NSW ESTUARIES - UNDERSTANDING CONDITION AND INFLUENCING MANAGEMENT

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Introduction

Over recent years the management of NSW estuaries has moved towards trying to better understand estuary condition to support actions to improve or maintain ecosystem health. Estuaries tend to be highly variable and their condition often reflects catchment and waterway related activities and the way in which an estuary responds to these pressures. An understanding of estuary condition and its relationship to estuary and catchment activities can be used to focus natural resource management activities including policy and program development, investment, designing management actions and understanding the effects of management practices.

The NSW Monitoring Evaluation and Reporting (MER) Program has produced State of the Catchments (SoC) Reports that provide an initial regionally based and standardised assessment of estuary condition and pressures along the NSW coastline and a baseline against which the health of many NSW estuaries can be compared.

This paper provides an overview of how the SoC Reports were prepared, MER Program datasets and products and discusses their utilisation in a range of estuary management processes.

Background

The NSW Natural Resources Commission (NRC) has set 13 state wide targets for natural resource management. The targets set out what needs to be achieved to ensure healthy, functioning landscapes and communities into the future (NRC 2005). The State Plan (NSW Government 2006 and 2010) sets out clear targets for the NSW Government to deliver across all its areas of responsibility, the 13 natural resource targets are included.

The natural resource management target for estuaries and coastal lake ecosystems is: 'By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems'.

The NSW MER Strategy (Natural Resources and Environment CEO Cluster 2006) was prepared in response to the NRC standard and targets (NRC 2005). The purpose of the MER Strategy is to refocus the resources of natural resource and environment agencies to establish a system of MER for natural resource condition.

The MER Strategy specified that SoC reports be prepared to:
- provide a preliminary assessment of the condition of natural resources in each catchment
- inform investment decisions within and between CMA regions

- inform other natural resource managers' investment decisions in each region
- assess progress towards catchment targets.

The SoC reports are a collaborative effort between NSW Government agencies and Catchment Management Authorities (CMAs). Agency and CMA MER responsibilities were agreed in 2007. As part of agency responsibilities 13 Theme Teams were established. The Teams are responsible for programs to track progress on the State-wide targets and for leading the development of the SoC framework.

Whilst other Theme Teams are generating and collating data of relevance to the Estuaries Theme (for example, native vegetation, soils and groundwater) this paper will concentrate on the Estuary Theme Team's work in preparing Estuary SoC Reports and associated information and products.

State of the Catchments Reports

The SoC reports are based on the geographic boundaries of CMAs. For the Estuaries Theme there are four SoC reports covering five CMA regions; Northern Rivers, Hunter-Central Rivers, Hawkesbury-Nepean and Sydney Metropolitan combined, and Southern Rivers.

The reports are a first iteration to enable comparison of the condition of estuaries to each other as well as regionally and State-wide. The main human induced pressures acting on each estuary are detailed to provide insight into the possible causes driving condition. The reports have used a mix of existing and newly collected data to, where possible, compare the condition and pressures between estuaries, regions and across the State.

In designing the monitoring programs and preparing the SoC reports the Theme Team undertook review of available information, data collection and analysis, and report design. The process is detailed fully in Roper *et al.* (in prep.) and key aspects are briefly discussed below. Whilst the MER Program is primarily designed to report at a State and regional scale, the information, data and products generated will also provide a useful base set of information for local estuary managers.

Identification of NSW Estuaries

For the purpose of the MER Program, a waterway was identified as an estuary if it was shown as an area feature adjacent to the coastline in the Land and Property Management Authority (LPMA) 1:25 000 topographic map series. Waterways with a permanent or intermittent connection to the ocean were included.

For ports, bays and harbours, each tributary and the semi-enclosed waterway has been defined as a separate estuary. Nine ports, bays and harbours with inflowing tributaries were identified. For example, Port Jackson has been defined separately from the tributaries of Lane Cove River, Middle Harbour Creek, Parramatta River.

A total of 184 estuarine water bodies were identified. The names assigned to each were sourced from the Geographical Names Board.

Physical Extent and Characteristics of NSW Estuaries

A detailed report is available on the GIS operations used to generate the basic spatial characteristics of estuaries and coastal catchments (Turner 2009). In summary:

- the water surface boundaries were initially derived as described above;
- the downstream boundary defined as the line across the entrance mouth;
- upstream estuary boundaries defined as the tidal limits (DNR 2006);
- lateral boundaries of estuaries defined in ecological terms. Mangrove and saltmarsh mapping by Industry & Investment NSW (I&I) were reconciled and merged with the water surface layer to create consistent layers of water, seagrass, mangrove and saltmarsh. The combined area was defined as the estuary surface area.

NSW coastal catchments have been previously digitised from the 1:25 000 topographic map series for the Stressed Rivers Assessments (DLWC 1999). On-screen digitising was used to re-define and separate out individual estuary catchments down to the entrance. Errors detected in catchment boundaries away from the entrance were also corrected.

Digitising the extent of NSW estuarine catchments above and below the tidal limits has been completed to facilitate exploratory analysis of links between catchment land use and estuary health. These data and analyses will be available for the next SoC reports.

Contextual Data

Contextual data is often required to interpret condition and the pressures and threats acting to influence the condition. ANZECC (2000) refers to these as ecosystem-specific modifiers. For example, chlorophyll a modifiers may include hydraulic retention time, mixing regimes, light regime, turbidity, temperature, grazing rates and type of substrate.

An assessment of the contextual data required for interpretation and whether it was 'context critical' or 'context-useful', together with the condition and pressure datasets potentially available for the SoC reports, were collated. The listing is available in Roper *et al.* (in prep.).

Indicators of condition

The objective of the MER Strategy is to assess the condition of natural resources, as such the SoC Reports have concentrated on condition indicators, in preference to the drivers, stressors and pressures which influence condition. Condition indicators were proposed by the NRC, based on advice from an Independent Scientific Expert Working Group (ISEWG 2005). Minor modifications were made through a series of pilot studies in collaboration with government agencies.

The selected condition indicators focused on estuarine biology as the monitoring endpoints. A mix of indicator groups was adopted representing elements of the structure, function and composition of estuarine ecosystems and included:

- eutrophication indicators:
    - microalgal abundance, measured as phytoplankton chlorophyll a
    - macroalgal abundance
    - water clarity as turbidity

- habitat availability indicators:
    - extent of seagrass
    - extent of mangroves
    - extent of saltmarsh
- fish assemblage indicators:
    - species diversity and composition
    - species abundance
    - nursery function
    - trophic integrity.

With the exception of macroalgal abundance, assessment of each of the above indicators has been included within the SoC reports where suitable data has been available. Development of a suitable methodology for determining macroalgal abundance is ongoing.

Determining condition

Essentially good condition is considered to approximate reference condition, such that the various ecosystem components (biological, physical and chemical) operate effectively to maintain a functioning ecosystem within the limits of natural variability. The magnitude of departure from reference condition then indicates the level of degradation or impairment of condition.

The methods used in gathering data, quality assurance, analysis and scoring for the condition indicators are detailed in Roper *et al.* (in prep.). The following provides a brief summary.

Eutrophication Indicators

Water quality data was sought from a wide a range of potential custodians including Sydney Water, Local Government and Universities. Quality control steps were undertaken for each dataset provided. The remaining data were stored in the KEVIN (Keeping Estuarine Values Integrated for NSW) and a series of Excel spreadsheets maintained by the Department of Environment, Climate Change and Water (DECCW). A more permanent database solution is being developed into which the KEVIN data will be migrated.

Relevant data for the condition indicators of eutrophication (chlorophyll a and turbidity) were extracted from the database and used with data collected as part of the MER Program (see Scanes *et al.* 2009).

A classification scheme was developed to determine reference conditions, as existing classification schemes do not classify estuaries by their response to stressors (see Hale and Butcher, 2008 and Barton *et al.* 2007). The primary objective was to group estuaries by their response to nutrients.

Abiotic drivers (flushing time and dilution factor) were identified and incorporated into the classification scheme. A number of conceptual models of estuary type were developed and biological responses as measured by chlorophyll a were used to validate the classification.

After reviewing a number of methods, trigger values for each estuary type were based on the 80th percentile of reference condition, consistent with ANZECC (2000).

Reference systems were determined by a measurement of disturbance based on the ratio of increase in total nitrogen (TN) loading in recognition that estuaries are generally nitrogen limited (Ryther and Dunstan 1971). Currently, the number of reference systems for which data are available is limited, meaning that the triggers are still State-wide within each estuary class. As further data become available, triggers may be able to be developed for regions.

Scoring of condition was based on deviation from reference condition. As ecological trigger points are unknown five condition classes (very good to very poor) were determined based on data distribution.

Habitat Availability Indicators

Where seagrass, mangroves and saltmarsh were present in mapping carried out by I&I over the last five years, spatial extent was compared with that of a survey carried out over 30 years ago (West *et al*. 1985). For a number of estuaries mapping was available at more frequent intervals, covering a greater time period (for example, West and Williams 2008, Williams and Meehan 2004).

For seagrass and saltmarsh extent the scale of change was based on five classes from very poor to very good. Where the change in mangrove extent was between -10% and +10%, a score of good was assigned, where change outside this range was identified, further analysis is required.

Fish Assemblage Indicators

I&I has compiled information from relevant fish biodiversity studies carried out since the late 1970s into an MS Access database known as the Estuarine Fish Ecology Database (EFED). The Estuarine Fish Community Index (EFCI) is a multi-metric index that combines four broad fish community attributes: species diversity and composition, species abundance, nursery function and trophic integrity into a single measure of estuarine condition. The index was developed for application to South African fish communities (Harrison and Whitfield 2004, Harrison and Whitfield 2006) and was trialed for NSW estuaries in the SoC reports.

The EFCI for NSW uses the best values observed for each metric for a particular estuary type in a particular region to define the reference conditions. Reference conditions were determined for five different estuarine geomorphic types. The extent of deviation from reference was used to assign thresholds for scoring each estuary. The overall index is calculated by summing all the individual metric scores, the index is then scored into five classes (very good to very poor).

Indicators of Pressure

Potential pressure indicators were sourced from a review of relevant literature including work of the Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management (for example, Scheltinga *et al.* 2004). A number of Catchment Action Plans also provided information on regional pressures.

Criteria relevant to the selection of pressure data feasible to collect included:

- data availability along all the NSW coastline

- time required to collate available data
- ability to gap-fill pressures using empirical relationships
- if no monitored data available, ability to model pressure
- strength of known link to resource condition in the literature
- readily available reference condition.

The indicators used in the first SoC reports are provided in Table 1, with a short rationale and a brief description of the method of assessment. A detailed description is provided in Roper *et al*. (in prep.).

Using the selected indicators, a correlation analysis was generated to assess whether metrics were too closely related to act as single metrics. As might be expected total suspended solids (TSS), TN and total phosphorus (TP) were highly correlated and are potentially redundant (Morris *et al.* 2007). TN was chosen to represent nutrient input but TSS has been retained for the purposes of this initial assessment. Further investigation will be undertaken on methods for defining and separating pressures.

Climate change

For coastal ecosystems such as estuaries, sea level rise; changes in water temperature; alteration to freshwater inflows and subsequent delivery of nutrients and sediments; changes to circulation patterns, water quality and salinity regimes may result in fundamental shifts in ecosystem structure and functioning. The major physical and ecosystem impacts of climate change have generally not been quantified at a regional scale. Climate change impacts have therefore not been included in the current SoC reports, some of this data may be available for the next round of reporting.

Table 1: Pressure indicators used in Estuary State of the Catchments reports.

Pressure indicator	Rationale	Method of assessment
Cleared land	Major pressure in many coastal catchments, known to result in increased inputs of eroded sediments, nutrients and organic material.	Land use mapped to 128 classes (as per Australian Land Use and Management scheme). Aggregated to 21 categories for hydrological modelling. Further aggregation into 9 classes for nutrient and sediment export modeling. Data for land uses excluding forest summed for estimate of the total area of disturbed land within each estuary catchment. Normalised by catchment area.
Population density	General measure of pressure, effects include increased pollution loads in stormwater, sewerage overflows, disturbance of riparian and foreshore vegetation, litter and general degradation of the environment	Census data for 1996, 2001 and 2006 (Australian Bureau of Statistics) used. Non-populated areas (National Parks and State Forests) removed from each Census Collection District, where a CCD intersected with a catchment boundary, population proportioned accordingly. The 2006 population normalised by catchment area. Population shift to coastal catchments is evident, population across NSW living in coastal catchments increased from 80.6% to 82.1% over 10 years.
Freshwater flow	Affects salinity levels, flushing time, aquatic plant distributions, migration and spawning of aquatic animals, frequency of estuary mouth openings and fish catches. Modified by catchment clearing and extraction of water.	Change in freshwater inflows from catchment clearing - the 2CSalt model was applied to 184 estuary catchments (Littleboy *et al.* 2009). Indicator adopted was the percentage increase in mean annual flow above pre-European settlement. Quantity of licensed water extraction - data on annual entitlements for streams from Licence Access System database (NSW Office of Water). The annual entitlements summed and normalised by mean annual flows.
Sediment and nutrient input	Sediment inputs are generated by soil erosion, riverbank and shoreline erosion. Coarse sediment settles out along river beds, floodplains and at tributary mouths, finer suspended sediment fills bays and central basins and reduces water clarity. A second source of sediment input is point source discharges from sewage treatment plants. Nutrient inputs are associated with catchment disturbance, fertiliser application, effluent discharges and urban stormwater. Can lead to increased growth of algae and loss of submerged vegetation leading to changes in habitats and the structure and function of estuarine food webs.	Flows from the 2CSalt hydrology models combined with the event mean concentrations of TSS, TN and TP (derived from literature or past DECCW monitoring projects) and summed with sewage discharge loads (licensed by DECCW and details stored on the Integrated Statutory Environmental Management System database) to estimate the percentage increase exported on an annual basis for current land use compared to an undisturbed catchment condition.

Pressure indicator	Rationale	Method of assessment
Disturbed habitat	Disturbed habitat can arise from removal of foreshore vegetation, placement of foreshore structures, aquaculture leases, barriers such as weirs, presence of the invasive *Caulerpa taxifolia* and trawling. These activities have a range of impacts on the foreshore, inter-tidal zones and estuary bed that can change the structure and condition of aquatic habitats.	Data on the presence of foreshore structures and aquaculture leases used. When available, riparian vegetation presence/absence will also be used.
Tidal flow	Both, breakwaters or training walls built to keep estuary entrances open and the artificial opening of lagoon entrances for purposes such as flood mitigation, result in an increase in salinity levels, tidal ranges and flushing which can alter water quality and the distribution and composition of aquatic vegetation and animal species. Entrance training can also increase the erosion of inlet channels altering sediment processes and feeding back into even larger tidal ranges. Artificial opening at levels below natural can also lower frequency of inundation of fringing vegetation such as saltmarsh.	Presence of one or more breakwaters or training walls at the entrance of permanently open estuaries determined through aerial photographic interpretation. For the level at which intermittently open estuaries were manually opened Councils and DECCW regional offices were contacted for existing records and/or personal knowledge.
Fishing	Fishing by recreational and commercial fishers removes finfish and shellfish from the estuarine ecosystem. Disturbance of habitats by boats, gear and people can also be associated with these activities.	Data on recreational fishing catches are available for very few estuaries. Annual commercial finfish and shellfish catch data are available from I&I for all estuaries open to the commercial fishing industry. As such, commercial catch data were utilized.

Indices of Estuary Condition and Pressure

The initial approach adopted has been to combine the condition indicators into a condition index and the pressure and stressor indicators into a pressure index with certain rules applied to both. The rules applied are outlined in Roper *et al.* (in prep.).

The SoC reports provide the condition index scores which were calculated for 100 of the 184 estuaries and the pressure index scores which were calculated for all 184 estuaries.

Overall NSW estuaries were assessed as shown in Table 2.

Table 2: Overall condition and pressure assessments for NSW estuaries.

Condition class	NSW Estuaries %	Pressure class	NSW Estuaries %
Very good	15	Very low	26
Good	21	Low	26
Fair	12	Moderate	42
Poor	5	High	6
Very poor	2	Very high	0
No data	46		

MER Program Information and Products

A number of products and datasets generated by the Estuary Theme Team are available to use in estuary management, these are discussed further below. This information is suitable for use in a number of estuary management processes.

Data Availability

Forty two datasets were collated or assembled during preparation of the Estuary SoC reports. Spatial datasets are held within corporate GIS systems maintained by DECCW and I&I. Geo-referenced data such as water quality, fish data and pressure data are held in a mix of corporate and local non-corporate formats including Access databases and Excel. Of the 42 datasets listed, 21 are in corporately supported systems, the other 21 are managed at a local level. Each agency is responsible for managing data in accordance with the MER Data Access and Management Framework and bringing all datasets up to that standard.

A central element of the Framework is metadata which is in the process of being prepared for all datasets. Those that are not already publicly available will be made available through the NSW Spatial Data Catalogue managed by the LPMA on behalf of the NSW Government.

A State of the Catchments website has been developed by DECCW for access to SoC reporting. The site will allow users to display and compare condition and pressure assessments. This will be available through the DECCW website and will be launched following publication of SoC reports.

Mapping of seagrass, mangroves and saltmarsh extent is available at (www.industry.nsw.gov.au).

Physical characteristics including catchment area, estuary area, estuary volume, average depth and entrance condition were determined for all 184 estuaries. This information will form a basic set of information that will be available through (www.environment.nsw.gov.au), replacing the former 'Estuaries of NSW' website. Other information collected by DECCW such as hydrographic surveys, tidal prism measurements and tidal surveys will also be available.

Water quality data assembled in the KEVIN database, catchment land use and generation rates for surface flow, TN, TP and TSS are available with CERAT (Coastal Eutrophication Risk Assessment Tool, DECCW 2009a). CERAT is discussed further below.

Coastal Eutrophication Risk Assessment Tool

The Coastal Eutrophication Risk Assessment Tool (CERAT) released by DECCW (2009a) allows decision makers to assess the potential ecological impacts of their planning decisions and to prioritise estuaries that are at risk of degradation (eutrophication) from land use activities. CERAT enables changes in catchment land use to be explicitly assessed in terms of effects on the condition of estuaries. CERAT has been distributed as part of DECCW's Ecosystem Health Assessment Tools Package (DECCW, 2009b). The tool and supporting information is available from DECCW. The CERAT model is also to be made more widely available through the OzCoasts website managed by Geosciences Australia (www.ozcoasts.org.au).

Conceptual Models

A set of conceptual models that provide an overview of different estuary types, habitats within estuaries and the disturbances and pressures on aquatic ecosystems has been prepared by DECCW (Claus and Imgraben, 2009) and has been distributed as part of DECCW's Ecosystem Health Assessment Tools Package (DECCW, 2009b). NSW is contributing to the development of a national set of conceptual models through the National Estuaries Network convened by GeoSciences Australia, these will potentially build on from the conceptual models currently available through OzCoasts and those of Claus and Imgraben (2009).

Data Collection

The monitoring programs initiated as part of the MER Program are ongoing to inform future SoC reports on a three yearly cycle. DECCW is continuing to monitor chlorophyll a and turbidity (and a number of other water quality parameters). The frequency and location of monitoring as well as monitoring protocols are available (Scanes *et al.* 2009).

Analysis of historic time series data for macrophytes is currently available for a small number of estuaries and any future mapping of historic trends in other estuaries will provide a better understanding of the variations of estuarine macrophytes within the individual estuaries. Mapping undertaken over the next three years will be dependent upon resourcing.

Further, ongoing research is being carried out by I&I on 'Fishery Independent' ways of measuring the abundance of estuarine fish (for example, Rotherham *et al.* 2007) as they may be used just as effectively for fish biodiversity assessments as more traditional assessments of harvestable fish stocks.

Informing decision making

State of Environment Reporting

The NSW government is required to report on the status, condition and trends in major environmental resources every three years through the NSW State of the Environment (SoE) report. Local Government also has obligations in terms of SoE reporting.

Information generated through the MER Program has been incorporated into New South Wales State of the Environment 2009 (DECCW 2009c). There is currently no formal link between Local Government SoE and the MER Program, however, discussions have been initiated with Department of Local Government and Local Government and Shires Association regarding linkages between the two.

Regional Natural Resource Management

Decision making processes of CMAs draw on information from multiple sources. Specifically, CMA MER processes are concerned with collecting, recording, analysing and using information to adaptively manage investment strategies and ensure that progress towards catchment targets is being achieved (DECCW 2009d). For most CMA evaluations multiple lines and levels of evidence is required.

Information from the MER Program can contribute to CMA decision making in a number of ways. Types of NRM decision made by CMAs, the relationship with MER Program information and its availability are outlined in Table 3. MER information, data and communication requirements of CMAs have been detailed more fully in Hyder Consulting (2009).

Coastal zone and estuary management plans

The draft Guidelines for the Preparation of Coastal Zone Management Plans (DECCW 2010) specify minimum requirements to be met when coastal zone management plans that address managing risks to estuary health are prepared by Councils. The MER Program can inform or support a number of these, as outlined in Table 4.

MER Program information may also assist Councils responsible for managing a number of estuaries in prioritising their planning or implementation processes. For example, it is generally more effective to conserve or maintain the good condition of estuaries than to restore those from a poor condition. Estuaries in good condition but vulnerable to degradation by virtue of their type (for example, lagoons) would be a priority. The SoC reports can support this process through the condition assessments provided.

Table 3: Broad CMA decision making and MER Program information and data requirements (based on Hyder 2009).

Types of NRM decision	MER information required	Availability
NRM priority setting (CMA level)	- Baseline data on NRM condition - Trends and rates of change - Major pressures and their type and level of impact - Condition thresholds - Conceptual models	- Yes (& further work being undertaken) - Further work required - Yes (& further work being undertaken) - Further work required - Yes
Developing catchment & management targets	- As above - Expected condition change from on-ground actions	- As above - Further work required (see MER Strategy 2010 – 2015*)
Areas/locations to target investment and amount of investment	- Resource condition (including identification of high conservation areas - Condition thresholds	- Yes (& further work being undertaken) - Further work required
Condition and performance monitoring and evaluation (at a range of scales – CAPS, programs, projects)	- Condition and performance indicators - Monitoring protocols and guidelines for condition and performance monitoring - Conceptual models	- Yes (& further work being undertaken - see MER Strategy 2010 – 2015*) - Yes (& further work being undertaken - see MER Strategy 2010 – 2015*) - Yes

* NSW MER Strategy 2010 – 2015, discussed further below.

Table 4: Coastal Zone Management Planning requirements (draft, DECCW 2010) and relevant MER Program support.

Coastal Zone Management Planning requirements (draft)	MER Program support
Identify the status of the estuary's health	- Baseline data on condition indicators available for many estuaries. - Guidance on relevant indicators and their application in determining condition. - Trigger values for estuary type available for use in estuary health assessments and reporting. - Guidance on relevant contextual data for interpretation of condition indicators.
Identify threats and risks to estuary health	- Identification and quantification of key pressures. - Guidance on relevant indicators and their application in determining pressures and stressors. - Conceptual models. - CERAT model. - Ongoing assessment of relationship between pressure and condition.
Develop an estuary health monitoring program, consistent with the NSW MER Strategy	- Protocols and guidance available (see section below on Estuary Health Monitoring). - Trigger values for comparison and reporting purposes.

Conversely, where estuaries are identified for rehabilitation activities that provide for the restoration of ecological functions in estuarine ecosystems, removing or managing the key pressure or stressor should be the precursor to rehabilitation activities. The SoC reports provide an overview of key pressures acting across the State. The CERAT model can also be used to identify those estuaries most at risk from eutrophication across a local government area.

Estuary Health Monitoring

Whilst monitoring carried out for the MER Program is designed to inform State-wide assessments, local estuary managers are encouraged to include the MER indicators and protocols as the basis for monitoring programs, to ensure a consistent estuarine monitoring framework within NSW. Whilst the condition indicators are applicable at a number of scales, it is recognised at the local scale, managers may need to add indicators relevant to local issues and/or to increase the spatial and temporal frequency of sampling. When monitoring is at a fine enough scale, comparisons are feasible between tributaries or specific sites within an estuary.

Ecosystem health assessment remains a funding priority for the NSW Estuary Management Program in 2011-2012, so Councils may seek financial support in undertaking localised assessments. Support in undertaking ecosystem health monitoring programs may also be available through CMAs (for example, Northern Rivers CMA's Ecohealth Program).

NSW Monitoring, Evaluation and Reporting Strategy 2010-2015

The NSW MER Strategy 2010-2015 (Natural Resource and Environment CEO Cluster, 2010) will guide the MER of natural resources in NSW over the next five years. The Strategy builds on the achievements and experience gained in implementing the NSW MER Strategy (2006).

The NSW MER Strategy 2010-2015 retains the condition monitoring arrangements in the original strategy, and introduces a more comprehensive performance monitoring component to report on the management actions taken across the State.

The Strategy places greater emphasis on communication including increased collaboration with MER partners, consultation with stakeholders, involvement of other agencies and NRM investors and dissemination of information to the wider community. A MER Communication and Engagement Framework will identify the methods and forums for engaging with stakeholders and opportunities for involvement. However, there is also the need for specific communication initiatives at a Theme level as part of their implementation plans (see below).

Comprehensive details on implementation actions, indicators and methods of measurement will be outlined in the MER Implementation Plan. The Plan is a version-controlled document rather than a static plan. To underpin the MER Implementation Plan, an inter-agency data agreement and related schedules will be brokered that will commit each MER partner to acquiring, managing and sharing MER data.

Ongoing Communication

Following a review of communication needs across the 13 MER Themes (Hyder Consulting 2009) a scoping exercise was undertaken for the Marine and Estuarine Themes (Newton, 2010). Based on feedback from CMAs and Councils it aimed to determine the most appropriate and effective tools for communicating Marine and Estuarine MER data and information to coastal CMAs and Councils, and potentially through these agencies to other stakeholder groups in NSW. The exercise has just been completed and will feed into the ongoing activities of the Theme Teams.

Conclusions

The NSW MER Program and SoC Reports provide the first assessment of the condition of NSW estuaries and the key pressures acting upon them. Along with the SoC reports a range of datasets and products have become available that can be used by estuary managers to inform a range of decision making processes.

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