

# A structured ecosystem-scale approach to marine water quality management

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## Abstract

Activities and developments in the coastal zone, and in adjacent catchments, pose an increasing threat to the sustainability of the natural and socio-economic goods and services supplied by marine ecosystems. Governing authorities have had to develop new policies to promote environmentally responsible and sustainable development practices, either through legislation and/or incentive mechanisms. These, in turn, created the need for holistic and integrated frameworks within which to design and implement environmental management programmes.

A structured ecosystem-scale approach for the design and implementation of marine water quality management programmes developed by the CSIR (South Africa) in response to recent advances in policies and legislation pertaining to sustainable utilisation of Southern Africa's marine environment is discussed. The framework provides an integrated scientific base within which to set, for example, wastewater emission targets, taking into account ecosystem process complexity. It also aims to support and stimulate local stakeholder empowerment and involvement.

**Keywords:** marine water quality, integrated management, ecosystem scale

## Introduction

Agriculture, industrial and residential developments in the coastal zone and in adjacent catchments pose an increasing threat to the sustainability of the natural and socio-economic goods and services supplied by marine ecosystems, even where such developments may create other socio-economic benefits.

Historically marine water quality was managed on an individual or case-by-case basis, which did not necessarily take into account possible cumulative or synergistic effects as a result of multiple activities or developments within a specific area. To account for cumulative or synergistic effects, a more holistic approach was required – rather focusing on the ecosystem than on individual activities or developments. Recent developments in numerical modelling, in particular its ability to integrate over different spatial and temporal scales, have permitted the development of such ecosystem-scale approaches.

In order to manage potential conflict, governing authorities had to develop new policies to promote sustainable development practices, either through legislation and/or incentive mechanisms. These, in turn, also created the need for holistic and integrated frameworks within which to design and implement environmental management programmes.

Internationally, different approaches to marine water quality management have been proposed. For example, in 1990 the Water Research Centre (United Kingdom) prepared a guide, particularly aimed at providing guidance in the design, operation and maintenance of environmentally acceptable marine outfall schemes for sewage (WRC, 1990). One of the

principle objectives of this guide was to 'provide a common framework for both engineers and scientists to take account of the inter-relationship between the environment and engineering aspects of marine treatment'. The framework addressed issues such as:

- Legal framework
- Environmental quality issues
- Planning of data collection studies
- Aspects of the engineering design and construction of marine outfall schemes
- Operation and maintenance (including monitoring).

In this context the United Nations Environmental Programme (UNEP) also prepared *Guidelines on Municipal Wastewater Management* (UNEP, 2002), providing practical guidance for implementing the *Global Programme of Action for the Protection of the Marine Environment from Land-based Activities* (GPA) on sewage. The need for '...a comprehensive, integrated and stepwise approach to urban wastewater management to improve human health and maintain environmental integrity...' is explicitly stated with a strong emphasis on strategies for ensuring effective institutional arrangements and social participation.

As part of the series on *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Environment Australia provided a management framework particularly aimed at the effective application of water quality guidelines in the arena of marine water quality management (ANZECC, 2000a). The framework recognises, amongst others, the need to:

- Define primary management aims, including environmental values
- Determine appropriate water and sediment quality guidelines
- Establish monitoring and assessment programmes, focused on water quality objectives

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