NSW DEPARTMENT OF **PRIMARY INDUSTRIES**

OFFSHORE ARTIFICIAL REEFS

MAJOR PROJECT DESCRIPTION REPORT

JUNE 2008

Project:
Offshore Artificial Reefs

Proponent:
NSW Department of Primary Industries (DPI)

Address:
202 Nicholson Parade
Cronulla NSW 2230

Contact:
Heath Folpp

Phone:
(02) 9527 8475

Fax: (02) 9527 8536

Email: heath.folpp@dpi.nsw.gov.au

Project Description

Nature of the activity

The New South Wales Department of Primary Industries (DPI) manages recreational fishing in ocean waters off NSW out to 200 nautical miles under the Fisheries Management Act 1994 (FM Act). A primary objective of the FM Act 1994 is "to conserve, develop and share the fishery resources of the State for the benefit of present and future generations". Further objects under the Act include promoting "ecologically sustainable development, including the conservation of biological diversity" and promoting "quality recreational fishing opportunities". DPI aims to improve recreational fishing opportunities in NSW through the development of Offshore Artificial Reef Structures (OARS).

Artificial reefs have been defined as "any material purposely placed in the marine environment to influence physical, biological, or socio-economic processes related to living marine organisms". Up to 40 countries around the world have constructed artificial reefs. Objectives for the deployment of artificial reefs include the enhancement of recreational and commercial fishing, coastal protection and mitigation of habitat loss and damage.

Purpose

In 2004, DPI began investigations into artificial reefs in coastal estuaries, progressing earlier work done by the Department in the 1970's. Using design specific concrete artificial reef units developed in the United States known as 'Reef Balls', a number of small artificial reefs were deployed in Lake Macquarie Botany Bay and St. Georges Basin between December 2005 and February 2007 (Figure 1). In each estuary, six individual artificial reefs were created with an associated long term monitoring program to evaluate the effectiveness of the reefs. Preliminary results indicate that the artificial habitat has been successful in maintaining an increase in fish abundance and diversity, accompanied by extensive marine plant growth on the surface of the Reef Balls units. The reefs have also been a success in terms of enhancing recreational fishing opportunities. Eight months after construction, catch abundance, catch diversity, and catch rates of recreational species on the artificial reefs were found to be as good as or better than control sites (naturally occurring reefs) within Lake Macquarie. This pilot estuarine artificial reefs project has provided the necessary monitoring and management experience required for the investigation of the potential implementation of large artificial reefs in NSW coastal waters.

Figure 1: A collection of individual concrete Reef Balls used to create the artificial reef in Lake Macquarie in December 2005 (image: DPI)

DPI is proposing to use artificial reef units made from steel, deployed in water depths between 25 m and 40 m to create offshore artificial reef structures (Figure 2). Four individual artificial reef units will create one artificial reef group (Figure 4). Therefore, three artificial reef groups (a total of twelve artificial reef units) are proposed to be constructed; one off Newcastle, one off Sydney and one off Wollongong (Figures 5, 6 & 7). Each artificial reef unit will be constructed on land, transported to the proposed site by barge and lowered onto the sea floor via crane. Each artificial reef unit would sit directly on the seabed and would not require additional anchorage other than the weight of the unit itself.

Primary objectives:

- undertake an environmental assessment of the proposed deployment of offshore artificial reef structures to examine biological, biophysical, economic, social and environmental impacts that may arise from their deployment;
- investigate statutory obligations for the deployment of artificial reefs in NSW coastal waters;
- investigate suitable and effective artificial reef designs for NSW coastal environmental conditions;
- deploy artificial reefs in 3 metropolitan zones in NSW, namely Newcastle, Sydney and Wollongong to enhance recreational fishing opportunities by providing additional fishing locations;
- implement a long-term scientific monitoring program to assess the effectiveness and impacts of the artificial reef structures over time.

Description and Scale

Artificial Reef Design

The material used in reef construction is a major consideration which will ultimately determine the success of the artificial structures. Key DPI staff visited South Korea and Japan in September 2007 to investigate artificial reef technology currently in use from two of the world's largest artificial reef manufactures and users. This 'best-practice' study was funded by the Fisheries Research and Development Corporation (FRDC) and allowed DPI to conduct inspections of a number of artificial reef designs and also participate in 'in-situ' artificial reef inspections. The visit to South Korea was hosted by Dr Chang Gil Kim from the Korean National Fisheries Research and Development Institute (NFRDI). Dr Kim has extensive experience in artificial reef design and management and was engaged by DPI in February 2008 to produce a report to aid with the selection of a suitable artificial reef design and configuration options for the NSW coast. It was recommended that from the target species identified and the oceanographic conditions experienced along the NSW coast that an octagonal two storied steel artificial reef unit would be most suitable (Figure 2).

The dimensions of the Octagonal two storied steel artificial reef unit are 11mx11mx13.6 m (Figure 3). The unit has an approximate internal volume of 826m^3 with a dry weight of 35.3 tonne. Structurally it is assembled with two shapes; rectangle and trapezoid-type octagon. The trapezoid-type octagon is attached to the rectangle for vertical relief. The rectangular section is fabricated from a variety of steel plates and beams. The internal steel plates provide surface area for organisms and a stimulus face against which current is locally modified to create complex current eddies and vortexes. DPI is currently waiting on advice on manufacture, transport and deployment options.

Figure 2: A completed octagonal two storied steel artificial reef unit manufactured on Cheju Island (South Korea) waiting for deployment in September 2007 (image: DPI).

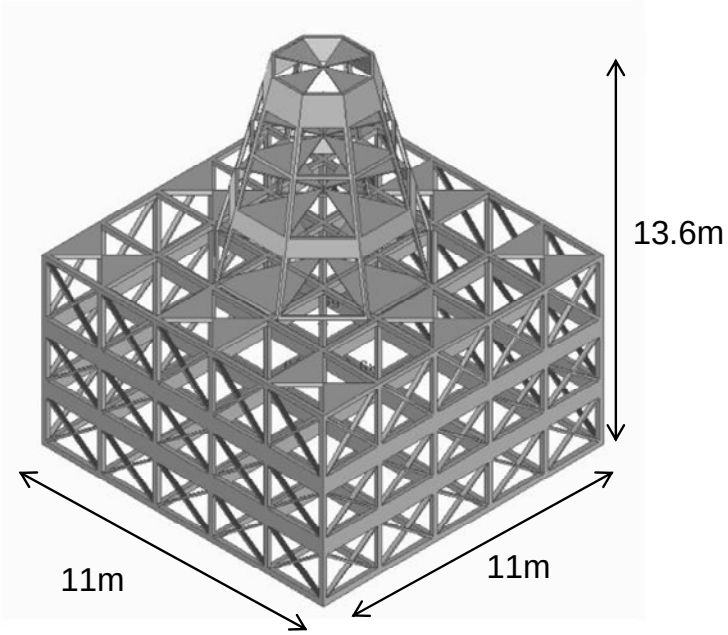

Figure 3: The dimensions of the octagonal two storied steel artificial reef unit are 11m x 11m x 13.6m, with an internal volume of approximately 826m^3 with a dry weight of approximately 35.3 tonne (Kim, 2008).

Artificial Reef Units and Group Configuration

Dr Kim's (NFRDI) report provided the basis for the selection of the steel multi-story artificial reef units and highlighted potential configuration options. This review found that the use of large steel multi-story artificial reef units would be most suitable for NSW coastal conditions and target species. The units themselves will be constructed from structural grade steel and have no potential pollution issue with regard to heavy metals, oils/grease, radioactive material or plastics. Four such units are proposed to be deployed off each of the three proposed locations; Newcastle, Sydney and Wollongong (12 in total). Pending the final configuration of the four units in each location, a total area of approximately 1200m^2 (0.12 hectares) is proposed to be required per reef group (based on four reef units spaced a minimum of 600m apart). However, the amount of actual bottom covered by the four reef units (reef group - known as the reef 'footprint') is 484m, which equates to approximately 0.03% of the total site. The exact configuration and spacing is yet to be finalised; an example of one potential configuration is shown in Figure 4. Final configurations for each location will be finalised as part of the Environmental Assessment (EA).

.

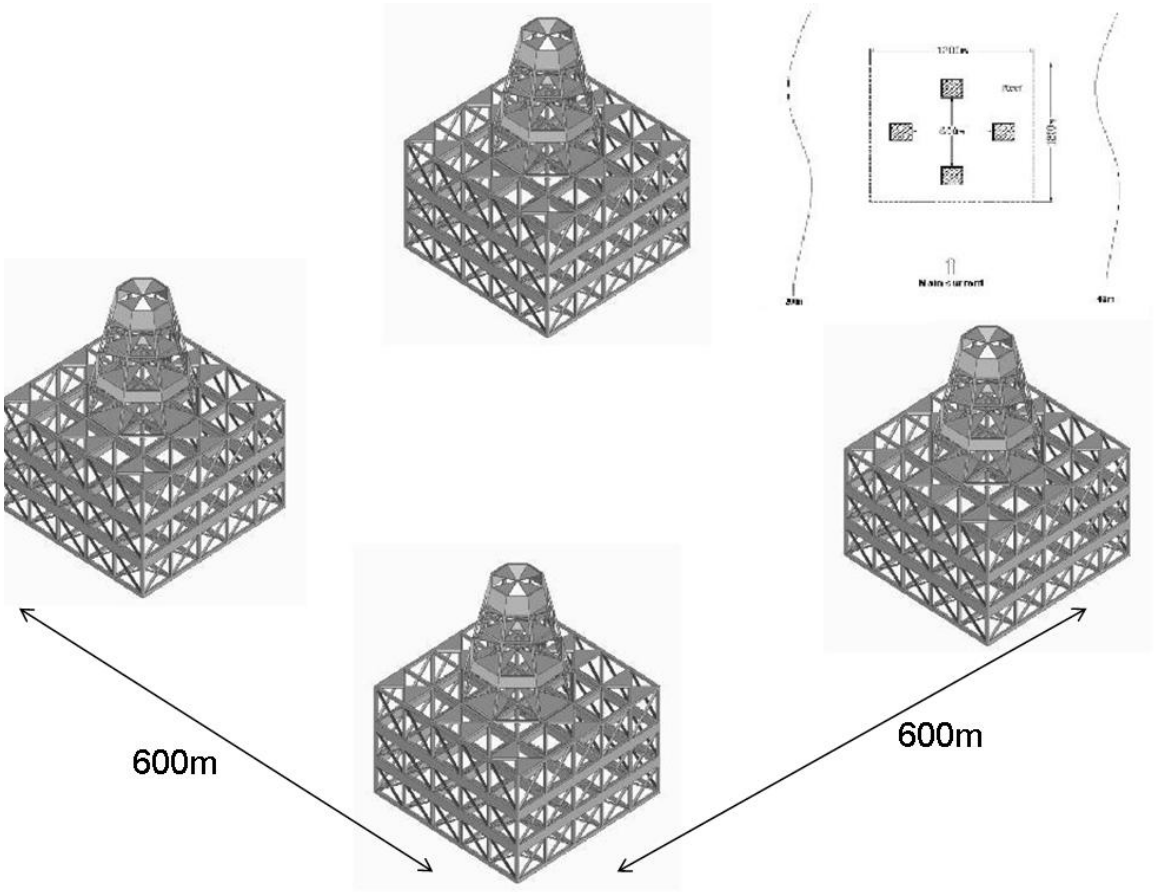

Figure 4: One possible configuration option would be the deployment of the four individual artificial reef units in an area of approximately 1200m², with a spacing of 600m between the units. Actual 'footprint' of the four units is approximately 484m (0.03% of the total area of the proposed site) (Kim, 2008).

Proposed Locations

Proposed sites – A Constraint Mapping report was commissioned by DPI and complied by The Ecology Lab Pty Ltd to highlight suitable sites for potential artificial reef deployment. However, these sites are still preliminary due to ongoing consultation with existing users groups, particularly commercial fishing operators. There is the potential for the exact coordinates of the sites to change on a relatively small scale pending the outcome of this ongoing consultation process. Detailed site inspections will be conducted to ensure the suitability of the seabed in the final proposed locations and to produce GPS coordinates for the location of the four individual artificial reef units proposed for each location (Newcastle, Sydney and Wollongong).

Newcastle Region

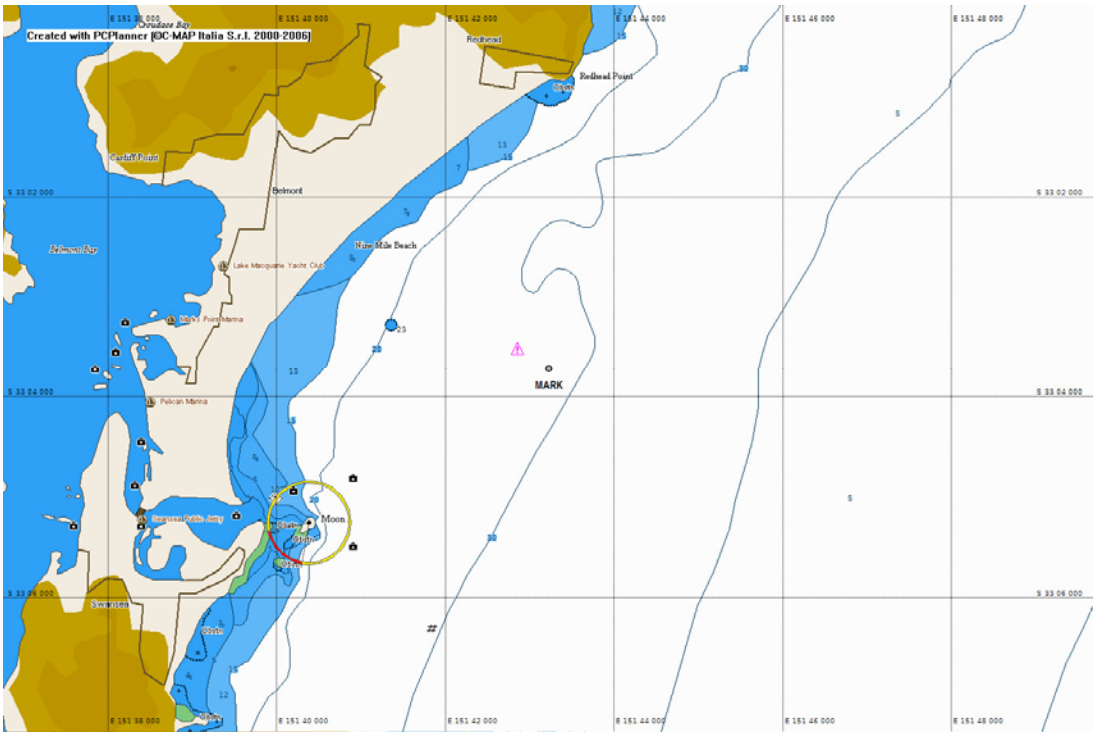

Figure 5: Proposed location for the Newcastle region offshore artificial reef denoted by 'MARK'. The coordinates are 33°03.706' S; 151°43.226' E (Datum: WGS84). *Note: this site still requires extensive ground-truthing by SCUBA and baited under water video (BUV); to be conducted as part of the detailed EA* - further consultation with commercial fishing operators is required.

Sydney Region

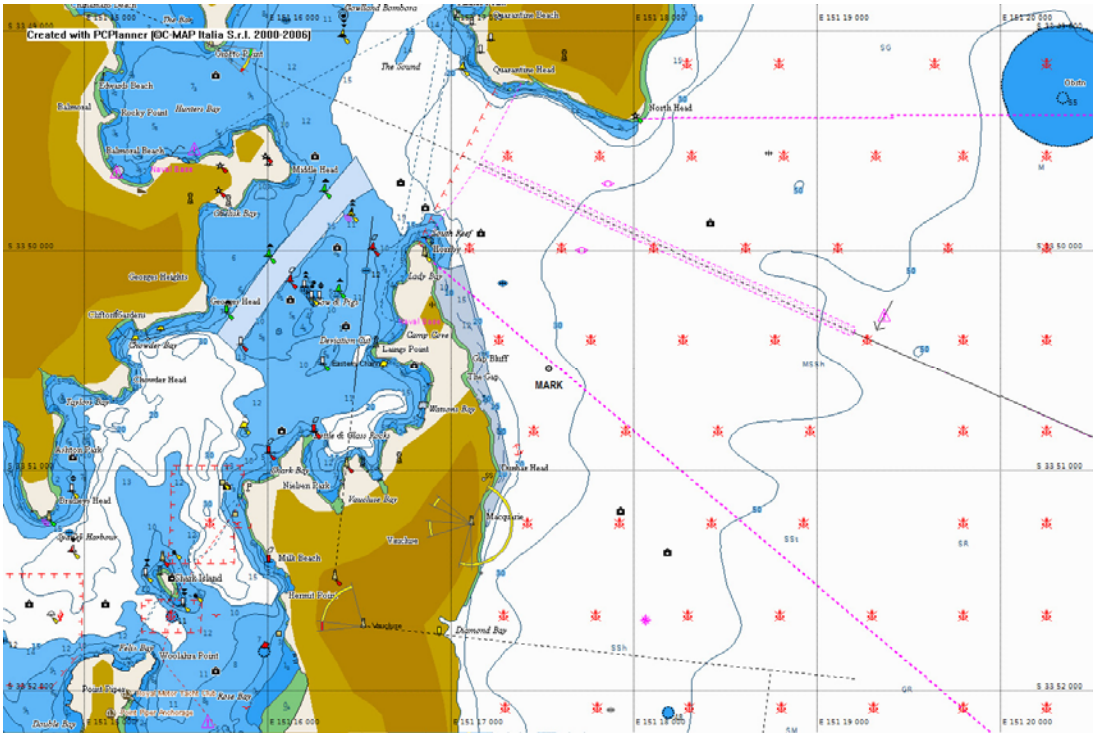

Figure 6: Proposed location for the Sydney region offshore artificial reef denoted by 'MARK'. The coordinates are 33°50.532' S; 151°17.535' E (Datum: WGS84). *Note: this site still requires extensive ground-truthing by SCUBA and baited under water video (BUV); to be conducted as part of the detailed EA* - further consultation with commercial fishing operators is required.

Wollongong Region

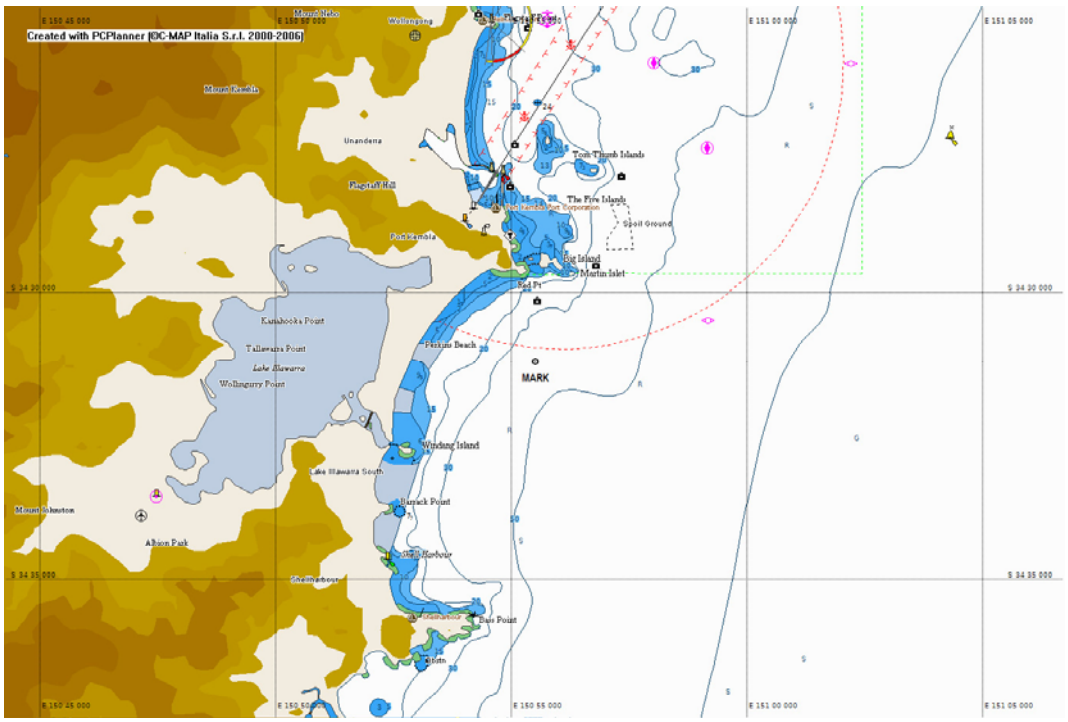

Figure 7: Proposed location for the Wollongong region offshore artificial reef denoted by 'MARK'. The coordinates are 34°31.200' S; 150°55.500' E (Datum: WGS84). *Note: this site still requires extensive ground-truthing by SCUBA and baited under water video (BUV); to be conducted as part of the detailed EA* - further consultation with commercial fishing operators is required.

Monitoring

Monitoring objectives

- Determine differences in the number, size and species composition of fish between artificial OARs and naturally occurring control reef locations.
- Relate differences in the variables measured (number, size and species composition of fish) to changes in physical variables such as temperature, current speed, direction, turbidity and salinity.
- Investigate how design factors i.e. height of reef and location of reef modules within the reef set affect number size and species composition.
- Assess the effectiveness of underwater video (UV) techniques for assessing fish populations associated with artificial reefs.
- Investigate the usefulness of ultrasonic telemetry as a methodology for determining patterns of behaviour of species recruiting to artificial reefs.
- Transfer knowledge regarding construction, deployment and monitoring of artificial reefs in other suitable locations.
- Utilise results to better understand how artificial reefs function ecologically and physically across spatial and temporal scales.

- Provide information to anglers regarding changes in the number of fish and type of fish that are attracted to artificial reefs and how these patterns vary between locations and time.

Methods

The project has been designed with the express purpose to examine the functional attributes of artificial reefs (size, configuration, position) as they relate to physical and biological factors in each deployment location. The scope of this project is limited to an assessment of the impact of artificial reefs on finfish populations and is not designed to assess impacts at the broader community level.

Before-After-Control-Impact (BACI) assessment designs will be employed to assess relative rates of recruitment and species composition between selected naturally occurring reefs and control locations over time. Techniques developed as part of the estuarine artificial reefs program will be adapted to provide a monitoring framework that would be suitable for structures deployed offshore. Improved underwater video (UV) technology combined with direct underwater visual census (UVC) of fish populations will be utilised to monitor fish populations around the offshore structures.

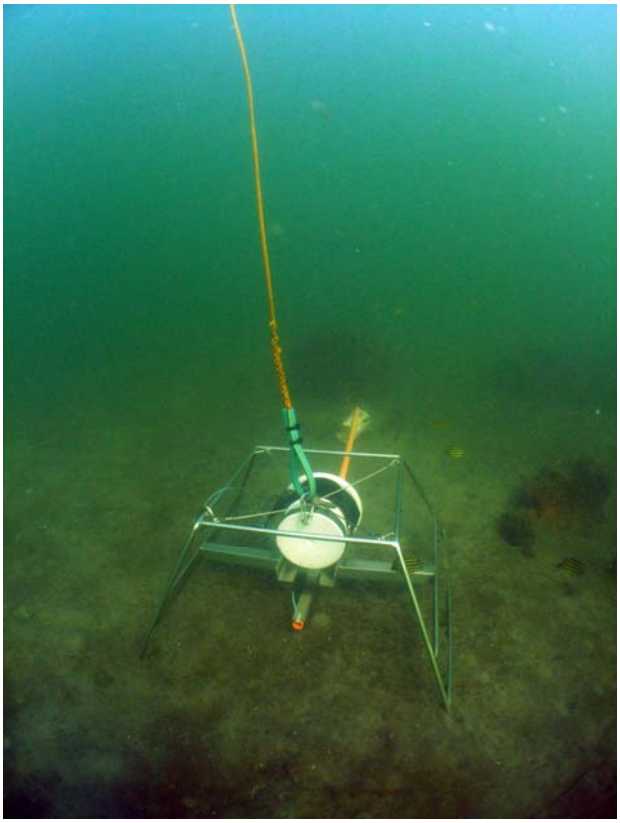

Figure 8: Baited Underwater Video (BUV) unit used during the pilot estuarine artificial reefs program (image: DPI).

Acoustic listening stations and tags will be deployed to better understand movements and residency times of fish inhabiting the reef. The monitoring program will also work in conjunction with Australian Acoustic Tagging and

Monitoring System (AATAMS) enabling the movement of fish tagged with acoustic tags to be tracked between the offshore artificial reef and AATAMS arrays. Monitoring techniques will include:

- The use of "flash memory" underwater video (UV) which can be deployed for several days to capture the low occurrence events that would be important for the assessment of offshore structures.
- Diver surveys (UVC) coordinated with the deployment of UV to provide a census of numbers of fish at each location and a means of validating the results of the UVC.
- Photographic surveys to record physical change on the sea floor (sedimentation and scouring) and growth of macroalgal species on artificial structures.
- Acoustic tagging technology in association with ATTAMS array to determine movement patterns of species associated with offshore artificial structures.
- Swath mapping (multibeam sonar) technology to detect localised changes in the seabed (scouring or deposition) as a result of OAR deployment.

Consultation and Major Planning Meetings

DPI has been involved in a number of artificial reef focus consultation meetings which have had participants from a range of interested Government Agencies and Departments and relevant stake holders including the NSW Dept. Planning (Planning); NSW Maritime Authority; Newcastle, Sydney and Port Kembla Port Corps.; NSW Dept. Environment and Climate Change (DECC); NSW Dept. Lands (Lands); the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) to determine:

- Statutory obligations under State and Commonwealth legislation
- Key areas of responsibility for Government Departments (State and Commonwealth) pertaining to the artificial reefs proposal
- Key areas of consideration (Planning Director-Generals Requirements – DGR's) for a detailed environmental assessment of the artificial reefs proposal

DPI has worked closely with Planning and DEWHA during this consultation process to consider all relevant State and Commonwealth legislation, relating to sea dumping, environmental planning controls, navigation, maritime heritage, coastal protection, fisheries management, conservation, ecologically sustainable development and climate change. Relevant State legislation includes the *Environmental Planning and Assessment Act 1979*; the *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1994* (FM Act) *Coastal Protection Act 1979* and the *Crowns Lands Act 1989*. Relevant

Commonwealth legislation includes the *Environmental Protection Act (Sea Dumping) 1981* (Sea Dumping Act), under which this permit is applied for; the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Historic Shipwrecks Act 1976*.

Planning meetings, aims and outcomes:

- September 2007 – Preliminary Planning Focus Meeting (PPFM)

Purpose: The PPFM was facilitated by Planning who administer the State *Environmental Planning and Assessment Act 1979* (EP&A Act). Approval for all major developments (including sub-surface artificial reefs) is required under this State legislation.

Key DPI staff involved in the development of the offshore artificial reefs proposal presented the preliminary aims of the project to representatives from a number of relevant Authorities and Department including the NSW Dept. Planning; NSW Maritime Authority; Newcastle, Sydney and Port Kembla Port Corps.; NSW Dept. Environment and Climate Change (DECC); NSW Dept. Lands (Lands); the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA).

Outcomes: It was established that the OARS proposal would require approval under the EP&A Act. Under this Act, developments considered as a major project are assessed under Part 3A (where the Minister for Planning's approval is required). As the proposed project was determined to be a Major Project under the Act, an environmental assessment (EA) is required to be undertaken prior to the establishment of the artificial reefs.

DPI was required to formalise the proposed sites by means of a Constraints Mapping (CM) exercise and produce a Preliminary Environmental Assessment (PEA) report for the setting of the formal 'Director-Generals Requirements - DGR's (environmental assessment guidelines) for the EA of the proposed project.

- January 2008 – Preliminary Environmental Assessment (PEA) working group

Purpose: The purpose of the meeting was to establish and rank the likely impacts of the proposed deployment of the OAR's (biological, ecological, physical and socio-economic).

Outcomes: An impact matrix was created that allowed all possible impacts to be categorised and ranked at a variety of scales to aid in the development of the PEA. When completed, this document was forwarded to all participating representatives for the PFM to aid in the formalising of the EA guidelines.

- March 2008 – Preliminary Focus Meeting (PFM)

Purpose: The PFM was facilitated by Planning and was attended by representees from the above mentioned Agencies and Departments who attended the first PPFM. The meeting allowed key DPI personnel to relay the findings of the CM and PEA to attendees so as the DGR's could be formally set by Planning.

Outcomes: DPI lodge *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral to determine if the artificial reefs proposal is a 'controlled action' (CA). In addition, DPI lodge a Sea Dumping permit Application to DEWHA under the *Environmental Protection Act (Sea Dumping) 1981* (Sea Dumping Act). This would allow DEWHA to determine Commonwealth requirements to be included in the environmental assessment guidelines for the artificial reefs proposal.