Australian Government

National Land & Water Resources Audit

An initiative of the Australian Government

LAND SALINITY

INDICATOR HEADING

Areas threatened by shallow or rising water tables

INDICATOR PROTOCOL

Baseflow salinity

Baseflow salinity

Endorsed

This protocol has been endorsed by the National Land and Water Resources Audit Advisory Council. Version 1.2 – March 2007 – updated November 2007. The indicators will need to be further developed as identified within the protocol.

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Status of indicator agreement

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).

Indicator Protocol: Baseflow salinity

Version:

1.2 – Updated 8th November 2007

It should be noted that this protocol is subject to change due to the evolving priorities and needs of users (refer to section 6).

Matter for target:

Land Salinity

Indicator heading:

Areas threatened by shallow or rising water tables

Indicators addressed under this heading are:

i) Depth to groundwater

ii) Groundwater salinity

iii) Baseflow salinity

iv) Location, size and intensity of salt affected areas

Indicator name:

Baseflow salinity

1. Definition

Baseflow salinity refers to the electrical conductivity measured in microsiemens per centimetre referenced to a temperature of 25^{o}C.

Baseflow is the groundwater component of stream flow. Baseflow salinity refers to the salinity of the groundwater component of stream flow. This is reported in microsiemens per centimetre at a temperature of 25^{o}C (µS/cm at 25^{o}C).

2. Rationale

Stream salinity is a useful indicator of catchment salinity. It may be comprised of baseflow (groundwater) and surface water components. Baseflow salinity is important because it indicates the relative contribution of groundwater salinity to total stream salinity.

In more rapidly-responding local groundwater flow systems, rising baseflow salinities over time generally indicate an increasing groundwater contribution to the stream flow and, therefore rising watertables. It is also an indicator that can be readily measured by community based initiatives such as Waterwatch or Saltwatch, and its value is often an educational and community involvement tool, as much as a salinity indicator.

Baseflow salinity can be a useful means for identifying sub-catchments where further salinity investigations may be warranted, it can be a difficult indicator to interpret correctly. Baseflow salinity levels can vary quite erratically, and to use baseflow salinity as an indicator for the potential development of salinity problems it needs to be interpreted in conjunction with other contributing factors such as climate and land-use. The indicator may be of limited use in catchments with ephemeral stream flow.

3. Monitoring methodology

3.1 Monitoring location selection

For initial prioritisation of sub-catchments, monitoring points for baseflow salinity should be located immediately upstream of the outlet or tributary node of the sub-catchment being monitored. If possible the entire stream should be sampled initially and sampling points should be selected where there are abrupt changes in stream salinity. Consultation with a hydrogeologist, hydrographer and the landholder is recommended before siting monitoring points.

3.2 Monitoring frequency required

Since monitoring frequency of baseflow volume and salinity in local flow systems is event-based (e.g. seasonal rainfall, land clearing etc), it is not possible to specify set time intervals.

3.3 Data measurement method

The standard unit of baseflow electrical conductivity (EC) should be adopted as microsiemens per centimetre (µS/cm) at 25°C.

Additionally, Total Dissolved Solids (TDS) in mg/L is also an acceptable measure of baseflow salinity provided a robust mathematical relationship between TDS and EC has been established at the monitoring site.

Baseflow salinity monitoring should be undertaken in accordance with Australian Standard AS/NZS 5667.6:1998 Water quality – Sampling – Guidance on sampling of rivers and streams.

3.4 Data collation/calculation method

EC/TDS relationship/correlation as per standard (see section 3.7).

3.5 Data storage and management

Links with the Australian Water Data Infrastructure Project (AWDIP) are being considered for the storage and transfer of baseflow salinity data, although it should be noted that this indicator is not explicitly covered by the proposed AWDIP indicators (below).

AWDIP is initially targeted at delivering the following water resource data and information to allow reporting against key Matters for Target under the National Monitoring and Evaluation Framework :

- Surface water
    - Salt load
    - Flow
- Groundwater
    - Salinity (EC or TDS)
    - Depth to watertable

- Climate
    - Rainfall
    - Minimum temperature
    - Maximum temperature

In the interests of improved coordination and reducing duplication it is sensible that salinity data be delivered via the AWDIP framework for reporting purposes.

Some technical issues may need to be resolved such as refining or developing processes to extract or interpret basic data to meet reporting requirements.

3.6 Data analysis and interpretation

Determination of baseline trends will require analysis of data that complies with the 'evaluation framework for dryland salinity' (Coram *et al*. 2001). This will involve simple hydrogeological modeling using integrated water level and salinity data sufficient to determine a baseline trend. The amount of data required will depend on the system and the extent to which groundwater levels and salinity and baseflow volume and salinity has already been monitored. Hydrographs and time series of salinity should be overlain on the rainfall record (separated into mm/day) for the length of observations. Comparison of longer-term trends with the long-term residual rainfall mass curve illustrating trends in seasonal rainfall over the same period should be performed to detect seasonal and longer climatic variations (Coram *et al*. 2001). Where the regional baseline trend cannot be determined, reasons for this should be documented (NRE 1999 – http://www.dpi.vic.gov.au/DSE/dsencor.nsf/9e58661e880ba9e44a256c640023eb2e/710df9df9f2e1877ca25704d00275d14/$FILE/99-00.pdf).

Where and when a trend has been established, a review of data and trends over the preceding three-year period will be conducted on a three- to four-year basis. The findings should be documented for reporting purposes.

Using hydrographs of groundwater levels, baseflow volume and salinity (where appropriate in local flow systems), and groundwater salinity measurements, salinity hazard and risk assessment should be determined every three to five years. The conversion of observations and trends into a salinity risk assessment will involve simple groundwater modeling. Methodology for this needs to be nationally consistent and will depend on the type of groundwater flow system. The salinity risk and hazard assessment should be compared to the *Australian Dryland Salinity Assessment 2000* (NLWRA 2000).

Sampling, field measurements, trends analyses and salinity risk assessment need to be nationally consistent.

3.7 Reliability, validity and quality assurance

The following should apply:

- Probes need to be calibrated
- Different conversion rates are used, depending on water chemistry. Refer to relevant state/territory agency for recommended conversion rate. For example:
    - In South Australia, a conversion ration of 0.56 is used**: TDS** (in ppm) x 0.56 = **EC** (in mS/cm)
    - A conversion ratio of 0.64 is used elsewhere: **TDS** (in ppm) x 0.64 = **EC** (in mS/cm)
- Field techniques need to be documented

3.8 Metadata

The metadata statement should be consistent with AS/NZS ISO 19105 standards (http://www.saiglobal.com/shop/Script/Details.asp?DocN=AS788380765825).

4. Reporting/Information Products

4.1 Audiences

Natural resource managers at all levels are demanding consistency between related datasets and seamless datasets providing uniform and standardised descriptions of similar features in order that the feature is defined or classified the same way across Australia.

The audience for information products derived from the use of this indicator include:

- National and state policy makers
- Natural resource managers
- Industry
- General public

National/state policy makers and regional natural resource managers are the primary audience for information products derived from the application of this indicator. The specific information needs and the scale of data required will vary depending on context; national scale data may or may not be useful for targeting on-ground management action. Smaller scale data may be needed to be used effectively in the NRM regions.

4.2 Products

4.2a Example information products for this indicator include:

- Plots of salinity trends at monitoring sites
- Maps of monitoring sites with recorded salinity information.
- Maps of baseflow salinity classes at monitoring sites

Examples under development.

4.2b With contextual information, other products could include:

- Trend analyses
- Baseflow salinity maps
- Conceptual models of salinity processes

Examples under development.

4.3 Confidentiality

Maintaining confidentiality of data will be the responsibility of the custodian of the data e.g. the relevant management authority at State/territory level responsible for monitoring and reporting salinity information.

4.4 Data collation/calculation method

Refer to section 3.6.

4.5 Data analysis, integration and interpretation information

For interpreted products, specify methodology, assumptions and additional data.

4.6 Data access and storage

It is important that national level information has the potential to be updated via links to relevant regional and State/territory database/information systems. It is proposed that national information is reported through the National Land and Water Resources Atlas and Data Library, and in the future the Australian Resources Online. It will be the responsibility of the Australian Government to host these services.

Data access arrangements need to be developed with various stakeholders and may influence data confidentiality (refer to section 4.3).

4.7 Product definition statement

A statement should accompany all products derived from the use of this indicator, and should contain the following:

- Type of product, including product description
- Why and when the product was produced
- Product contents

5. Implications of proposed indicators and data collection / reporting with respect to existing activities

To be advised.

6. Future development

The baseflow salinity indicator is likely to change. It may be excluded as a ‘primary’ indicator or only used as contextual information. Stream salinity may be a better indicator due to the inherent difficulty in collecting data on baseflow salinity. Stream salinity is easily measured.

7. Links to other indicators

Baseflow salinity of streams is likely to be a more closely related indicator to depth to groundwater in many local flow systems. Rising baseflow salinities over time generally indicate an increasing groundwater contribution to the stream flow and, therefore, rising watertables, but the converse need not necessarily apply. Baseflow salinity should be monitored concurrently with watertable elevations in local flow systems.

A closely related indicator is the location and size of salt-affected areas caused by shallow or rising groundwater. Salinity outbreaks in the landscape are already routinely monitored in most States and Territories.

8. Further information

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9. Glossary

Aquifer	A saturated permeable geologic structure that can transmit significant quantities of water.
Discharge	Volume of water flowing out of an aquifer (aquifer discharge), volume of water flowing in a stream (stream discharge), or volume of groundwater flowing through the soil surface (groundwater discharge) – past a specific point in a given period of time.
Groundwater flow system	Distinct landscape types which have similar hydrogeological characteristics controlling salinity. These characteristics include geology, landform and relief.
Hydrogeology	The study of interrelationships of geologic materials and processes with groundwater.
Intermediate flow system	Groundwater flow systems which are intermediate in scale between local and regional flow systems. They generally occur within individual catchments but also sometimes flowing between smaller sub-catchments. They tend to occur in valleys, and typically occur over a horizontal scale of ten to fifty kilometres.
Local flow system	Groundwater flow systems with recharge and discharge areas within a few kilometres of one another. They tend to occur in areas of higher relief within individual sub-catchments and groundwater flow paths are generally less than 5 kilometres long.
Model	A collection of algorithms which digitally simulate the dynamics of a groundwater flow system.
Piezometer	A small diameter tube installed into an aquifer that is used to measure the elevation of the watertable. A piezometer is slotted or screened at the bottom and sealed off above the slotted or screened section.
Regional flow system	Groundwater flow systems with laterally extensive aquifers, which may be thicker than 300 metres, and recharge and discharge areas separated by distances of fifty or more kilometres. The aquifers are usually wholly or partly confined, and can be overlain by local and intermediate flow systems.