum diameter (from arm tip to arm tip) of each COTS found within the belt transect will be recorded. Because *Drupella* usually occurs in aggregations (groups of individuals), the number and relative size of aggregations observed within the belt transect will be recorded. Aggregation size will be categorised as *low, medium* or *high* (0-10, 10-20, >20 individuals per aggregation, respectively).

Opportunistic notes regarding the presence/absence or abundance of other important reef invertebrates, such as *Trochus* spp., tridacnid clams, or the corallivorous starfish, *Culcita* spp., will also be made.

See Appendix II for the invertebrate data sheets to be used during this survey.

Quality control

Potential observer effects will be minimised by ensuring regular quality control procedures are implemented during the field survey.

2.3 OPERATIONAL PROCEDURE

This section outlines the way the procedure for transect deployment and the sequence in which the benthic community videography (Section 2.1), the underwater visual fish census (Section 2.2.1) and the invertebrate observations (Section 2.2.2) will be undertaken.

All surveys will be performed along three replicate transects located for the long-term monitoring of coral reef communities.

The targetted habitat will be located from the surface using a hand held GPS. The start of the first transect will be marked with a weighted buoy randomly placed within the targeted habitat. A second weighted buoy (with a catch bag containing a 50 m fibreglass tape attached to the weight) will be deployed next to the initial buoy. The replicate transects are at the same depth, and run parallel to and approximately 20 m from the first transect. Their starting points are also marked with a weighted buoy and the second weighted buoy with attached catch bag.

The first two divers enter the water and the standby diver/tender operator remains on the tender vessel. The first diver (the transect layer) is equipped with a compass, an underwater notebook and a pencil, and retrieves the fibreglass tape from the catch bag at the transect marker buoy.

The second diver (fish observer) is equipped with a slate, a pencil and fish observation data sheets (Appendix I).

Beginning at the first (middle) transect's weighted buoy, the transect layer sets out the fibreglass tape while towing the second weighted marker buoy which is used to mark the end of the transect. The transect layer records the compass bearing and any benthic features that may assist in relocating the site in the underwater notebook.

The fish observer conducts the 50 m by 5 m fish census (Section 2.2.1) whilst accompanying the transect layer as the transect lines are deployed (effectively a dive buddy pair).

The transect layer waits for the fish observer to finish the fish census, then the pair proceed to the second transect marker buoy (and subsequently to the third transect) repeating the above process to the left of the first transect. When the third transect is laid to the right of the first transect, the transect layer and fish observer proceed to retrieve the tapes, starting at the first transect.

The third diver (videographer) and fourth diver (invertebrate observer) enter the water after the first transect has been approximately half deployed. The videographer is equipped with the digital video camera and clapperboard. The invertebrate observer is equipped with a slate, pencil, and invertebrate census data sheets (Appendix II). The videographer records the clapperboard which details the site number, transect number, date and location, for a minimum of 5 seconds. A 360° panoramic shot is recorded at the beginning of the transect and includes the transect line. The videographer proceeds to follow the fish observer (remaining approximately 25 m behind), while swimming slowly (approximately 10 m per minute) along the transect with the digital video camera held perpendicular to the transect line and 0.5 m above. A 360° panoramic shot is recorded at the end of the transect and includes the transect line (See Section 2.1).

The invertebrate observer follows behind the videographer at an approximate distance of 5 m (effectively a dive buddy to the videographer), recording observations of *Drupella* spp. and crown of thorns seastars (See Section 2.2.2).

The videographer and invertebrate observer proceed to the second transect marker buoy (and subsequently to the third transect) repeating the above process.

Once the survey team have returned to the tender, GPS waypoints are recorded for each of the transect buoys. All six transect marker buoys and associated catch bags are retrieved.

2.4 HABITAT VERIFICATION

2.4.1 Method: Operational procedure for habitat verification

The habitat mapping verification team will consist of three personnel; a tender operator, a data recorder and a camera hand. At each site a visual observation will be made using either a bathyscope placed over the side of the tender or a drop-down video camera (lowered over the side of the tender to record a minimum of 30 seconds of video footage of the seabed). Site data will be recorded on the habitat mapping data sheet (Appendix III).

Instructions for the setting up, operation and care of the drop-down video camera are as follows.

Setup

1. Connect camera to power and video to VDU and power pack.
2. Connect video recorder to VIDEO OUT jack.
3. Ensure dropline attached to camera is weight bearing.
4. If required attach weight to dropline.
5. Choose power source on POWER SWITCH ie. built-in 12 V batteries or external 12 V power source. It is important to have the correct power source selected.
6. Turn ISOLATOR switch on.
7. Check that there is enough space of the video tape before setting out on the survey.
8. Ready for operation.

Operation

1. Write site number, date and location on the clapper board.
2. Video the clapper board for a minimum of 10 seconds then press PAUSE on the video recorder.
3. Lower camera into the water and commence recording.
4. Record a minimum of 30 seconds of benthic habitat.
5. Enter all data into the standardised habitat data sheet (Appendix III), ensuring GPS location (in decimal degrees) and datum are recorded.
6. Switch video and camera power off.
7. Retrieve camera.
8. Check footage regularly to ensure video data is being recorded.

Equipment care

1. DO NOT allow knots or twists to occur in the cable. Figure-eight the cable on the deck or in the prawn crate.
2. DO NOT step on the cable. Treat cable with CARE.
3. Clean and silicon grease camera connection plug daily.
4. DO NOT use CRC, WD40 or similar lubricants on electrical connections.
5. DO NOT attach weights or other objects to camera or cable, only to the dropline.
6. BEWARE of vessels propeller.
7. DO NOT allow camera to hit the side of the vessel.
8. DO NOT allow camera to hit or drag along the seabed.
9. 240 V power supply is NOT to be used on vessels. Only use 12 V power supply.
10. Disconnect power to camera when not in use.
11. Wash down camera and cable after use (ensure connections are not exposed to water).

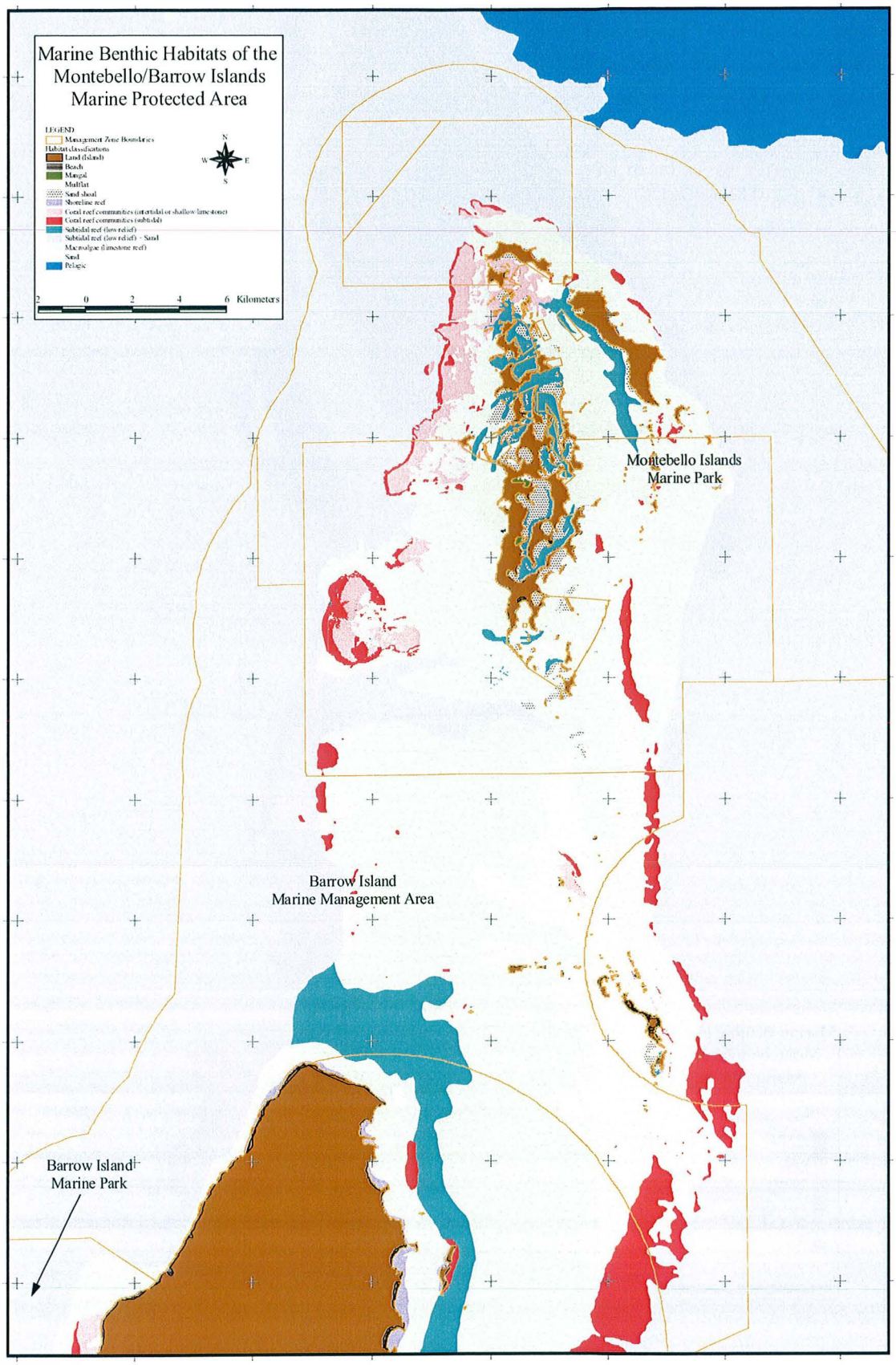

Figure 4. Existing benthic habitat map for the northern extent of the Montebello/Barrow Islands Marine Protected Area.

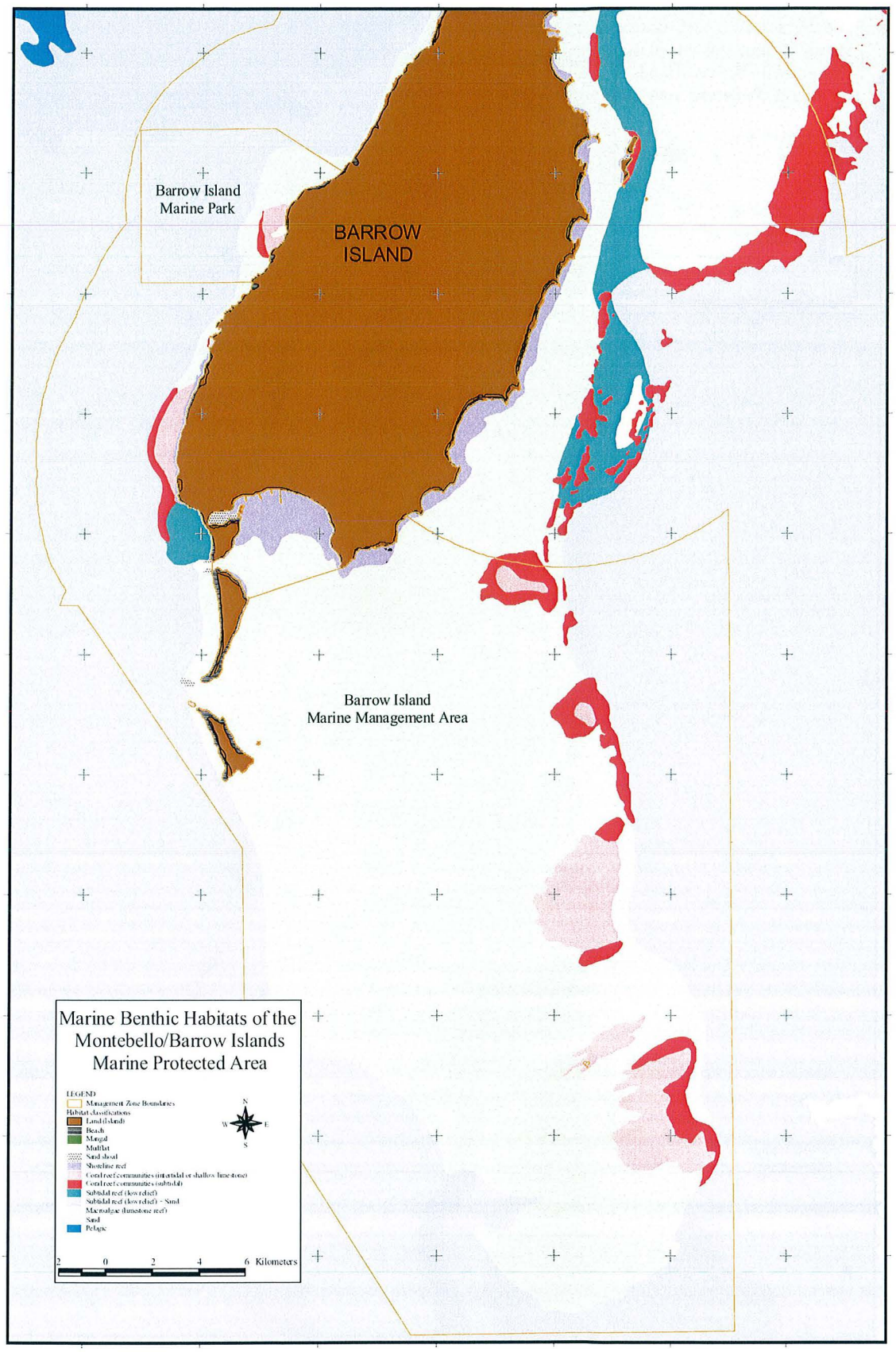

Figure 5. Existing benthic habitat map for the southern extent of the Montebello/Barrow Islands Marine Protected Area.

2.4.2 Habitat verification site selection

Sites on representative cross-zone transects to determine the nature and extent of coral reef and other benthic communities will be located on the seaward reef slopes of the Montebello Islands, the Lowendal Shelf, Barrow Shoals, and selected areas west of Barrow Island. Ocean conditions and rules governing tender operations will partly influence site selections

Quality control

Habitat classification training will occur regularly during the field survey using onboard reference material and will include reviewing collected video footage.

2.5 VISION

Both digital stills and digital video will be taken opportunistically. Nominal subjects for photography are outlined below.

2.5.1 Environmental values

Benthic habitats
Major floral species
Major faunal species
Landscapes
Seascapes

2.5.2 Recreational activities

Recreational fishing
Surface water sports
Beach activities
Diving & snorkelling
Boating
Sailing
Anchorages

2.5.3 Commercial activities

Petroleum facilities and vessels
Pearling and aquaculture facilities
Port infrastructure
Commercial Tourism Operators

2.5.4 Cultural values

Wrecks
Lighthouses
Other structures

2.5.5 Management and science

Boat activities
Scientific diving
Community education
DEC staff interacting with the public

3 Project Management

3.1 SURVEY VESSEL

The vessel being used on this survey is the Western Australian Department of Fisheries patrol vessel, the *PV Walcott*. The *PV Walcott* has two tenders which will be utilised for the field survey (within a 5 nm range from *PV Walcott*):

1. Dinghy - Aluminium 4.1 metre, powered by 15 Hp Yamaha. 2 x 20 L fuel tanks and has two personal floating devices (PFD) and safety equipment (flares, torch, anchor, handheld VHF radio, etc).

2. Auxiliary vessel - Polyline plastic, 5.7 metre, powered by 115Hp Yamaha - In survey (5 people) - 1 x 150 L fuel tank and has all safety equipment (2 Radios-VHF and DoF, PFDs, flares, etc).

The auxiliary vessel will be used by the benthic monitoring team and the habitat verification team will use the aluminium tender when conditions allow.

3.2 SURVEY TEAM

The team will comprise of six DEC staff from the Marine Science Program, Exmouth District, Pilbara Region and Environmental Management Branch, and four DoF staff from the patrol vessel *PV Walcott* and the Karratha Regional Office (Table 2). The nominal roles of team members are shown in Table 3.

3.3 VEHICLE REQUIREMENTS

3.3.1 Karratha

Arrangements have been made with the DEC Pilbara Regional Office in Karratha to provide a vehicle for Thursday 7 December (0930) to be returned Friday 8 December (0945).

3.3.2 Exmouth

Arrangements have been made with the DEC Exmouth District Office to provide a vehicle for Thursday 21 December (1600) to be returned Friday 22 December (1200).

Table 2. Field survey team and contacts.

TEAM MEMBER	ROLE	CONTACT NUMBERS
Kevin Bancroft (KBA)	**Project Leader** **Field Team Leader** Research Scientist DEC Marine Science Program	Ph (08) 9334 0257 Fax (08) 9334 0327 Mob 0429 360 102
Dr Suzanne Long (SLO)	**Science Coordinator** Research Scientist DEC Marine Science Program	Ph (08) 9334 0198 Fax (08) 9334 0327 Mob 0427 999 642
Rob Connell (RCO)	**Dive Supervisor** Marine Ranger (South) DEC Pilbara Region	Ph (08) 9947 8000 Fax (08) 9947 8050
Shannon Armstrong (SAR)	Research Scientist, DEC Marine Science Program	Ph (08) 9334 0228 Fax (08) 9334 0327 Mob 0427 519 622
Dr Alan Kendrick (AKE)	Senior Regional Marine Ecologist DEC Pilbara Region	Ph (08) 9947 8000 Fax (08) 9947 8050 Mob 0427 387 606
Steve Rogers (SRO)	**Skipper** *PV Walcott* Department of Fisheries	*PVW* mob 0428 940 018 *PVW* Sat 0011 881 621 415 125 or 0011 872 763 914 076 *PVW* Fax 0011 872 600 362 370 Pers mob 0419 049 379
Murray Verney (MVE)	**Crew** *PV Walcott* Department of Fisheries	'as above'
Matt Hilyard (MHI)	**Crew** *PV Walcott* Department of Fisheries	'as above'
Clint Wadley (CWA)	**Tender operator** Senior Fisheries & Marine Officer Department of Fisheries Karratha District Office	Ph (08) 9944 4337 Fax (08) 9144 4348 Mob 0429 088 210

Table 3. Nominal roles of team members.

STAFF	DATA RECORDER	VIDEO OPERATOR	TRANSECT	TENDER OPERATOR	TANK FILLS	DATA ENTRY	HABITAT MAPPING
KBA	✓	✓	✓			✓	✓
SLO	✓	✓	✓			✓	✓
AKE	✓	✓	✓			✓	✓
SAR	✓	✓	✓			✓	✓
RCO	✓	✓	✓	✓		✓	✓
SRO				✓	✓		
MVE				✓	✓		
MHI				✓	✓		
CWA				✓	✓		

3.4 FIELD SCHEDULE

The field schedule shown in Table 4 is nominal and will be determined on a daily basis in consideration of the local conditions.

Table 4. Preliminary field schedule.

DATE	ACTIVITY
Thursday 7 December	▪ KBA & SAR depart Perth @ 0710 arrive Karratha @ 0910 ▪ KBA & SAR pick up District vehicle ▪ KBA & SAR to collect and prepare field equipment ▪ KBA & SAR to pick up hire dive tanks ▪ KBA & SAR overnight on the *PV Walcott*
Friday 8 December	▪ SLO departs Perth @ 0710 arrives Karratha @ 0910 ▪ AKE & RCO to meet at PV Walcott @ 0830 ▪ Depart for Montebello Islands @ 1000 ▪ Undertake induction on vessel ▪ Preparation of field equipment ▪ Brief field staff as to roles, safety, diving etc... ▪ Undertake habitat verification of targeted sites
Saturday 9 – Wednesday 20 December	▪ Undertake all field program (this will be determined on a day to day basis, in consideration of the local metocean conditions of winds, waves and tides) ▪ North Montes 9-11 December ▪ Sth Montes 12-14 December ▪ Visit Apache facility on Varanus 13/14 (Meet at 0900) ▪ Lowendal shelf 15-17 ▪ Double Island 18-19 December ▪ Barrow Shoals 20-21 December
Thurs 21 December	▪ 0800 undertake further habitat mapping verification ▪ 1100 Steam to Exmouth ▪ 1600 Arrive Exmouth ▪ SLO departs Learmonth @ 1800 arrives Perth @ 1945
Friday 22 December	▪ KBA & SAR to organise packing & freighting of all field equipment ▪ KBA & SAR to organise freighting of hire equipment back to Karratha ▪ KBA & SAR to depart Learmonth @1345 arrive Perth @ 1630

3.5 SAFETY

3.5.1 General

Field operations will be carried out in accordance with Departmental diving and boating guidelines (Department of Conservation and Land Management 2004; 2005). Copies of these guidelines are included in the field equipment.

3.5.2 Diving

All diving activities, both scuba and snorkelling shall be in accordance with the Departmental diving policy *CALM diving code of practice* (Department of Conservation and Land Management 2005). The Dive Supervisor is responsible for diving safety at all times. The Dive Supervisor for this survey will be Rob Connell. A Departmental dive plan has been approved.

3.5.3 Boating

Boating and navigation are the responsibility of the vessel skipper and shall be conducted in accordance with the DoF marine operations manual (Department of Fisheries 2004) and the CALM boating policy *Safe marine operations in CALM* (Department of Conservation and Land Management 2002). Boating safety issues are the responsibility of the vessel skipper and tender operators, in consultation with the Field Team Leader, Kevin Bancroft. Personnel qualified to be tender operators include the *PV Walcott* crew, Rob Connell and Clint Wadley.

3.6 PREDICTED OCEAN CONDITIONS

3.6.1 Tides

Neap tides will occur during the middle week of the December 2006 field survey. Sites that are subjected to strong currents (eg. channels between islands, reef gaps, etc) will be surveyed during neap tides (between 12-18 December) and/or at slack water.

Tidal conditions throughout the field trip are shown in Appendix IV – the tidal range graphics from Seafarer's Tides 2006. The tidal amplitude at North West Island ranges from 2.2 m at the beginning of the survey, to 0.8 m for the middle week and will increase to about 1.7 m towards the end. The tidal amplitude at the Barrow Tanker Mooring is greater and ranges from 3.6 m to 0.9 m to 3.2 m over the same period.

3.6.2 Cyclones

Cyclonic waves and winds originate from tropical low pressure systems that travel southward along the WA coastline, often crossing the coast between Port Hedland and Exmouth. Cyclones typically occur in tropical Western Australia from December to April. The contingency plan, if a cyclone threatens the area during the survey, is to steam directly to the cyclone anchorage at Hampton Harbour at Dampier. The crew of the *PV Walcott* will be maintaining a weather watch as part of their daily duties.

3.6.3 Swell Waves

Swell waves arrive from the south-west and originate from temperate low pressure systems to the south of WA. Swell waves are strongly seasonal and impinge on reefs on the western side of the Montebello Islands and Barrow Island. Average wave heights are greater (1-2 m) in the winter period (April to September) than in the summer period (November to March). It is anticipated that swell waves will be low (<1 m) over the period of this survey.

3.7 COMMUNICATIONS AND EMERGENCY CONTACTS

3.7.1 DEC offices

Marine Science Program, Kensington	Ph: 9334 0299 Fax: 9334 0327
Pilbara Regional Office, Karratha	Ph: 9143 1488 Fax: 9144 1118

Exmouth District Office, Exmouth		Ph: 9947 8000 Fax: 9947 8050

3.7.2 DoF

Karratha District Office		Ph: 9144 4337 A/h: 0418 937 214
Exmouth Office		Ph: 9949 2755 A/h: 0419 910 182
PV Walcott		mob: 0428 940 018 Sat ph: 0011 881 621 415 125 0011 872 763 914 076

3.7.3 Infrastructure

Dampier Port Authority		Ph: 9159 6555 Fax: 9159 6557
Varanus Island (Apache)	Medic/Radio Operator Field Supervisor Camp Manager	Ph: 9422 7301 (VHF Ch 16) Ph: 9422 7300 (VHF Ch 16) Ph: 9422 7335
Barrow Island (Chevron)	Field Supervisor Emergency Response	Ph: 9184 3730 A/h: 9184 3700 A/h: 9184 3762 Ph: 9184 9000

3.7.4 Volunteer sea rescue groups

Exmouth Volunteer Marine Rescue Group Graham Page	Ph: 9949 2426 Mob: 0418 813 416 VHF Ch 16 & 21 27MHz Ch 88 & 91
West Pilbara Volunteer Sea Search & Rescue Group, Dampier	Ph: 9183 1327 VHF Ch 16& 21 27MHz Ch 88 & 91

3.7.5 Medical services

Fremantle Hyperbaric/Diving Services	Ph: 9431 2233 A/h: 9431 3333
Karratha District Hospital	Ph. 9143 2333
Exmouth District Hospital	Ph. 9949 3666
Royal Flying Doctor, Emergency line	Ph: 1800 625 800
Dampier Medical Centre	Ph. 9183 1333 Fax. 9183 1075

St Johns Ambulance,	Emergency calls	Ph: 000
	Non-emergency calls	Ph: 13 12 33
	Karratha (Call)	Ph. 9144 1222
	Karratha (Administration)	Ph. 9185 1222
	Exmouth (Administration)	Ph: 9949 2933

3.7.6 Mariculture

Morgan's Pearl Farm (Montebello Islands)	Ph. 9184 5175
Mark Beale	VHF 16 & 72

3.8 DEC BUDGET

Table 5 provides an estimate of the budget.

Table 5. Field survey budget estimate

Item		Budget $$
Vessel	*RV Walcott* 2 d steaming @ $5000/d	10000
	12 d in the MBIMPA @ $2500/d	30000
	12 d victualising	1000
Airfares	4 flights (to Karratha @ $542)	2168
	4 flights (from Exmouth @ $486)	1944
Misc expenses	misc meals & sundries	500
	Consumerables (video tapes, waterproof paper etc)	400
	Accommodation 1 night/2 staff	400
	Hire car 2d	500
Equipment	Still Cameras (14d @ $100)	1400
	Video cameras 2 of 14d @ $100	2800
	MiniDV video tapes (20 @ $20)	400
	Misc items	500
	Dive BC & Regs	300
	Tank & fills	0
Freight	(two ways)	600
DEC salary		36,420
TOTAL		**$89,332**

3.9 EQUIPMENT

3.9.1 Diving

Personal dive gear (wetsuits, snorkel & mask, fins, weight belts)
Buoyancy vests and regulators (5 MSP, 3 Exmouth District)
Scuba spare kit
Diver floats & lines
Scuba tanks (2 DoF, 8 Exmouth District)
Lead weights

3.9.2 Drop down video camera

Battery pack and VDU units (2)
Dropdown cameras and cabling (100 m and 50 m) (2)
Electrical tool kit

3.9.3 Video camera

Sony HD DV miniDV video cameras and underwater housing (2)
Strobe kit (1)
Batteries & charger

3.9.4 Digital still photography

Nikon D200 digital still camera and underwater housing (1)
Strobe kit (1)
Canon S50 digital still camera and underwater housing (1)
Batteries & charger

3.9.5 Position fixing

Garmin GPSmap 76CSx with charts (1)
Garmin GPSmap 76 (1)
AA batteries & charger

3.9.6 Data recording

Habitat verification data sheets (100)
Invertebrate data sheets (60)
Waterproof notebooks (6)
Pencils 2B & HB (48 ea)
Chalk (10)
Clapper boards (Magna Doodle ©) (2)
Chalkboard clapper board (1)

3.9.7 Miscellaneous survey equipment

Clipboards (3)
Scribes
2 m measures (4)
50 m fibreglass tapes (5)
100 m weighted transect lines (2)
100 mm poly floats with 15 m line (6)
AA batteries (24)
Lead weights (6)
Bathyscope

4 Data management

Hard copies of this report will be held at the following locations:

1. Marine Science Program, Science Division, Department of Environment and Conservation, 17 Dick Perry Avenue, Western Australia, 6152. Ph: (08) 9334 0333.

2. Woodvale Library, Science Division, Department of Environment and Conservation, Ocean Reef Road, Woodvale, Western Australia, 6026. Ph: (08) 9405 5100 Fax: (08) 9306 1641.

3. Archives, Woodvale Library, Science Division, Department of Environment and Conservation, Ocean Reef Road, Woodvale, Western Australia, 6026. Ph: (08) 9405 5100 Fax: (08) 9306 1641 (CD also attached).

4. Pilbara Region, Department of Environment and Conservation, Lot 3 Anderson Road, Karratha Industrial Estate, Karratha, Western Australia, 6530. Ph: (08) 9143 1488 Fax: (08) 91441118.

5. Serials Section, State Library of Western Australia. Alexander Library Building, Perth Cultural Centre, Perth, Western Australia, 6000.

Digital copies of this report will be held at the following:

1. The Science Division Server:
   T:\529-CALMscience\Shared Data\Marine Science Program\MSP_reports\msp_2006-05

2. CD-ROM [MSP_2006-05]

5 Report Distribution

DEC

- Dr Neil Burrows, Director, Science Division;
- Dr Chris Simpson, Leader, Marine Science Program;
- Ian Walker, Regional Manager, Pilbara Region;
- Jennie Cary, District Manager, Exmouth District;
- Peter Dans, Acting Manager Marine Policy and Planning Branch;
- Dr Ray Masini, Manager, Marine Ecosystems Branch;
- Strategic Development and Corporate Affairs Division; and
- All DEC field survey participants.

DoF

- Steve Rogers, Skipper, *PV Walcott,* Department of Fisheries; and
- Keith Saunders, Senior Fisheries and Marine Officer.

Industry

- Libby Howitt, Environmental Scientist, Apache Energy Limited; and
- Dorian Moro, Ecologist, Gorgon HES Team, Chevron Australia Pty Ltd.

6 Science communication

A copy of the field program report will be sent to DEC Strategic Development and Corporate Affairs Division where it will serve as the basis of a press release.

7 References

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8 Appendices

Appendix I. Visual finfish census data sheet

VISUAL FINFISH CENSUS DATA SHEET

Site No: **Date:**

Transect No: **Recorder:**

Current: **Viz:**

Taxon	Count			
Lutjanids				
Lethrinids				
Plectropomus spp.				
Epinephelus/Cephalopholis spp.				
Epinephelus tukula	<50 cm	50 cm – 1 m	1 – 1.5 m	>1.5 m
Cheilinus undulatus	Juv	<50 cm	50 cm – 1 m	>1 m
Choerodon spp.				
Carangids				
Scombrids				
Sharks				
Other				

Appendix II. Invertebrate census data sheet

INVERTEBRATE CENSUS DATA SHEET

Site: **Transect:** **Date:** **Time:** **Recorder:**

COTS	Diameter (cm)		
***Drupella* spp.**	0-10 indivs/agg	10-20 indivs/agg	>20 indivs/agg
Other invertebrate observations	eg *Trochus*, tridacnids, *Culcita*...		

Site: **Transect:** **Date:** **Time:** **Recorder:**

COTS	Diameter (cm)		
***Drupella* spp.**	0-10 indivs/agg	10-20 indivs/agg	>20 indivs/agg
Other invertebrate observations	eg *Trochus*, tridacnids, *Culcita*...		

Site: **Transect:** **Date:** **Time:** **Recorder:**

COTS	Diameter (cm)		
***Drupella* spp.**	0-10 indivs/agg	10-20 indivs/agg	>20 indivs/agg
Other invertebrate observations	eg *Trochus*, tridacnids, *Culcita*...		

Appendix III. Habitat data sheet

MARINE SCIENCE PROGRAM

HABITAT MAPPING DATA SHEET

SITE N°.		LOCATION NAME	
LAT	……..°……..'S	LONG	……..°……..'E
DGPS/GPS		DATUM	GDA94
DEPTH (M)		TIDAL RANGE	
DATE		TIME	
RECORDER		OBSERVAT^{n} METHOD	
MPRSWG		IMCRA BIOREGION	
SUBSTRATE TYPE		RELIEF	
VIDEO TAPE N°	……/……..# ……..- …….. (Bioregion) (MPRSWG) (number) (YYYYMMDD)		
VISUALLY DOMINANT ORGANISM (S)			
DESCRIPTION…… …… …… …… …… …… .			
HABITAT TYPE			

SITE N°.		LOCATION NAME	
LAT	……..°……..'S	LONG	……..°……..'E
DGPS/GPS		DATUM	GDA94
DEPTH (M)		TIDAL RANGE	
DATE		TIME	
RECORDER		OBSERVAT^{n} METHOD	
MPRSWG		IMCRA BIOREGION	
SUBSTRATE TYPE		RELIEF	
VIDEO TAPE N°	……/……..# ……..- …….. (Bioregion) (MPRSWG) (number) (YYYYMMDD)		
VISUALLY DOMINANT ORGANISM			
DESCRIPTION…… …… …… …… …… …… .			
HABITAT TYPE			

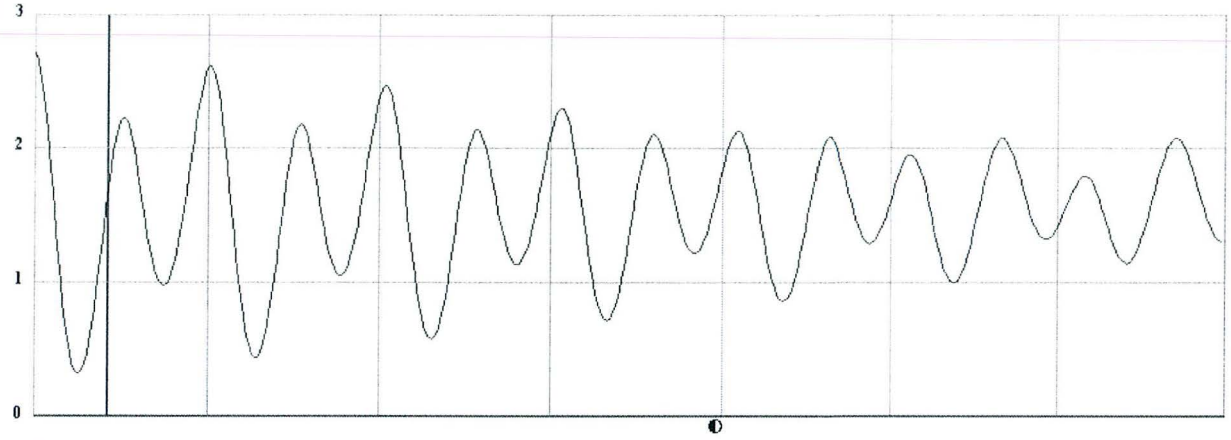
Appendix IV. Tidal range graphic from Seafarer's Tides

NORTH WEST I.

Local Standard
Timezone: -8:00 U.T.

20° 22' S 115° 31' E

PREDICTION DATUM: 1.52 (m)



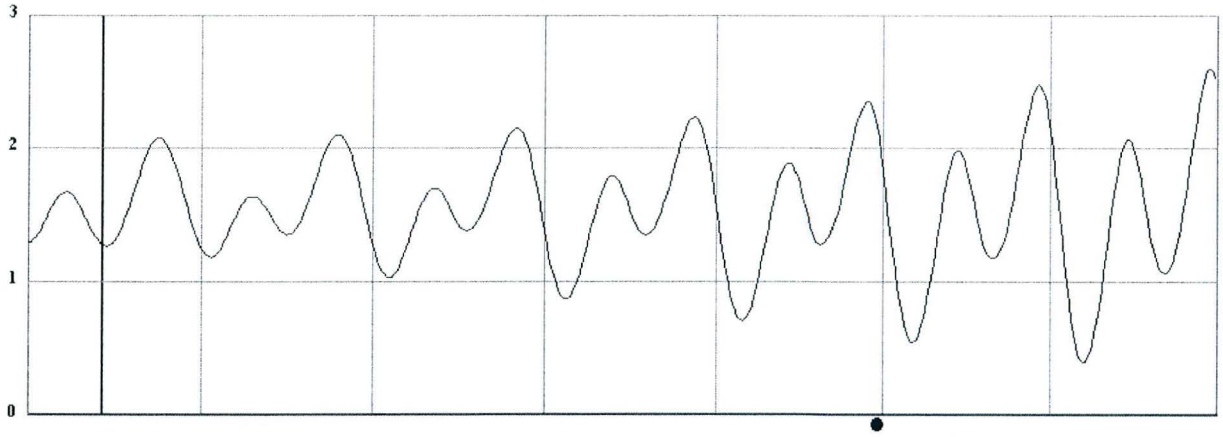
Dec 8 Fr		9 Sa		10 Su		11 Mo		12 Tu		13 We		14 Th	
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
0629	0.3	0035	2.6	0110	2.5	0146	2.3	0225	2.1	0312	1.9	0417	1.8
1244	2.2	0705	0.4	0741	0.6	0816	0.7	0852	0.9	0932	1.0	1020	1.2
1810	1.0	1321	2.2	1401	2.1	1444	2.1	1533	2.0	1627	2.0	1727	2.0
		1850	1.1	1933	1.2	2021	1.2	2121	1.3	2242	1.4		

NORTH WEST I.

Local Standard
Timezone: -8:00 U.T.

20° 22' S 115° 31' E

PREDICTION DATUM: 1.52 (m)



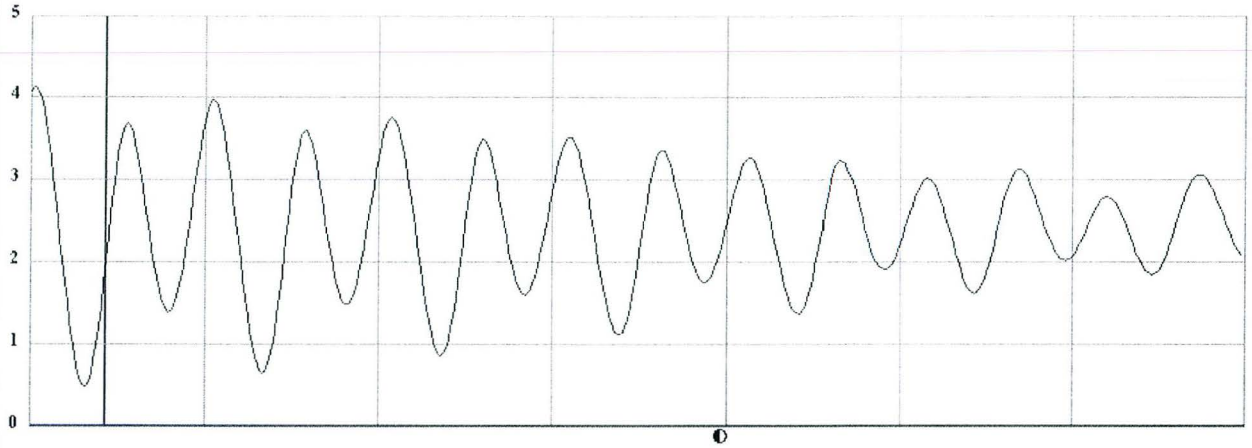
Dec 15 Fr		16 Sa		17 Su		18 Mo		19 Tu		20 We		21 Th	
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
0025	1.3	0149	1.2	0245	1.0	0327	0.9	0403	0.7	0436	0.5	0511	0.4
0547	1.7	0738	1.6	0905	1.7	0955	1.8	1031	1.9	1103	2.0	1134	2.1
1122	1.3	1234	1.3	1341	1.4	1436	1.3	1522	1.3	1603	1.2	1644	1.1
1830	2.1	1934	2.1	2033	2.2	2121	2.2	2202	2.4	2240	2.5	2316	2.6

BARROW I. - TKR MRG

Local Standard
Timezone: -8:00 U.T.

20° 49' S 115° 33' E

PREDICTION DATUM: 2.42 (m)



Dec 8 Fr		9 Sa		10 Su		11 Mo		12 Tu		13 We		14 Th	
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
0030	4.1	0110	4.0	0147	3.8	0225	3.5	0302	3.3	0345	3.0	0445	2.8
0726	0.5	0802	0.6	0837	0.9	0910	1.1	0943	1.4	1017	1.6	1100	1.8
1315	3.7	1352	3.6	1427	3.5	1503	3.4	1543	3.2	1630	3.1	1737	3.1
1902	1.4	1938	1.5	2015	1.6	2056	1.8	2146	1.9	2300	2.0		

BARROW I. - TKR MRG

Local Standard
Timezone: -8:00 U.T.

20° 49' S 115° 33' E

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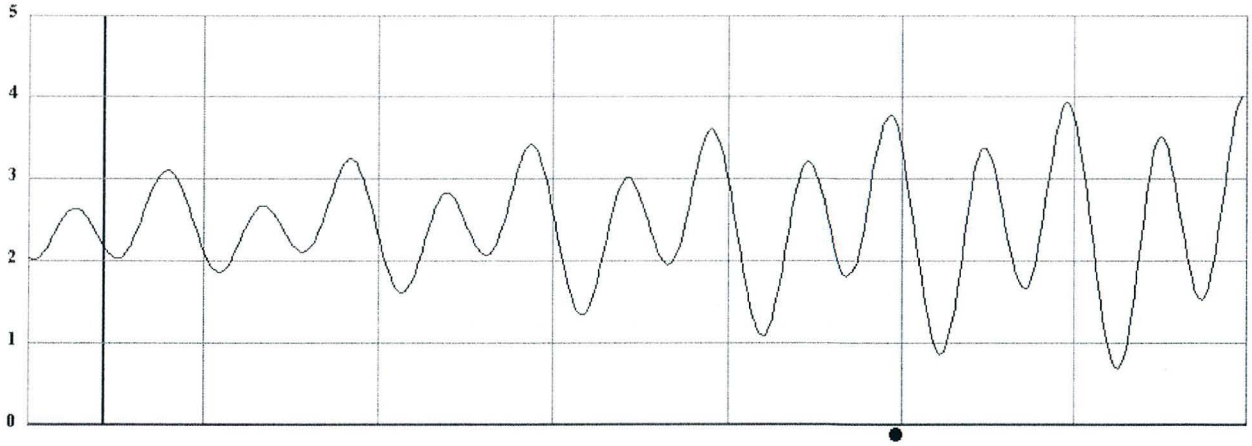

Dec 15 Fr		16 Sa		17 Su		18 Mo		19 Tu		20 We		21 Th	
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
0039	2.0	0208	1.9	0312	1.6	0400	1.3	0442	1.1	0521	0.9	0559	0.7
0622	2.6	0811	2.7	0923	2.8	1012	3.0	1050	3.2	1126	3.4	1200	3.5
1206	2.0	1335	2.1	1450	2.1	1544	2.0	1625	1.8	1703	1.7	1740	1.5
1902	3.1	2011	3.2	2100	3.4	2142	3.6	2220	3.8	2259	3.9	2337	4.0