Implementation Plan for the Facility for the Automated Intelligent Monitoring of Marine Systems – FAIMMS

2008-2009

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Introduction

This is the Implementation Plan for the Facility for the Automated Intelligent Monitoring of Marine Systems, FAIMMS, a facility of the Australian Integrated Marine Observing System (IMOS). FAIMMS is managed within the Great Barrier Reef Ocean Observing System (GBROOS) geographic node of IMOS by the Australian Institute of Marine Science (AIMS). The plan covers the period from July 2008 to June 2009; that is the 80/09 financial year.

The IMOS project, of which FAIMMS is a facility, started in mid 2007 and so the financial year 2008-2009 forms the second year of operation for the project which terminates in mid 2011. The facility has submitted formal project plans to IMOS and these can be found on the IMOS web site (www.imos.org.au), this implementation plan is to give more detail to the higher level plans already submitted.

Any marine activity needs to take into account the vagrancies of the weather and the complex logistics that drive field work. As such there is always a level of risk and uncertainly in any plan that requires the cooperation of the weather and any number of other factors. For this reason this document should be seen as what is intended to be undertaken not as a record of what will be undertaken.

Previous Activities and Outcomes – 2007-2008

The project work started in September 2007 and through to mid 2008 the following work has been completed or will be completed:

- Hiring of project staff;
- Establishment of the project office;
- Working with the project partners the overall goals and outcomes;
- Design of the overall project;
- Design of the equipment including novel designs for much of the sea-going equipment;
- Site visits to Heron and One-Tree Islands, Davies and Rib Reefs;
- Field testing of on-water equipment and communications;
- Design, development and test deployment of communications solutions;
- Development of high speed surface ducted reef based microwave links;

- Planning for the deployment of line of sight microwave links for Heron and One-Tree Islands;
- Development and deployment of data schemas and data management frameworks for the project;
- Presentations at a number of conferences (AMSA, 2007, ISSNIP, 2007 amongst others) including a number of publications;
- Development of a web site for the project data.

Planned Activities

The second year will see the first major deployments of equipment as well as site visits for future deployments. The equipment will be fine tuned to reflect lessons learnt during the deployments and subsequent operation. A major focus will be on data management and ensuring that the data collected by the system is made available both to the eMII component of IMOS and to users in general.

Planned Deployments

Heron Island: July 6th – August 6th, 2008.

Planning is well underway for the first major deployment of the equipment at Heron and One-Tree Islands. The deployment will consist of the following:

- Deployment of a nextG base station on the Heron Island tower;
- Deployment of a nextG base station on the One-Tree Island water tower;
- Deployment of six (6) relay-spars in the Heron Island lagoon to create the on-reef network for Heron Island;
- Deployment of five (5) sensor floats in the Heron Island lagoon to measure movement of water with the daily tidal flushing, the floats will measure surface and bottom temperature and salinity, depth, location (via GPS) and optionally light;
- Deployment of one (1) multi-float in the Wistari Channel, this will be a multi-purpose large float that initially will measure surface and bottom temperature and salinity, depth, location, temperature at set depths via a thermistor string and PAR.
- Deployment of three instrumented sensor-poles in the One-Tree lagoon, these will measure surface and bottom salinity and temperature, depth and temperature with depth via a thermistor string.

The planned location of equipment is shown in Figures One (Heron) and Two (One-Tree).

Rib Reef: 11th – 15th August 2008

Ship time has been allocated to deploy a base station and one multi-float at Rib Reef off Townsville. The following equipment will be deployed:

- Deployment of a nextG base station on the AMSA pylon;
- Deployment of one (1) multi-float to the north of the reef, this will contain top and bottom salinity and temperature, location and temperature with depth via thermistor string.

The planned location of equipment is shown in Figure Three.

Davies Reef – 13th – 21st September 2008

Ship time has also been allocated for the Davies Reef deployment which will see the installation of a base station on the existing AIMS Davies Reef tower and a series of sensor-floats in a transect across the reef and two large multi-floats along the long axis of the reef to provide information about within reef water transport.

The following equipment will be deployed:

- A nextG base station on the existing AIMS Davies Reef tower;
- Five (5) sensor floats forming a transect across the reef;
- Two (2) multi-floats along the long axis of the reef, these will support future work.

As well as the nextG base station the surface ducted microwave will be upgraded and put into operational mode, due to power limits this will be used during day-light hours when solar power is available, the nextG link will be used at night. An upgraded wind generator will also be installed for the microwave link and the option of a video camera will be investigated as time permits.

The planned location of equipment is shown in Figure Four.

Orpheus Island – 6th – 14th May 2009

The exact equipment to be deployed will be determined through a site visit due for late 2008. Orpheus Island is a 'high' or continental island and so represents a new set of challenges and so the site visit will be critical in designing the equipment to be deployed.

The anticipated set of infrastructure to be deployed includes:

- A base station using the upgraded microwave communications link;
- A number of relay-spars to bounce the wireless network around the island to the sensors;
- Two or three multi-floats up in the passage between Orpheus and Pelorous Islands;
- Two sensor floats in Pioneer Bay near the research station;
- Optionally an additional sensor float on the sea-ward side of the island.

The planned locations of equipment is shown in Figure Five, note that this are very preliminary as the site survey has not yet been completed.

Moreton Bay – November 2008

The deployments in Moreton Bay will be done in conjunction with the Centre for Marine Studies (CMS) at the University of Queensland. CMS have a sensor design that they wish to deploy, FAIMMS will be providing the communications and data management components and so this is a joint venture between FAIMMS and CMS.

The exact timing and nature of the deployments is still being developed.

Planned Site Visits

Site visits are an essential part of developing the platforms, logistics and deployments for each site. It is essential that the equipment deployed at each site meets the unique needs of that site and that the location and type of equipment is directed towards the scientific issues relevant to that site as well as the bigger IMOS/GBROOS level issues. The project also needs buy-in from the local station operators for servicing and level-one trouble shooting and so a working relationship with the staff on the ground is essential.

Orpheus Island – October 2008

Planning for the site visit is underway with the station staff and a time of around October 2008 has been nominally set. The exact date will be set once more planning has been completed.

The requirements of the site visit include:

- To look at the best method to get the wireless network around the island to the area where the sensors are to be deployed;
- How best to mount the fixed equipment including the idea of mounting some equipment on land;
- Range and signal strength for the wireless equipment;
- Locations for moorings and for the sensor floats;
- Logistic support and general planning for the deployment.

Lizard Island – mid 2009

The Lizard Island deployment is potentially the most complex logistically and so a site visit will be essential to work through the location, type and timing of the deployment. At this stage the intention is to a site visit in mid 2009 with the deployments done in late 2009, the hope is to have these in place before the coral spawning which normally occurs in October/November.

No planning has begun for this site visit but as the work for the other visits and deployments progresses this will be done.

Moreton Bay – as required

The Moreton Bay deployments are being overseen by the Centre for Marine Studies and given the easy access to this area the site visits will be organised as required.

Communications Links

The project is to facilitate the installation of high speed links into each of the seven sites. Each site will use differing technologies and in many cases the project is just contributing funds to supplement other sources of funding. Where the links are multi-access links (used by more than one party) the project will look to a carrier, such as AARNet, to own and manage these links.

For the initial installations the Telstra nextG network will be used where this is available and when the full communication links are in place the data will be moved across to these. The full links will support much faster data rates and so open up new areas of sensors.

Currently work is underway to provide links to all sites except to Myrmidon Reef and Lizard Island. For Myrmidon Reef the existing HF radio may be used until a higher speed technology can be found. This will have only a minor impact on the project as a limited amount of equipment is designated for Myrmidon and this could be done using existing HF technology.

Lizard Island is more problematic. Given the multi-use nature of this site we would like to put in a robust high speed link but apart from satellite there is no easy technology that can be deployed. The site visit will look at the option of using Telstra nextG (which should work), Satellite or microwave. The best option is microwave but issues of back-haul from the mainland jump-off point as well as access to towers remains an issue.

Heron Island – November 2008.

The Heron Island link is in planning stage with funding obtained for the link to Heron although funding to jump this across to One-Tree has not been obtained at this time. For this reason a nextG connection will be used at One-Tree.

The Heron Island link will be owned and operated by AARNet on behalf of the partners. Quotations have been obtained and a contractor will be appointed by the end of May 2008 with a completion date of November 2008 or soon after.

Orpheus Island – August 2008.

Quotations for this link have been obtained and a suitable contractor will be appointed with the link due to be completed by August 2008. This work is a simple upgrade to the existing link and so is more straight forward.

Rib and Davies Reefs

Both these sites will use the Telstra nextG system to communicate and the links will be installed as part of the initial deployments.

Service Visits

Sites are to be serviced every six months and normally this will be done in conjunction with the GBROOS mooring trips which have a similar schedule. With all of the major deployments to come it is uncertain how much time and need there will be for servicing and what resources will be free to undertake this. When the project moves into the operational phase then the servicing will be more routine.

The Heron and One-Tree sites will be re-visited in March 2009 in conjunction with a planned moorings trip although it is anticipated that other visits may be required to fine-tune the deployment. As the other sites will only just be operational during the life of this plan their service visits will be covered by future plans.

Planned Outcomes

As well as the deployments and site visits there are a number of other planned outcomes, these include:

- The development of a data web site for access to the data and data / information products as well as other services related to the deployments;
- Presentations at a number of conferences including the International Coral Reef Symposium in July and a workshop on the management of sensor data in New Mexico in September;
- Development of data standards for the data being managed including full metadata, sensorML based system description and XML based data exchange;
- All metadata and data streams lodged with the eMII project using agreed to protocols;
- Full suite of data management systems in place including quality control, status and sensor control systems;
- Set of validated sensor float designs that will be made available to other agencies;
- Initial work on future sensor systems including the use of cheaper sensors paired with reference sensors, the use of 'smarter sensors' and a range of smaller sensors that can be located in precise habitats or locations.

Note that basic data management systems are already in place and as new equipment is deployed the data are immediately available via the GBROOS-data web site at:

http://data.aims.gov.au/gbroosdata

Governance and Structure

The FAIMMS component of GBROOS is governed under GBROOS and so is project managed by AIMS and overseen by the GBROOS Scientific Advisory Group (SAG) who are appointed from the GBROOS community.

A FAIMMS Technical Group will be formed to advise on the technical components of the sensor network project. This group will be formed under the GBROOS SAG but will include a range of agencies that are working on sensor related issues rather than reflecting the agencies directly involved with GBROOS. The Technical Group will meet a number of times each year but will mainly communicate via electronic means. It is anticipated that the initial meeting will be in August after the Heron and One-Tree deployments.

Issues and Risks

There is an enormous amount to be accomplished in the duration of this plan. As with any sea based project the weather and logistics can interfere with the best planning and so, as always, these are issues and risks that can impact the project.

The major risks identified for the next twelve months include:

- Non-arrival of key equipment from suppliers;
- Large scale failure of the equipment either due to design issues or severe weather;
- Inability to gain access to sites due to weather or lack of on-site support;

- Dramatic increase in the time required to undertake the work.

Of these the main real risk is non-supply of key equipment. The fact that IMOS has injected large amounts of money into a limited number of suppliers means that delays for some equipment are expected. This is not easily dealt with as often initial promised delivery times turn out to be unrealistic so delaying other work.

Most of the other risks can be dealt with by prioritising the work and talking with the various partners to ensure that activities occur as expected.

Planned Activities and Outcomes for 2009-2010

The project will move from the initial deployment phase into an operational phase during this period and the emphasis will change accordingly.

The main anticipated activities and outcomes will be:

- Deployment at Lizard Island and Myrmidon Reef to complete the roll out of equipment;
- Regular service visits instigated to all sites;
- Development of the second generation of equipment to be rolled out at service visits;
- Development of specialised applications at key sites in conjunction with partners, this will be overseen by the GBROOS Scientific Advisory Group and will look to value add to the infrastructure deployed;
- Increased focus on the delivery of data products including work directly with modellers to produce value added products;
- Refinement of designs and incorporation of a new generation of smarter systems;
- Increased communication of the project to the scientific and general communities;
- Work with eMII to develop integrated data products and services.

Summary Time-Table

From the items above the following timetable can be developed for the year:

- July-August Deployments at Heron and One-Tree Islands
- August Deployment at Rib Reef
- August Communication link to Orpheus Island upgraded
- September Deployment at Davies Reef
- October Site visit to Orpheus Island
- November Communication link to Heron (and maybe One-Tree) operational
- November Deployment at Moreton Bay (dependant on partners)
- March Service visit to Heron and One-Tree Islands
- May Deployments at Orpheus Island
- June-July Site visit to Lizard Island

Conclusion

The next twelve months will see most of the FAIMMS infrastructure deployed and so will be a period of intense work. The sheer volume of tasks to be undertaken itself represents a risk and will present a number of challenges. The return will be a dramatic increase in the infrastructure deployed, the first real data available and the start of an exciting and innovative project.

Most of what is to be done has been proven in tests and field trials but there is an enormous level of uncertainty with the weather and working in the marine environment that has the capacity to delay or alter the schedules presented here. The designs have been based on our knowledge of systems we have deployed but there is every chance that the designs will need to be fine tuned or even radically re-designed. The cumulative impact of these uncertainties will make the coming year interesting and, while we will have problems, the final set of implementations that come from the work will represent the state of the art.

The project will deliver most of the planned outcomes over the next twelve months that will see the first large scale sensor network deployment in the marine environment.

Figure One. **Planned Deployments for Heron Island. Initial deployment will include the base station, the six relay-spars, the five sensor floats and the Wistari multi-float. The other multi-floats will be deployed on subsequent visits.**


Multi-Float (proposed)
Multi-Float (proposed)
Heron Island Base Station
Sensor Float
Relay-Spar: No Instruments
Relay-Spar: No Instruments
Relay-Spar: No Instruments
Sensor Float
Sensor Float
Sensor Float
Relay-Spar: No Instruments
Sensor Float
Multi-Float
Relay-Spar: No Instruments
Relay-Spar: No Instruments
8814 ft
© 2008 MapData Sciences PtyLtd, PSMA
Image © 2008 DigitalGlobe
©2007 Google™
Pointer lat -23.450528° lon 151.952110°
Streaming 100%
Eye alt 30500 ft

Figure Two. **Planned Deployments for One-Tree Island. Initial deployment will include the base station and three relay-poles with sensors, multi-float buoys will be deployed on subsequent visits.**

Figure Three. Planned Deployments for Rib Reef.

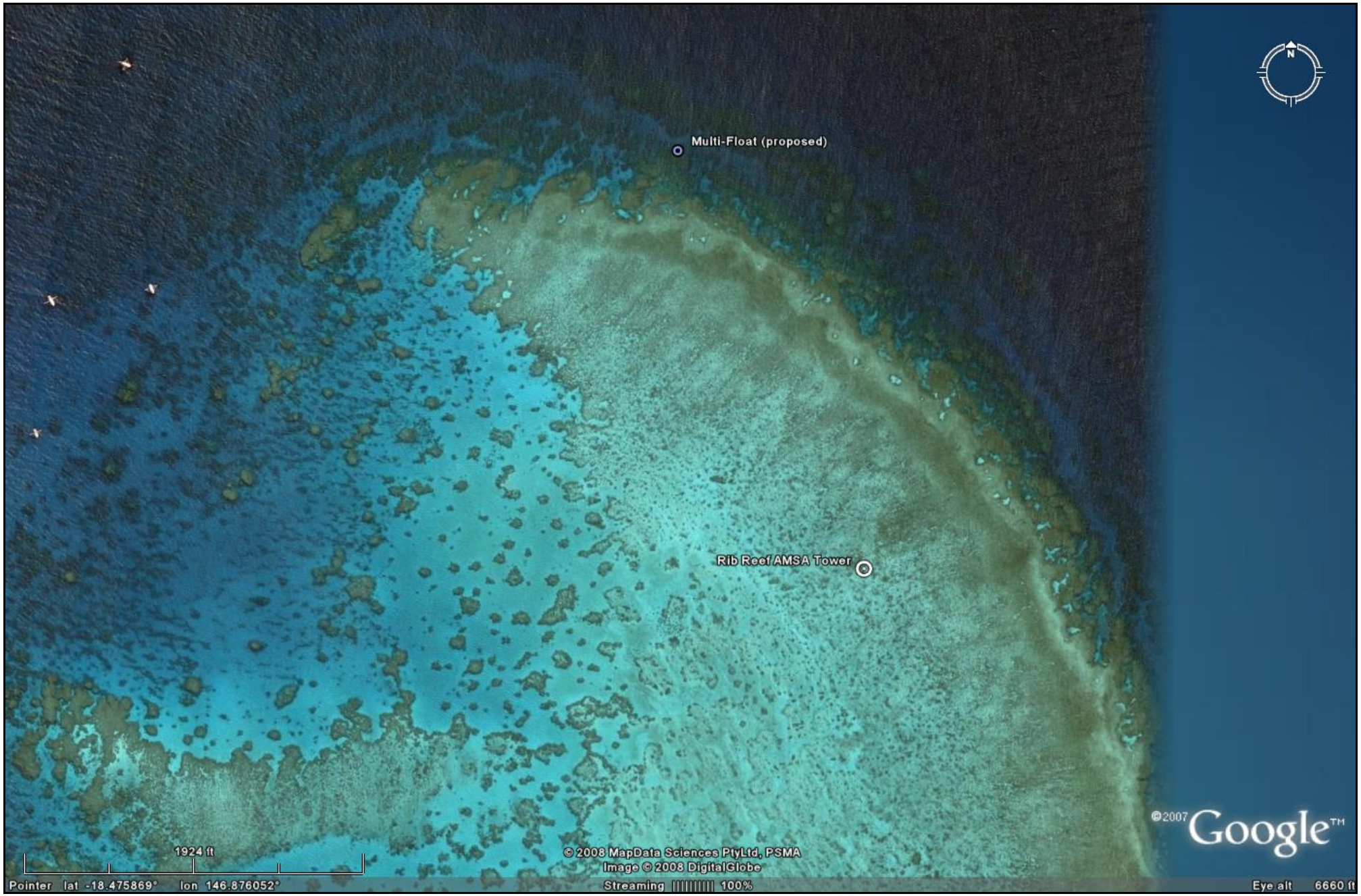

Figure Four. **Planned Deployments for Davies Reef. Initial deployment will include the Base Station and the sensor-floats, the multi-floats may also be deployed depending on time and resources, if not they will be deployed on subsequent visits.**

Figure Five. **Planned Deployments for Orpheus Island. The exact deployment will be decided after the site visit but will include the Base Station, Relay-Spars and one or more multi-floats.**