Australian Mooring Network Facility Project Plan

Proposal under the IMOS (EIF) Five Year Strategy: Enhancement and extension of IMOS – July 2009 to June 2013

Proposals should be submitted to:
Tim Moltmann, IMOS Director, University of Tasmania
email: tim.moltmann@imos.org.au

Overview:

Proposed Infrastructure Investment:	A national system of moored sensors and associated water samples
IMOS Facility:	Australian Mooring Network (AMN)
Operating Institution:	CSIRO Marine and Atmospheric Research (CMAR)
Facility Leader (for this Proposal):	Tim Lynch , CMAR, 03 6232 5239, tim.lynch@csiro.au
Other(s) key people involved:	John Middleton (SARDI), Vittorio Brando (CSIRO), Ming Feng (CSIRO), Moninya Roughan (SIMS and UNSW), Rob McCauley (Curtin University), Craig Steinberg (AIMS), Anthony Richardson (CSIRO and UQ), Bronte Tilbrook (CSIRO), Peter Thompson (CSIRO)
Collaborating Institutions:	South Australian Research and Development Institute (SARDI), Commonwealth Science and Industry Research Organisation (CSIRO), Sydney Institute of Marine Science (SIMS), Curtin University, Australian Institute of Marine Science (AIMS), University of Queensland (UQ), University of Technology Sydney (UTS), Macquarie University, Australian Antarctic Division (AAD), NSW-Department of Climate Change and Water (DECCW),Oceanographic Field Services (OFS), Manly Hydraulics Laboratory (MHL), Sydney Water Corporation (SWC), National Marine Science Centre (NMSC), Flinders University, University of Adelaide. Australian National University (ANU), Queens University, (Ontario, Canada)

Table of Contents

Nature of Investment

The Australian Mooring Network AMN is an established facility of the Integrated Marine Observing System (IMOS).The facility infrastructure is composed of nationally distributed systems of coastal and continental shelf moored sensors and associated biogeochemical (BGC) water sampling. The multiple datasets collected measure physical, chemical and biological parameters of coastal waters.

The AMN is the largest and most scientifically diverse of the IMOS facilities. The initial NCRIS funding for the facility was $14,602,782 (Table 1). A further $4,447, 371 was provided to the

facility in the initial 2009-10 allocation of the Education Investment Fund (EIF) and $7, 320, 079 to extend the facility through from 2011-2013. Finally $4, 885, 346 was provided to the facility to enhance its operations from 2010-2013. This provides a grand total of $31, 255, 578 invested in mooring infrastructure and associated water sampling between 2006 and 2013.

Table 1. Approved Budget for AMN sub-facilities

AMN	**NCRIS**	EIF				**Grand Total**
Sub-Facility	**NCRIS 2006-11**	Extension 2011-13	EIF 1st $8M 2009-13	Enhance Essential 2010-13	**EIF Total**	
6a Queensland Nthn Territory	**2,683,000**	1,736,275	1,177,579	2,023,008	**4,936,862**	**7,619,862**
6b New South Wales	**2,528,999**	1,570,950	50,000	147,629	**1,768,579**	**4,297,578**
6c Southern Australia	**2,883,599**	1,021,014	50,000	352,204	**1,423,218**	**4,306,817**
6d Western Australia	**2,031,346**	741,636		318,796	**1,060,432**	**3,091,779**
6e Acoustic Observatories	**843,000**	357,706			**357,706**	**1,200,706**
6f National Reference Stations	**3,632,838**	1,892,497	3,169,792	2,043,709	**7,105,999**	**10,738,836**
Grand Total	**14,602,782**	7,320,079	4,447,371	4,885,346	**16,652,796**	**31,255,578**

The recurring theme of the facility is monitoring the behaviour and attributes of all of Australia's continental shelf boundary currents. The facility achieves this by combining elements of physical and chemical oceanography with marine biology across most states and one territory of Australia.

Structure of the AMN

The foundation structure of the AMN was for 7 sub-facilities which have individual contracts with IMOS. The original sub-facilities and their host organisations in brackets were:

- National Reference Stations (NRS) - Coordination & Analysis (CMAR)
- Western Australia (CMAR)
- Passive Acoustic Observatories (Curtin University of Technology)
- Queensland and Northern Australia (Australian Institute of Marine Science - AIMS)
- New South Wales (Sydney Institute of Marine Science - SIMS)
- South Australia (South Australian Research and Development Institute - SARDI)
- Satellite Ocean Colour – Calibration & Verification (CSIRO).

During this planning process, a variety of changes have been suggested for the AMN structure.

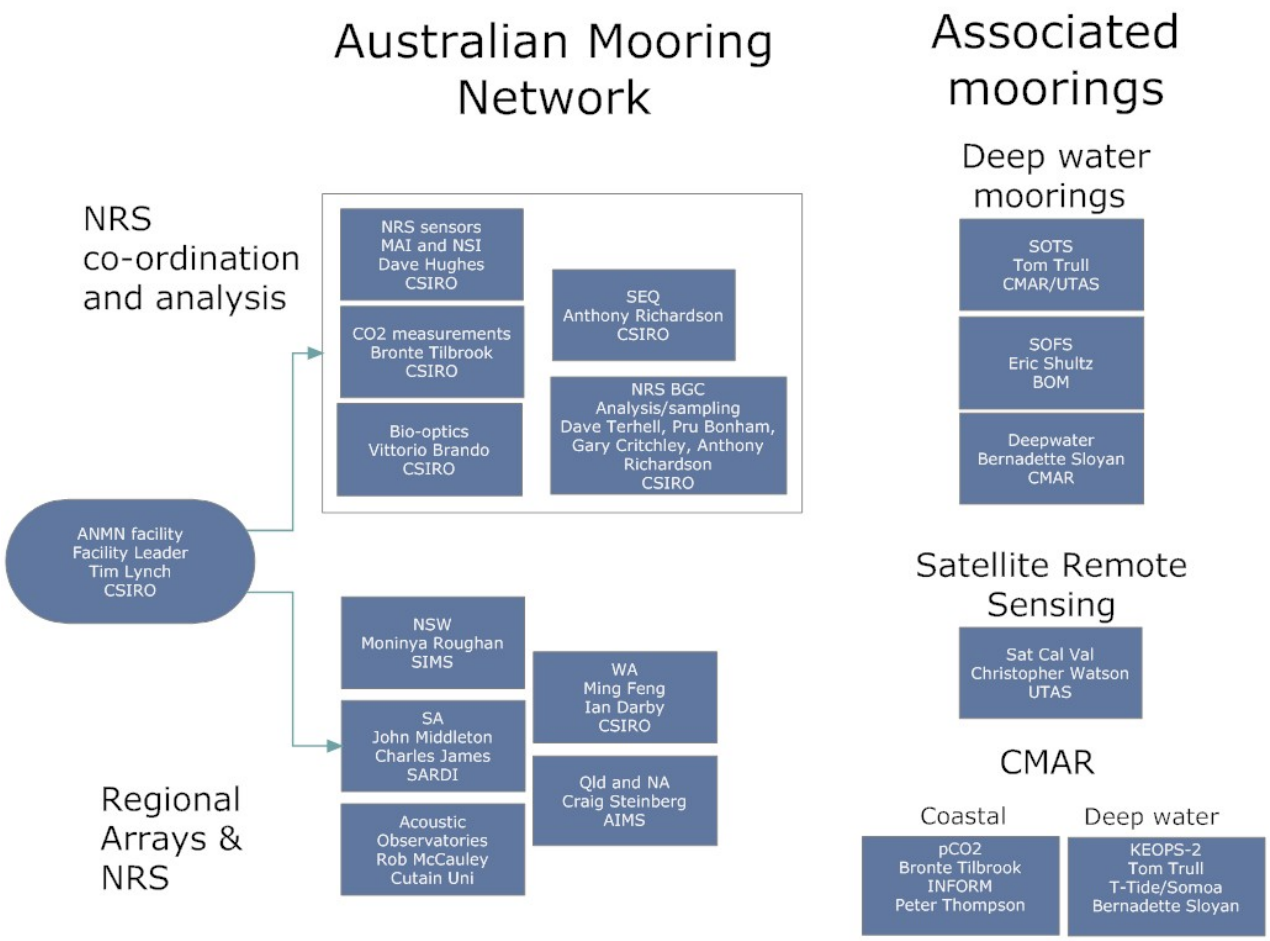
For the NRS sub-facility enhancement funding has been approved for moored instruments to monitor carbon dioxide changes related to ocean acidification, the East Australian Current (EAC) offshore from South East Queensland (SEQ) and Ocean Colour. These additions will become units (or sub-sub-facilities) in the NRS sub-facility.

The other major enhancements approved were for the Queensland and Northern Australian sub-facility. The sub-facility received additional funds to build infrastructure to monitor the oceanography of the continental shelf components of the Indonesian through flow and the Kimberley.

Finally the Satellite Ocean Colour – Calibration & Verification sub-facility has been moved to the Satellite Remote Sensing facility.

The proposed final structure of the AMN, their host organisations, leaders and functional units are provided in Figure 1, new functional units are in red.

Figure 1. Structure of the AMN and associated moorings



Relationship with other Facilities

The AMN had a strong existing relationship with the Southern Ocean Time Series (SOTS), which was the other IMOS facility that was mostly concerned with moorings and oceanographic sensors. The SOTS facility has been expanded to become deepwater moorings or the Australian Bluewater Observing Sites (ABOS). In particular, AMN infrastructure deployed offshore in South East Queensland and the Bonaparte Gulf in NW WA (Indonesian through flow) will complement deep water arrays deployed by ABOS.

This facility also has strong links with the Satellite Remote Sensing Facility (SRS). The SRS facility will deploy moorings along satellite paths to calibrate sea level elevation and other parameters with remote sensed data. Both this work and moorings for ABOS will be undertaken by the CMAR Ocean Sensor Deployment (OSD) team which is also responsible for the CSIRO components of the AMN. Although the Satellite Ocean Colour – Calibration & Verification sub-facility is being proposed to be moved to the SRS facility an enhancement for bio-optical observations is to be carried out at NRS moorings.

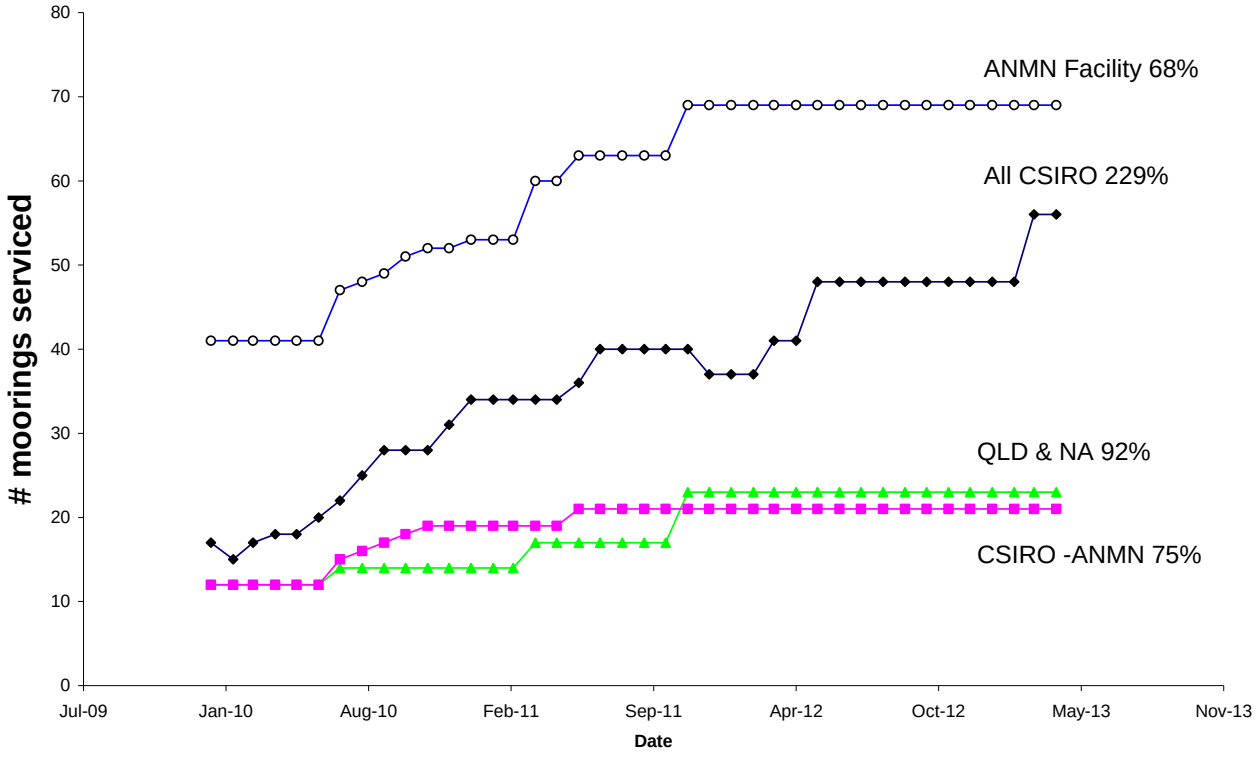
Finally the facility has links with the Ships of Opportunity (SOOP) facility through the Continuous Plankton Recorder (CPR) sub-facility which undertakes analysis of zooplankton samples for the AMN and through the Research Vessels Real-Time Air-Sea Fluxes sub-facility which collects information that is complementary to the AMN pCO_2 moorings.

Implementation Strategy:

The first years (2006-2010) of the AMN have been a start up and capacity building process with the full complement of NCRIS moorings now deployed. This has included establishment of instrumented monitoring sites in WA, SA, TAS, NSW, QLD and NT as well as the development and implementation of a standard system of BGC water sampling. While having achieved considerable progress the AMN is set to expand in the future with the remainder of NCRIS funds, already committed EIF funding, the EIF extension and EIF enhancements. This includes completion of approved mooring deployments such as the North Stradbroke Island (NSI) NRS, deployment of ADCPs for all NRS sites and also deployment of moorings that measure pCO_2 at the Maria Island, Yongala and Kangaroo Island NRS. Further approved enhancements include a new array of moorings across the north of Australia which will contribute to the North Australia Observing System (NAOS). Extension funds also include bridging finance between NCRIS and EIF for the 2010/11 financial year to continue already committed EIF funded projects, such as operation of the NSI NRS and initial pCO_2 moorings.

The potential projected growth of the facility to June 2013 for deployed and serviced moorings is 68%. This includes a 75% growth for the CSIRO controlled aspects of the AMN and a 92% increase in moorings to service by AIMS. All moorings serviced by CSIRO, which include ABOS and SRS as well as other projects has a potential to grow by 229%.

Figure 2



Matching scope to resources:

NRS

Extensive budget modelling was undertaken for this proposal with the full cost of moorings and BGC sampling established. The proposal and budget submitted for AMN (including NRS) were not fully-supported by the IMOS Advisory Board, and the budget was capped (Table 1). This has resulted in the need to match the scope of ANMN, and the NRS in particular, to resources available under NCRIS and EIF.

The initial NCRIS contract included:

a) Extend the NRS from 3 to 9 stations
b) Allow existing stations to add biological sampling and remote sensing ground truthing
c) Collect CTD, DO, PAR, fluorescence and turbidity measures at 3 depths
d) ADCPs at all NRS stations ***
e) All references stations will telemeter a reduced data set via iridium satellite

*** Though mentioned in the NCRIS contract, funds for the ADCPs only became available from the 2009-2010 allocation of EIF funding.

A scientific steering committee has been formed to oversee the NRS network, and over the next six months will provide advice on issues such as sensor sampling rates, and variables, depths, frequencies and analyses for physical samples. This will ensure that decisions about matching scope to resources are guided by scientific requirements. These decisions will be made within the context of advice from the IMOS board as outlined below:

1) No further investment in real time at this stage –MAI and one other site (possibly NSI) to real time using Iridium, YON and DAR to real time using NextG, and Port Hacking to be reviewed to see if real time can be delivered within the existing budget which accommodates monthly sampling (vs a minimum of quarterly at other NRS sites).
2) No further investment in ADCP's at this stage, including development of ADCP telemetry and additional ADCPs to allow servicing hot-swaps for continual measurements and calibration.
3) Meteorological measurements to be limited to the four sites currently with surface expression .
4) Physical (BGC) sampling to continue at all sites if achievable and affordable. Preliminary analysis indicates that only six of nine sites could be supported using current variables, depths, frequencies and analyses. There will either be full sampling at a reduced number of sites, or reduced sampling at all sites, based on advice from the NRS scientific steering committee.

Shelf Arrays

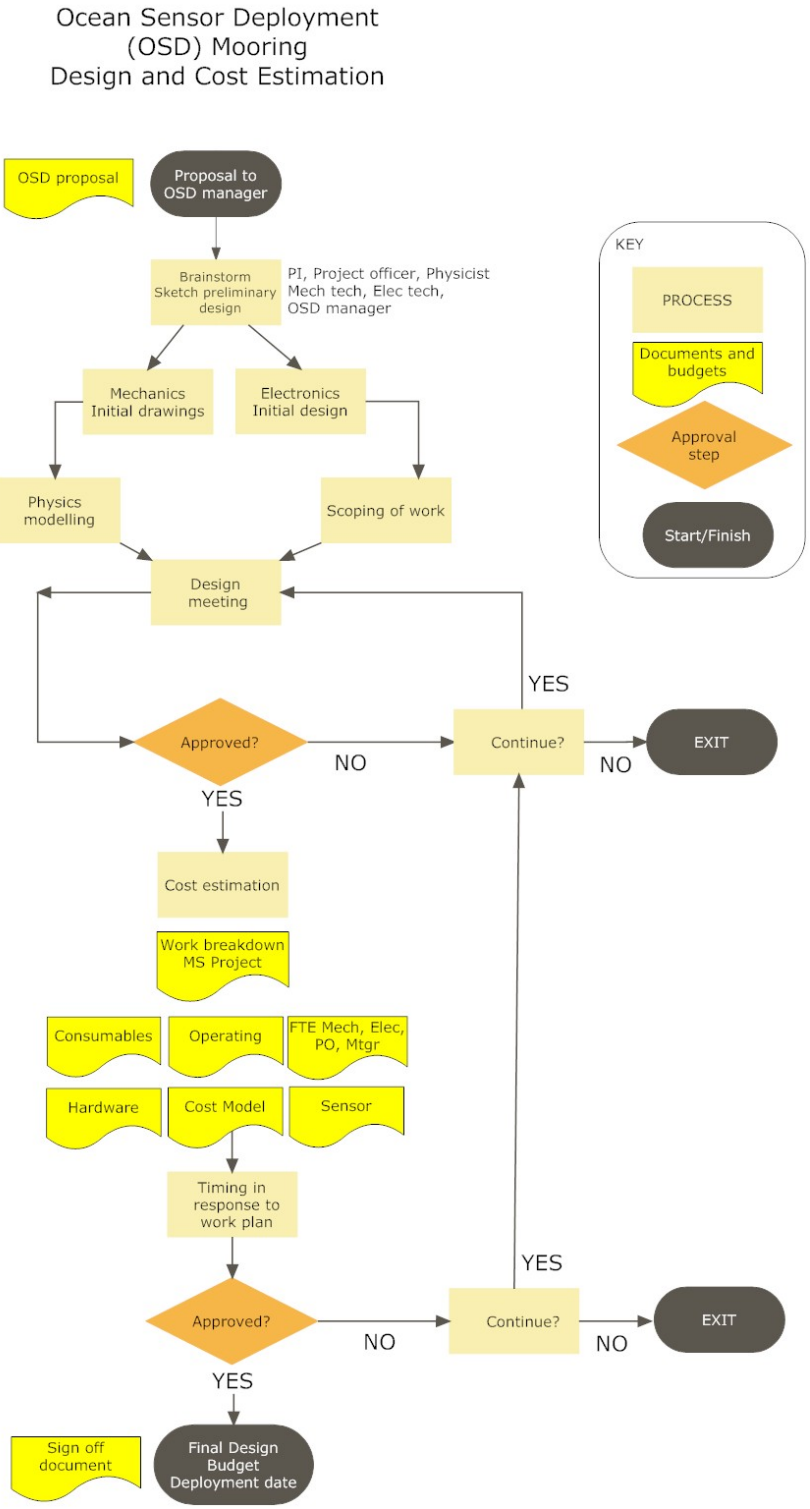
Decisions about matching of scope to resources be made within the context of advice from the IMOS board as outlined below:

1) There will be no additional ADCPs to allow servicing hot-swaps for continual measurements and calibration or funds to build moorings that will hold the telemetering ADCP
2) Ensure that the scope of existing and new shelf mooring arrays is matched to available resources

In regards to point 1), some sub-facilities have adequate ADCP's to undertake continuous sampling however for others this may either result in gaps in some dataset as ADCPs are rotated through deployments or less sites need to be chosen as a sub-set to provide continuous

measurements. In these cases additional funds are being sort as capital co-investment to allow for hot swapping of gear. Also, ADCP data will not be telemetered. In regards to point 2) the following flow chart provides a pathway towards scope capture and cost estimation (Figure 3). While seemingly complex the flow chart is essentially a two step approval process composed of 1) What do you want and 2) What does it cost and when can we do it.

Figure 3. Flow chart of scope capture and cost estimation for CSIRO moorings



National Reference Stations co-ordination and analysis

The NRS forms the backbone of the AMN, providing context to other studies with a time series of datasets to monitor changes in oceanographic and biological properties. Three of the sites, Maria, Rottnest and Sydney (Port Hacking) are long term monitoring stations (since 1942). Essentially the NRS sites are "areas" where multiple moorings with various instruments are located in close proximity to each other, and where water samples are taken (Figure 4).

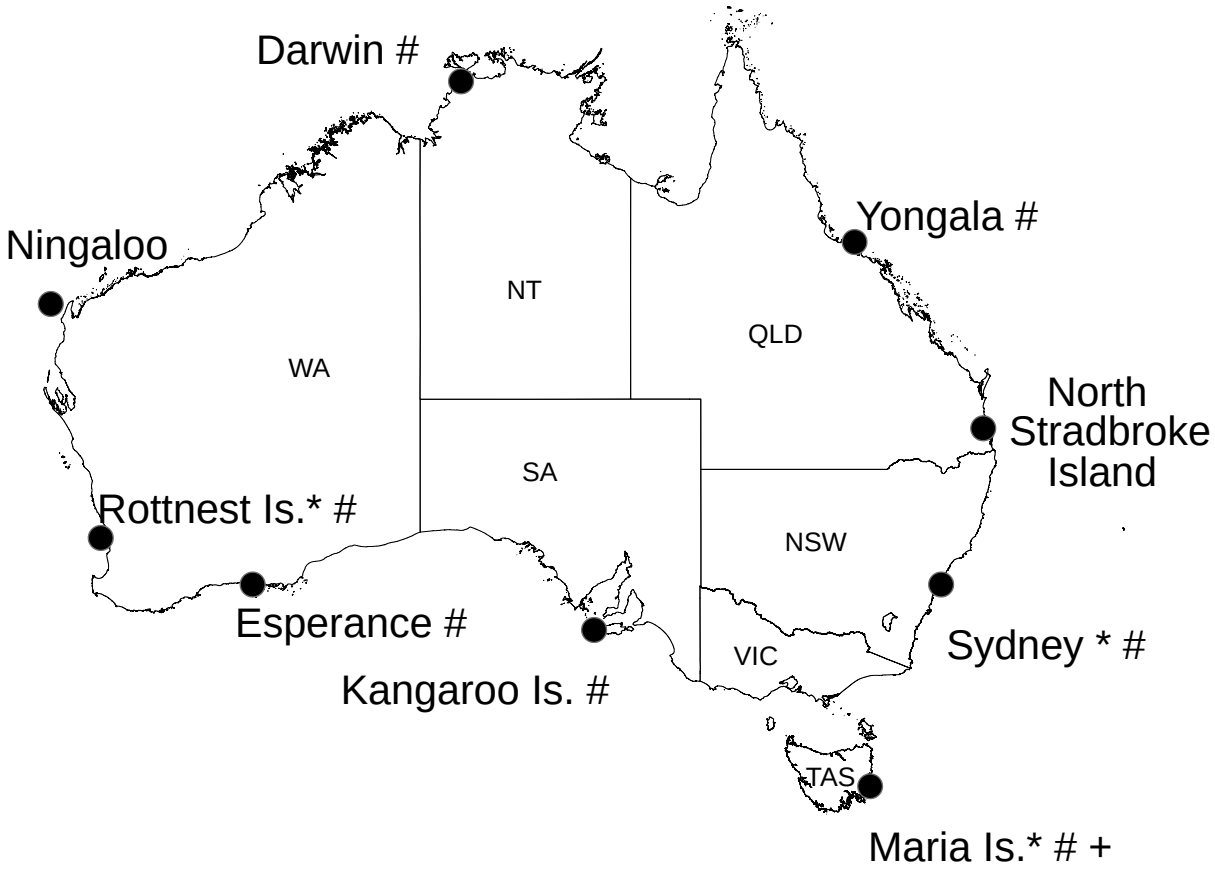


Figure 4. NRS location status 2009, * indicate historical site, # indicates sub-surface mooring infrastructure deployed, + surface telemetry gear deployed

The NRS sub-facility conducts sampling and servicing of the Maria Island and North Stradbroke Island NRS only. The NRS sub-facility does, however, undertake analysis of BGC samples collected from the other NRS sites. Servicing, BGC sampling and the associated budget responsibility for all other NRS are with regional sub-facilities (eg Rottnest NRS is serviced by the Western Australian sub-facility).

NCRIS and EIF EXTENSION – NRS co-ordination and analysis

The NRS co-ordination and analysis sub-facility has a national role to fulfil in the system and the IMOS extension will allow the following activities to continue:

a) Facility management support
b) Facility technical support for WQM sensors

c) Analysis each year of biogeochemical (BGC) samples
d) Co-ordination of BGC data collection including provision of data to eMII
e) Deployment of $pC0_2$ moorings at Maria and Yongala NRS, data retrieval and delivery to eMII
f) Maria Island (MAI) NRS
g) North Stradbroke Island (NSI) NRS
h) A contingency fund to self-insure for facility-wide gear loss

EIF ENHANCEMENT– NRS co-ordination and analysis

Proposed enhancements to the NRS analysis and co-ordination sub-facility which were funded include:

1) An additional pCO_2 mooring at the Kangaroo Island NRS
2) A pool of bio-optical instruments (WETLabs ECO triplet B with internal Battery, data-logger and eco-wipers) for deployment and hot-swapping at four NRS sites.
3) Two SEQ shelf moorings as a cross shelf transect offshore from the NSI NRS

pCO_2

The carbon and acidification component of the sub-facility will install moorings at NRS on the Australian shelf to determine changes in ocean CO_2 uptake and acidification in our region. The moorings will be combined with underway observations in the SOOP program to obtain regional coverage with higher frequency sampling at the NRS.

Each mooring site will be equipped with surface CO_2 systems, using proven and robust technology. The sensors will determine surface pCO_2, dissolved oxygen, temperature and salinity. During implementation up-take of servicing responsibilities by regional sub-facilities will be negotiated. Co-location of the pCO2 moorings with the BGC sampling is important as it will allow sensor data to be calibrated and checked against actual analysed units for these parameters

Bio-optics

The Bio-optics component of the sub-facility will argument the Chlorophyll fluorescence and RED scattering measurement acquired by WQMs on the NRS moorings, with measurements of CDOM fluorescence and scattering at BLUE & GREEN bands. This will be achieved with a pool of WETLabs ECO triplet B instruments with internal Battery, data-logger and eco-wipers. The pool will ensure hot-swaps for four NRS moorings (one in the water, one ready to deploy for each mooring, and few spares in sub-facility labs for quick replacements). The bio-optic unit will be responsible for building hardware to mount the sensors onto each NRS.

This unit within the sub-facility will be wholly responsible for the data stream: each NRS operator would receive calibrated instruments, deploy them and send them back to the unit where data would be downloaded, QA/QC-ed, and then uploaded to eMII, the instruments would be calibrated and then sent back for deployment.

Additional BGC analysis will be required on samples collected at the 4 relevant NRS of spectral absorption apportioned to Phytoplankton, Coloured Dissolved organic matter and non-algal particulate matter, which will provide calibration of the instrumental data (the budget for this activity includes a resource of 0.1 FTE per year for laboratory analysis).

South East Queensland

An array of 2 moorings across the shelf break (200m and 400m) will complement the coastal NSI NRS (67m) and provide an opportunity to monitor the EAC and cross shelf interactions. These moorings will also be closely associated with the ABOS EAC array forming a coherent cross shelf and slope transect.

Western Australian

The Western Australian sub-facility manages infrastructure for two NRS (Rottnest and Esperance) and two shelf mooring arrays (Two Rocks and Perth Canyons). These arrays provide data to monitor the variability in the Leeuwin and continental shelf currents both in-terms of along-shore and cross-shore structures as well as how other oceanographic processes, such as upwelling within the Perth Canyon, interact with this boundary current.

A third NRS, Ningaloo, is now deployed but the responsibility for this mooring will, for operational reasons, be transferred to the Queensland and Northern Australian sub-facility for management.

NCRIS and EIF EXTENSION – Western Australia

The extension to the Western Australian sub-facility will include continued operations:

1) Servicing of two NRS sites, at Esperance and Rottnest. Monthly BGC sampling will only be carried out at the Rottnest station. ADCP measurement will be undertaken for all three WA NRS.
2) Servicing of a shelf mooring arrays of five moorings deployed as a cross shelf transect just north of Perth off Two Rocks, comprising 3 thermistor moorings and 2 thermistor and ADCP moorings. Salinity/fluorescence measurements on one of the shelf break moorings have been requested by the WA Node and were approved in the NCRIS budget. Due to technical issues with long deployments of the WQMs, alternative options and funds will be negotiated with the facility.
3) Servicing of an array of three moorings, which have been designed and built around the Perth Canyon, comprising 2 thermistor moorings and 1 thermistor and ADCP moorings. Salinity/fluorescence measurements on one of the shelf break moorings have been requested by the WA Node and were approved in the NCRIS budget. Due to technical issues with long deployments of the WQMs, alternative options and funds will be negotiated with the facility.

NCRIS and EIF EXTENSION – Queensland and Northern Australia

The Queensland and Northern Australia sub-facility consists of three NRS sites at Yongala, Darwin and Ningaloo and four pairs of array moorings located north to south along the Great Barrier Reef (GBR). For the array moorings, each of the 4 pairs has an outer mooring on the continental slope in water greater than 200m and an on-shelf mooring sitting in shallower water around 30-70m deep. Like other AMN moorings, the array deploys a range of instrumentation including ADCPs and WQMs. The sub facility's objective is to observe the cross-shelf exchange of water between the Coral Sea and the GBR. Water moving along and onto the GBR will be measured by monitoring the southward flowing EAC and the northward Hiri western boundary current. The moorings located in the southern GBR monitor the strength of currents related to upwelling events detectable on the Capricorn-Bunker Shelf, which supply deep, nutrient-rich water to the reef.
The extension to the Queensland and Northern Australia sub-facility will include continued operations of the GBR moorings, established in 2007 and the roll out and servicing of the Northern Australian Observing System (NAOS) moorings from 2010.

1) Servicing and data upload of three NRS sites, at Darwin, Yongala and Ningaloo
2) Deploy real time telemetry at Darwin and Yongala
3) Servicing of shelf mooring arrays consisting of 4 pairs of outer shelf and slope moorings along the GBR
4) Provision, deployment and servicing of the moorings component of the Northern Australian Observing System comprising:
    a. Arafura and Wessels Mooring pair
    b. Shelf component of the Indonesian Throughflow (ITF) transect (three moorings) in tandem with the BAOS operated deep water components
    c. ITF BAOS instrumentation: 3 ADCPs and 3 PIES
    d. Kimberley mooring transect (four)
    e. Pilbara mooring transect (three)

It must be noted that funding of the full NAOS mooring array is dependent upon the level of State Government funding. At the moment only the Bonaparte Gulf (ITF shelf) and Kimberley (partial) transects have confirmed funding.

Acoustic Observatories

The Acoustic Observatories sub-facility has deployed 2 arrays of acoustic listening stations that passively record sounds from the ocean. The acoustic loggers have been developed by the Centre for Marine Science and Technology (CMST) over the last 20 years and the stations provide baseline data on ambient oceanic noise, detection of fish and mammal vocalizations linked to ocean productivity, monitoring of multiple species of whales and detection of underwater events. Examples of information available on physical sea noise sources includes: seasonal and climate driven inter-annual changes in rainfall over large ocean areas; calculating the size and propagation speed of seafloor ruptures due to earthquakes; deriving long term trends in seismic activity in subsea fault zones; or monitoring Antarctic ice calving.

Arrays are located in the Perth Canyon in Western Australia, Portland in South Australia and are to be deployed offshore from Cape Hawke, NSW. These sites have been chosen due to their biological interests; for example, the Perth Canyon is a focal feeding area for pygmy blue whales, *Balaenoptera musculus brevicauda*, and the station has now been in operation since 2000. Thus by the end of the proposed sampling period, mid 2013, ten whale seasons, over 14 years, will be available. This particular array is also closely matched to the moorings being deployed in the canyon by the Western Australian sub-facility. This will allow for multidisciplinary correlations between the acoustic data, which records biological processes and the oceanographic physical and chemical data which is being collected by the WA sub-facility.

NCRIS and EIF EXTENSION – Acoustic Observatories

The extension of the sub-facility would allow for the continuation of servicing of the existing passive acoustic moorings. Each acoustic observatory comprises four moorings with sea noise loggers in underwater housings, hydrophones, ORE CART releases and associated mooring gear. The three arrays that are part of the EIF extension are:

1) Perth Canyon acoustic array (WA)
2) Portland acoustic array (SA)
3) Acoustic array (NSW)

New South Wales

The New South Wales sub-facility is establishing a transect of moorings and measurements off Sydney, which includes the Port Hacking 100 (Sydney) NRS. Like the NRS sites at Maria and Rottnest Islands, data has been collected for over 70 years at Port Hacking (Sydney). The transect consists of three moorings in 65, 100 and 140m of water off Bondi and a mooring in 100m off Port

Hacking and BGC water sampling station at the PH 100 mooring off Port Hacking. This region is typically downstream of where the EAC separates from the coast, and is often influenced by EAC eddies. Data collection will support research on the marine ecosystems associated with these eddies and, as the sub-facility is located in the most densely populated area of Australia, issues such as water quality, waste disposal, shipping hazards, harmful algal blooms and recreation are also of particular research interest.

The sub-facility has also deployed two moorings across the shelf at Coffs Harbour, upstream of the EAC separation point, and a single mooring at Jervis Bay, south of Sydney. There are also plans to deploy a single mooring at Eden in southern NSW. The arrays will enhance the AMN coverage along the coast of south-eastern Australia to provide long term monitoring of the continental shelf oceanography both upstream and downstream of the EAC separation point.

NCRIS and EIF EXTENSION – NSW

The extension relates to the deployment and maintenance of shelf moorings and BGC sampling across the continental shelf offshore from NSW.

1) Servicing and data upload of the Sydney NRS site Port Hacking 100
2) Continuation of the BGC sampling at the single PH100 NRS location
3) Continuation of Coffs Harbour moorings CH070 and CH100.
4) Continuation of the Sydney moorings SYD100 and SYD140.
5) Continuation of the Sydney NRS mooring PH100.
6) Continuation of the Jervis Bay mooring JB070.
7) Deployment and continuation of the Eden mooring ED100.
8) Continuation of in-kind mooring data (waverider and ORS065) being delivered to IMOS portal.

South Australia

The Southern Australian sub-facility is deploying six moorings to monitor the large seasonal coastal upwelling of water that occurs along the continental shelf during summer. This includes a NRS site at Kangaroo Island, located at a convergence point of isobaths to monitor upwelling/outflow events as well as long-term variations in the strength of the coastal current. The array also includes a slope mooring at the 600m isobath to measure the Flinders Current. The Flinders Current is in part driven by the Tasman Outflow, a remnant of the EAC, and also forms a link to the west where it becomes the Leeuwin Undercurrent. Three shelf moorings are located in the path of both upwelling and down welling to measure the alongshore currents and exchange, and the planktonic systems as they evolve towards the St. Vincent and Spencer Gulfs and Eyre Peninsula. An outer shelf mooring examines outflows of saline rich water from coastal gulfs during Austral winter as well as enhanced upwelling from the du Couedic Canyon. A substantial water sampling program is also undertaken to measure temperature, salinity, nutrients, phytoplankton, viruses and bacteria. The purpose of the sampling and mooring programs is to understand and monitor the boundary/shelf currents and ecosystems of the region.

NCRIS and EIF EXTENSION – SA

The extension relates to the deployment and maintenance of shelf moorings along the coast of NSW.

1) Maintain and service the Kangaroo Island NRS - KAI
2) Maintain and service five slope and shelf moorings: SAM5CB, SAM2CP, SAM8SG, SAM3MS and SAM7DS
3) Undertake eight 6-day field surveys per annum and measure environmental variables at five biological stations: B01, B02, B03, B05 and KAI

Access, pricing regimes

How will access be provided

An AMN and IMOS principle is free access to data. All AMN data will flow through the IMOS portal managed by eMII. Data from all asset groups will be provided both for telemetry and download of delayed data in a timely and reasonable manner.

How data will be managed

Data management will be the joint responsibility of eMII, and the sub-facilities. For many aspects of the data streams software has been developed (matlab toolbox and deployment database) to enable the processing, data delivery and QC of the moored instrument data. Delayed mode QC, in which the data are subjected to a thorough check, can only be done every 1-6 months after a mooring is serviced. This will be handled by individual sub-facilities and the data delivered to eMII, ensuring that all of our mooring data is of the highest quality.

The BGC data will be delivered from the analysts, via Hobart and then to eMII. The parameters being measured have established QA/QC protocols that are already of International standard and are outlined in the BGC sampling manual. The exception to this is the Profiled CTD data processing which is currently under development and will incorporate accepted QA/QC as in use for the Australian Marine National Facility.

Dependencies on external / other facilities (national and international)

Funding is complex with NCRIS, the initial EIF funds and the next round of EIF funds being split between extension and enhancement budgets. In particular bridging finance for the 2010/11 financial year for the initial EIF funds will be sought under the extension funding model as special extension funding. Individual sub-facility plans also have a variety of external dependencies with the numerous collaborating organisations.

Collaborative structures for allocation of priorities

The design of AMN is the result of a national, collaborative process via the sub-facility leaders of the network and input from regional nodes. National coordinating meetings for the facility are held twice a year between representatives of CSIRO, AIMS, SARDI, Curtin University and SIMS to ensure that national priorities, such as effective data coverage are met. This project is also overseen by the IMOS office.

The NRS will also be the subject of a scientific review to determine collaborative structures and allocation of priorities. Terms of reference will be developed between the facility leader and the IMOS director.

Governance

Performance indicators

Performance indicators for the existing infrastructure are provided in the IMOS AMN facility report 2008-09. Additional performance indicators are provided in individual sub-facility plans.

Describe key risks and risk management strategies

The following key risk and mitigation strategies are for facility wide issues. More detailed risk management is provided in chapter form for the various sub-facilities and in the initial EIF project

proposal. Issues raised in the 2008 IMOS Review were addressed in the IMOS AMN facility report 2008-9.

Risk 1 – Project management of sub-facilities

Delivery of infrastructure and management of projects require considerable FTE. During the first two years of NCRIS funding there was a mismatch between expectations and delivery. This resulted in several milestones being missed for the WA and NA & QLD sub-facilities. The risk is that sub-facilities will over-commit and under-deliver on milestones.

There are no position descriptions of either facility of sub-facility leadership roles. As IMOS is designed to be on-going this lack of explicitness increases the risk of project failure following staff turn-over particularly at a facility leadership level. Also allows for inconsistencies nationally at the sub-facility level.

Mitigation strategy 1a – Project management of sub-facilities
The management overhead of sub-facility leaders should be made explicit. Operators of individual sub-facilities will budget to provide either in-kind or costed support of 0.2-0.3 FTE to account for expected sub-facility management work load.

Mitigation strategy 1b – Project management of sub-facilities
An FTE analysis model was developed for the WA sub-facility. This outlines FTE requirements for mooring preparation, deployment, recovery and servicing. This model will be made available to test expectations against proposals.

Mitigation strategy 1c– Project management of sub-facilities
The AMN facility leader will develop position descriptions for a sub-facility with the operators and sub-facility leaders, for endorsement by the IMOS office. This will help develop an understanding of what the required commitment by operators and sub-facility leaders are to an ongoing program and also allow for more seamless staff turn-over.

Mitigation strategy 1d – Project management of sub-facilities

Each leader will nominate a proxy or deputy who can assume responsibility during periods of leave, high work or staff turnover.

Risk 2 - Conflicts of interest

There are two conflicts of interests that impact the AMN Facility.

a) Some individuals are both node and facility or sub-facility leaders, which limits the availability of individuals to contribute to planning or reporting.
b) The AMN Facility leader's organisational job as CMAR mooring manager has already resulted in prioritisation conflicts between the AMN and other facilities such as SOTS which rely on the same resources.

Mitigation strategy 2a - Conflicts of interest
The AMN will request from operators that facility and sub-facility leaders are not also node leaders.

Mitigation strategy 2b - Conflicts of interest
The CMAR mooring team will develop three units one for deep water work one for coastal and shelf work and the . Co-ordination of the units will be assisted by the NRS co-ordination and analysis project officer who will be jointly funded by AMN and the deepwater mooring sub-facility.

Risk 3– Operational vs. research infrastructure

There is a risk that telemetry streaming will produce the perception that the facility is an operational rather than research infrastructure. Operational infrastructure guarantees continuous service provision, which demands significantly more resources.

Mitigation strategy 3 – Operational vs. Research infrastructure
The AMN will ask eMII to produce a disclaimer that all telemeter data streams are research infrastructure with explanations of the limitations of this funding model.

Risk 4 – Loss of gear and cost over-runs

Attrition of gear is ongoing and there is no formal mechanism to report gear loss through the facility. This risk increases at identified sites, which have a higher incidence of fishing or boating interactions. During the first two years of NCRIS funding a $700,000 contingency fund was depreciated completely mostly due to cost over-runs.

Mitigation strategy 4a – Loss of gear and cost over-runs
A contingency fund of $365,000 provided as part of the EIF extension to self insure the facility from 2011-2013.

Mitigation strategy 4b – Loss of gear and cost over-runs
Risky sites will be identified by the IMOS technical director and will not be self insured under the contingency fund.

Mitigation strategy 4c – Loss of gear and cost over-runs
All gear lost or samples over $20,000 will require a report detailing the type, date and location to the Facility.

Risk 5 - QC and QA

The AMN is cumulatively increasing the amount of data being up-loaded to eMII. While some moored sensor data is being being placed through rudimentary automatic Quality Control (QC), Quality Assurance (QA) is more variable, primarily due to the decentralised nature of the facility and a lack of dedicated staff to assess the data. The risk to the facility is that a damning critique of aspects of the data will be undertaken by an outside organisation that has free and open access to the data.

Mitigation strategy 5a – QC and QA

A review of QC and QA will be undertaken as part of the NRS scientific review. Working with the recommendations of this report the facility will work closely with eMII to implementing national standards and protocols for each level of data QC and QA for each data stream.

Mitigation strategy 5b– QC and QA

As part of the review IMOS node members will be identified to provide scientific oversight for each data stream.

Mitigation strategy 5c – QC and QA

The facility and sub-facility leaders will engage with the scientific community to publish preliminary data making methodologies explicit and comparing new data streams to historical data.

Mitigation strategy 5e – QC and QA

As part of the review data QC and QA procedures for internationally recognised programs such as Argo will be considered.

Other risks

A final risk, of gear depreciation was identified. As IMOS is designed to be ongoing there is a known gear depreciation issue with life spans of deep water gear being 10 years and coastal gear being less at 5 years. IMOS policy is that it won't fund depreciation, which is for the Operators to manage. IMOS will however fund capital cost, to rollover the asset base on an appropriate life cycle. This risk, however, requires additional consideration outside the scope of this facility proposal.

BUDGET

Detailed budget in 'Final IMOS EIF Project Plan' submitted to DIISR 26 February 2010