



Australian Government

**National Land & Water Resources Audit**

*An initiative of the Australian Government*

# ESTUARINE, COASTAL AND MARINE HABITAT INTEGRITY

INDICATOR HEADING

## **Estuarine, coastal and marine habitat condition**

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INDICATOR GUIDELINE

### **Sedimentation/erosion rates**

#### **Recommended by the Audit for further consideration**

This version of the guideline has been developed through the National Land and Water Resources Audit and was informed by expert review and broad consultation on national indicators via national coordination committees and their associates. Version 1 – June 2008 does not yet have the final endorsement of any jurisdiction. The document is for guidance only and is presented to provide a basis for on-going discussion. It may require further consideration by a jurisdictional based reference group before national endorsement.

Sedimentation/erosion rates

# Status of indicator agreement

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The National Land & Water Resources Audit (the Audit) coordinates the collation of data to support reporting on natural resource condition required under the National NRM Monitoring and Evaluation Framework (National M&E Framework).

The National M&E Framework identifies three requirements for monitoring natural resource condition:

- a set of resource condition indicators to measure progress toward the agreed national outcomes on a medium and long term basis
- a set of indicators for monitoring community and social processes relevant to or affected by NRM programs, as well as measures of the adoption of sustainable development and production techniques
- contextual data pertinent to the indicator being considered.

The Audit Advisory Council has agreed to a process for achieving a practical set of indicators under the National Monitoring and Evaluation Framework.

This process is to:

- obtain on-going **recommendations** from the relevant **National Coordination Committees** for each thematic area (including “Matters for Target”) on appropriate indicators, protocols and information needs
- seek **endorsement** from the **Audit Advisory Council** that the indicators and protocols can be implemented at the national, state / territory and regional levels
- seek **agreement** from the Natural Resource Policies and Programs Committee (**NRPPC**) (or the Marine and Coastal Committee –**MACC**- for Estuarine, Coastal and Marine) that the indicators will be used and promoted by jurisdictions to underpin evaluations of NRM initiatives.

The NRPPC and MACC report to the Natural Resource Management Ministerial Council (NRMMC).

# Introduction

This suite of “indicator guidelines” is relevant to the Estuarine, Coastal and Marine Habitat Integrity Matter for Target.

Two indicator headings are identified:

1. Estuarine, coastal and marine habitat extent and distribution
2. Estuarine, coastal and marine habitat condition.

Initially, 31 potential indicators were developed to measure the effect of the stressors on ecosystem condition (physical/chemical and biological) and habitat extent (Scheltinga et al., 2004). These indicators were reviewed at a national workshop (Souter and McKenzie, 2006) and further refined to 19 nationally agreed indicators (Table 1).

Drawing on a series of state/territory trials and national consultations; the documentation for the indicators has been modified from a “protocol” format that sought to define both measurement standards and reporting (information) products to one that presents “guidelines” for the collection and storage of monitoring data.

These “indicator guidelines” should be used as standards for the collection, collation and storage of data in order to assist NRM service providers and community groups make observations that can potentially be pooled and re-used at a later date.

Ten ECM indicators were prioritised and guidelines have been developed through extensive consultation and reviewed by key experts in the field.

Table 1. Nationally agreed ECM Resource Condition Indicators. Indicators prioritised for documentation and included in this document are shown with an asterisk.

Indicator heading	Indicator
<b>Estuarine, coastal and marine habitat extent and distribution</b>	<ol style="list-style-type: none"> <li>1. Extent and distribution of key habitat types*</li> </ol>
<b>Estuarine, coastal and marine habitat condition</b>	<p>Biological condition</p> <ol style="list-style-type: none"> <li>2. Algal blooms</li> <li>3. Animal or plant species abundance*</li> <li>4. Chlorophyll a*</li> <li>5. Coral bleaching</li> <li>6. Mass mortality events</li> <li>7. Pest species (number, density, distribution)*</li> <li>8. Targeted pathogen counts</li> <li>9. Vertebrates impacted by human activities</li> </ol> <p>Physical/chemical condition</p> <ol style="list-style-type: none"> <li>10. Dissolved oxygen*</li> <li>11. Nutrients*</li> <li>12. pH</li> <li>13. Presence / extent of litter (marine debris)*</li> <li>14. Salinity (EC)</li> <li>15. Sedimentation/erosion rates*</li> <li>16. Shoreline position</li> <li>17. Temperature</li> <li>18. Toxicants (in water / sediments / biota)*</li> <li>19. Turbidity / water clarity*</li> </ol>

# Sedimentation/Erosion rates

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## Matter for target:

Estuarine, coastal and marine habitat integrity

## Indicator heading:

Estuarine, coastal and marine habitat condition

## Indicator name:

Sedimentation/erosion rates

This document presents the recommended monitoring guidelines for collecting, collating and reporting information on sedimentation/erosion rates for national, state/territory and regional application.

## 1. Definition

This indicator reports on the sedimentation or erosion rates within an estuarine, coastal or marine system.

AIM : To determine the rates of sedimentation or erosion occurring in estuarine, coastal or marine systems.

## 2. Rationale

Sedimentation is the process by which material is deposited from the water column to the bed. Conversely, erosion occurs when material is removed. The sedimentation/erosion rate in waterways is naturally variable because of the variability in natural processes influencing it such as water-current/flow patterns, climate (rainfall, seasonality), geology, slope (or topography), etc.. Human activity (eg dredging, impoundments, hydrodynamic alterations, land clearing, etc.) may also result in changes to sedimentation/erosion rates.

Increased sedimentation/erosion rates can result in important changes to the form and function of waterways. For example, they may cause changed shoreline and mudflats area, channel infilling, habitat/benthic community smothering or removal, community composition changes, increased turbidity levels, and the burial or resuspension of nutrients, trace elements, toxicants and organic matter.

[BT]“The net result of enhanced sedimentation rates are an increase in the maturity of coastal waterways, and a decrease in their overall lifespans. Reductions in the biodiversity, health and integrity of coastal ecosystems may also occur. In order to make better-informed management decisions there is clearly a need to accurately assess the rate and nature of sedimentation within coastal waterways and any changes in other sedimentological parameters over time.” (OzCoast and OzEstuaries, [http://www.ozcoasts.org.au/indicators/sediment\\_rates.jsp](http://www.ozcoasts.org.au/indicators/sediment_rates.jsp)).

Sedimentation in marine waters is related to proximity to rivers and the degree of impact by river flood plumes as well as wind-driven resuspension events in shallow waters.

Information on sedimentation and erosion can be found at the OzCoast and OzEstuaries

website (<http://www.ozcoasts.org.au/indicators/index.jsp>).

### **3. Monitoring methodology**

The exact details of the monitoring method used will depend on the region and particular aspects of the study. Whenever possible, the methods used should be consistent with these guidelines to allow for comparison between regions. However, expert local advice should be obtained to ensure that the monitoring of this indicator is conducted at an appropriate spatial and temporal scale to allow the resulting data to be statistically assessed so that demonstrated changes are verifiable.

#### **3.1 Monitoring locations**

In general, the monitoring of this indicator will occur in estuarine and coastal areas where human-induced changes to sedimentation/erosion rates are thought to be having detrimental effects. Control sites should also be monitored.

Within an estuary or coastal/marine zone there will be natural areas of deposition (slow water velocities) or erosion (high water velocities). These are the areas to monitor for any change to the natural rates of sedimentation or erosion. Sites should be representative of the habitat being monitored, use control points or reference points, and sample a sufficient number to account for natural variability.

#### **3.2 Monitoring frequency required**

Annual monitoring is sufficient for most studies and should preferably occur after the wet season.. However, more frequent monitoring may be needed, depending on the study and the management actions and NRM issues being monitored (for example, monitoring at a time and frequency chosen to provide information that can be used to influence action such as after a land disturbance or a significant disturbance of other areas of an estuary).

#### **3.3 Data measurement method**

Both sedimentation and erosion rates are measured in terms of vertical change in sediment surface (ie accumulation or loss) over time. Sedimentation rate may also be measured in terms of sediment mass accumulation (ie density per unit area over time). This is more accurate in systems where compaction or change in sediment composition is important.

There are several methods for examining rates of sedimentation or erosion.

- A commonly used method to determine sedimentation/erosion rates is to install rods in the sea bed to measure depth changes due to sediment accumulation/loss. The South Australian Coastal Protection Board has over 30 years of data from beaches and their immediate subtidal areas.
- Large changes in sedimentation/erosion rates occurring over longer time periods can be measured from the differences observed in bathymetric maps from different time periods). This method cannot estimate 'recent' sedimentation rates.
- Changes in particle size distribution. Change from large to smaller particles (ie silt and mud) at the top end of many temperate estuaries often means that sedimentation is occurring while the converse indicates erosion is occurring. Long cores can be used to establish an erosion/sedimentation history.
- Shoreline position changes can be monitored via aerial photography or satellite imagery over time.

- Trends in shoreline position related to beaches can be monitored through measurement of the high water mark and beach profile. (See Hunter *et al.* (2004) and Department for Environment and Heritage (2005) for information on methods used).

### **3.4 Data collation / calculation method**

Data collation and calculation methods will depend on the data measurement used. Data for a specific site should be collated over the study period and the average value calculated and compared against reference sites or baseline values.

### **3.5 Data storage and management**

Data should be stored by state/territory agencies and by the collectors (if different) of the data. If possible, the public should have access to the data (and report summaries) through a website hosted by state/territory government.

### **3.6 Data analysis and interpretation**

Changes in sedimentation/erosion rate data can be used to determine whether a waterway has been subjected to enhanced sediment loads or erosion caused by human action.

A significant increase in sedimentation rate within an area is often the result of an increased sediment load entering the system (eg from land clearing) or increased resuspension and deposition from within the system (eg from dredging activities). Changes to the hydrodynamics of a waterbody will result in changes to sedimentation and/or erosion rates (eg sea walls can change the water-current pattern occurring along the coast and increase beach erosion in some areas and sand accumulation in others).

### **3.7 Reliability, validity and quality assurance**

Quality assurance and control measures are important to minimise avoidable errors in the data and thus give more confidence in the data collected and conclusions made. Individuals collecting the data must have had adequate training in sample collection.

### **3.8 Metadata**

Metadata documentation should be completed for all datasets (see Appendix A). The metadata statement should be consistent with current ANZLIC standards, which now comply with ISO 19115.

See the following web site for the Metadata Profile:

[http://www.osdm.gov.au/ANZLIC\\_MetadataProfile\\_v1-1.pdf?ID=303](http://www.osdm.gov.au/ANZLIC_MetadataProfile_v1-1.pdf?ID=303)

For the Metadata Guidelines see:

[http://www.osdm.gov.au/ANZLIC\\_MetadataProfileGuidelines\\_v1-0.pdf?ID=397](http://www.osdm.gov.au/ANZLIC_MetadataProfileGuidelines_v1-0.pdf?ID=397)

## **4. Reporting / information products**

### **4.1 Audiences**

Regional natural resource managers will be the main audience for information on specific estuaries and coastal waters. State and federal managers will be more interested in the collation of information into regional summaries/reports.

### **4.2 Products**

The annual changes in sedimentation/erosion rate, with estimates of uncertainty (eg 95% confidence limits), should be reported for each location and are probably best represented by

tables and graphs. Once sufficient information on sedimentation/erosion rates is available for a location, it will be possible to produce tables or graphs showing trends and their statistical significance. These trends can then be reported as an estimate of change from previous baseline data. The size of change that can be statistically detected with the methods used should also be reported.

Maps showing areas of sedimentation/accretion and erosion can also be produced.

### **4.3 Confidentiality**

Data confidentiality is the responsibility of the data custodian.

### **4.4 Data collation/calculation method**

The development of regional summaries/reports for state and national managers will require the collation of local datasets.

### **4.5 Data analysis, integration and interpretation information**

Any national/regional level information products (ie interpreted products) need to be linked to the regional/local information that was used to create it (ie to the relevant state/territory and regional databases/information systems). Any specific methodologies, assumptions, additional data and changes in confidence in the interpreted products need to be stated.

### **4.6 Data access and storage**

National level products should be developed with the needs of the various stakeholders in mind. Data access and storage for national level products should be through a nationally known and recognised web site such as 'OzCoast and OzEstuaries'. Links should then be made to state/territory and regional web sites to access the underlying products/datasets.

### **4.7 Product definition statement**

Each product should have a product definition statement. The product definition statement follows the same general format as the metadata statement referred to in 3.8.

## **5. Current national activities**

Currently there are no national activities directly related to sedimentation and erosion rate monitoring *per se*. However, the Department of Climate Change has initiated a "First Pass" national Australian Coastal Vulnerability Project that is examining coastal vulnerability to sea-level rise, changes in storminess and other climate change-related hazards.

## **6. Future development**

More data related to sedimentation and erosion rates from around Australia need to be collected to determine the natural variability of this indicator and what it can really tell us about estuarine, coastal and marine resource condition.

## **7. Links to other indicators**

Animal or plant species abundance (indicator)

Water clarity (indicator)

Turbidity/suspended particulate matter in aquatic environments (matters for targets)

## 8. Further information

Department for Environment and Heritage. 2005. *Recreational Beach Width for Adelaide's Metropolitan Beaches*. Technical Report 05/02. Prepared by the Coastal Protection Branch for the Coast Protection Board, Adelaide.  
[www.environment.sa.gov.au/coasts/adelaide\\_studies.html](http://www.environment.sa.gov.au/coasts/adelaide_studies.html).

Department for Environment and Heritage. 2006. Recreational beach widths along the Adelaide coastline. *Coastline* No. 36, May 2006.  
[http://www.environment.sa.gov.au/coasts/pdfs/coastline\\_36.pdf](http://www.environment.sa.gov.au/coasts/pdfs/coastline_36.pdf).

Hunter, J., Hennecke, W., Coleman, R. and Sharples, C. 2004. TASMARC (TASmanian Shoreline Monitoring and ARChiving project).  
[http://www.acecrc.org.au/uploaded/117/797286\\_52tasmarc.pdf](http://www.acecrc.org.au/uploaded/117/797286_52tasmarc.pdf).

*OzCoast and OzEstuaries*. 2007. Web site. <http://www.ozcoasts.org.au/index.jsp>.

Simms, A., Woodroffe, C. and Baumber, A. 2002. Modelling of Sediment Input into Coastal Lakes. *Proceedings of the 2002 Coast to Coast Conference*. 4-8 November, Tweed Heads, NSW.  
<http://www.coastal.crc.org.au/coast2coast2002/proceedings/Theme4/Modelling-sediment-input-coastal-lakes.pdf>.

South Australian Coastal Protection Board. 2000. Monitoring sand movements along the Adelaide coastline. *Coastline* No. 32, June 2000.  
<http://www.environment.sa.gov.au/coasts/pdfs/no32.pdf>.

*Tasmanian Indicator Compendium*. NRM Estuarine, Coastal and Marine Indicator plus the Tasmanian Extension: Shoreline Position. 2006.  
[http://www.environment.tas.gov.au/downloads/FP\\_NRM%20ECM%20Indicator%20plus%20Tas%20Extension\\_Sedimentation\\_Shoreline%20Position\\_v1\\_0.pdf](http://www.environment.tas.gov.au/downloads/FP_NRM%20ECM%20Indicator%20plus%20Tas%20Extension_Sedimentation_Shoreline%20Position_v1_0.pdf).

## 9. Glossary

Accretion – The gradual addition to the shore or bank of a waterway by deposits of sand or silt.

Baseline data – Information collected to form a reference set for comparison of a second set of data collected at a later time; used to interpret changes over time usually after some condition has changed. ([nces.ed.gov/pubs2000/studenthb/glossary.asp](http://nces.ed.gov/pubs2000/studenthb/glossary.asp)).

Benthic – On the bottom of a body of water or in the bottom sediments.

Erosion – The action or process of eroding (ie specifically the wearing away by the action of water).

Impoundment – An accumulation of water into ponds/dams by human-engineered blocking of natural drainage.

Sedimentation – The process by which suspended particles in water settle to the bottom.

Spatial – Pertaining to space or distance.

Temporal – Pertaining to time.

Topography – Detailed study of the surface features of a region.

## Appendix A: Metadata statement

<b>Monitoring program</b>	The name of the monitoring program
<b>Custodian of data/Contact</b>	The business name and address/contact details of the custodial organisation or responsible party
<b>Summary of program</b>	A brief narrative summary of the program
<b>Geographic extent</b>	The ordinary name(s) of the locations where the data was collected (ie study area)
<b>Indicators monitored</b>	List of all indicators monitored
<b>Method of data collection</b>	Summary of the methods used to collect the data
<b>Past/future sampling</b>	Description of when sampling started, how often it occurred, when it will finish
<b>Quality assurance</b>	Description of the quality control/assurance procedures used
<b>Data access</b>	1) Location: Where and how the data is stored. If it can be accessed remotely (ie from a website) 2) Format in which dataset is stored and available 3) Any restriction or legal prerequisites that may apply to access and use of the data
<b>Other comments</b>	Any other comments
<b>Information source(s)</b>	Where information on the program can be found (eg reports, literature, websites)
<b>Date metadata created</b>	Date when the metadata record was created