



National sediment compartment framework for Australian coastal management



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ABSTRACT

The concept of coastal sediment compartments was first used in the 1960s in the United States. It has since been recognised as appropriate for defining sections of the Australian coast, but had not been uniformly adopted around the nation in the way that has underpinned management, as in other countries. In 2012, the Australian Government supported a project to better understand coastal sediment dynamics using the sediment compartment approach as a framework within which to consider future shoreline behaviour and the impacts of climate change, including rising sea level, changing wave climates and sediment budgets. This paper outlines the sediment compartment project and uses case studies to demonstrate its application. The project consisted of three steps. The first step involved delineation of a hierarchy of coastal sediment compartments following a nationally agreed set of criteria, integrating the onshore/offshore geologic framework with known patterns of sediment movement and those inferred from surface landforms. This identified more than 100 primary compartments bounded by major structural features such as headlands or changes of shoreline orientation. At a finer scale, approximately 350 secondary compartments were identified, many of which encompass smaller scale structural features that define tertiary scale compartments or cells. For verification of this sediment compartments approach to coastal planning and management, the second step of the study comprised case studies of contrasting compartments with different patterns of sediment supply, transport and deposition. The third step, involved embedding all secondary compartments around the continental coast into the Shoreline Explorer, within the *CoastAdapt* toolbox (National Climate Change Adaptation Research Facility). Information regarding the sensitivity of shorelines to change was compiled at the compartment scale, based upon evidence such as substrate, sediment transport attributes and oceanographic forcing, including waves, tides and storm processes. Presentation of information through *CoastAdapt* within the compartments framework provides a resource to facilitate improved coastal planning and management over different implementation levels, from national strategy scale down to local policy scale. Case studies from several contrasting settings around the Australian coast demonstrated the potential and feasible application of the sediment compartment approach at different spatial and temporal scales.

1. Introduction

A sediment compartment approach has been used in a number of countries as a means to improve coastal management at a range of spatial scales, through a better understanding of sediment mobility and

transport within and between each compartment. The concept was first outlined in the United States (Inman and Chamberlain, 1960; Bowen and Inman, 1966), where it was incorporated into beach management by Komar (1976). Sediment cells, also called littoral drift cells, were delineated for much of the coast of the United Kingdom, based on

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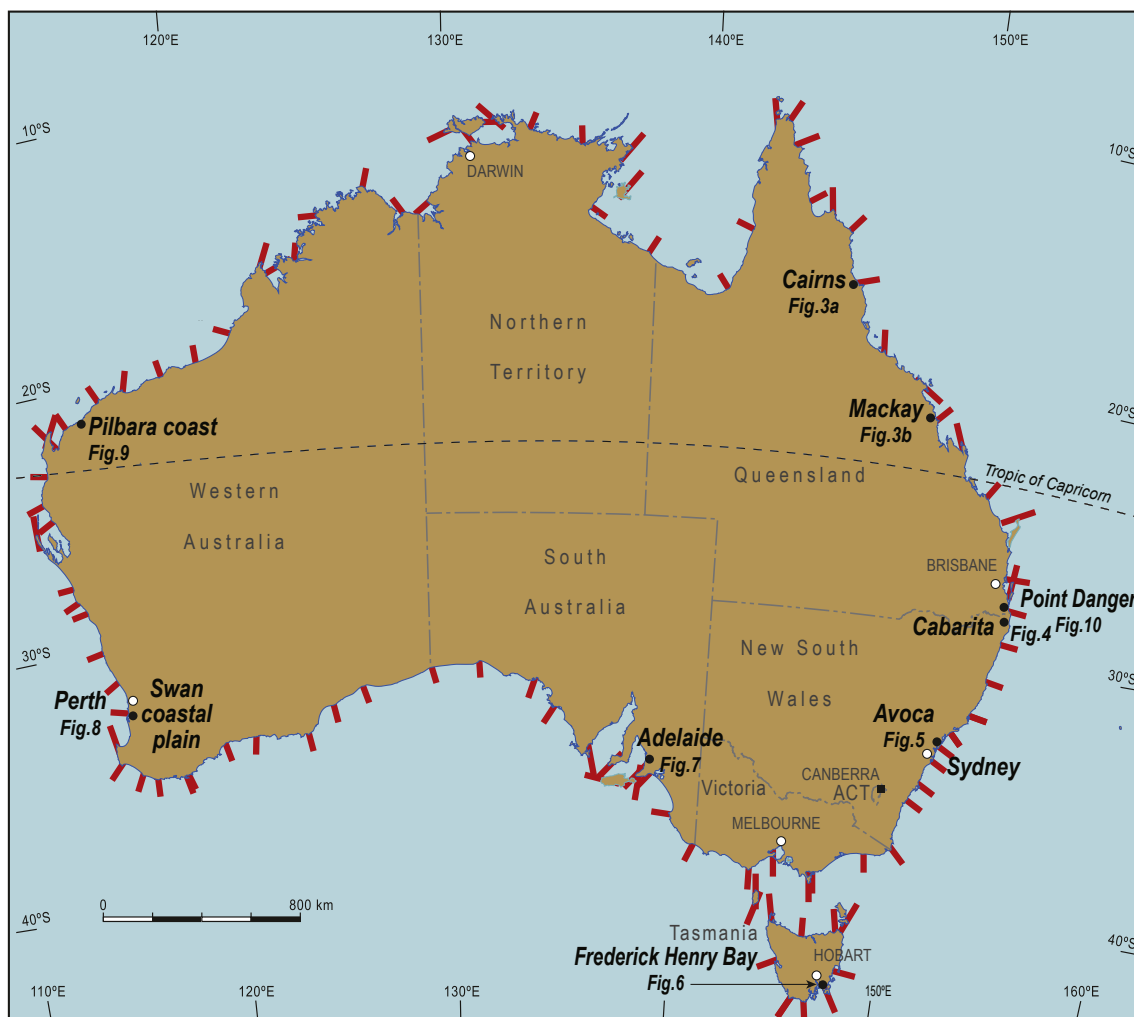


Fig. 1. Boundary points of primary sediment compartments around the Australian coast (from McPherson et al., 2015), and the location of pilot and case study sites.

perceived interruptions to movement of sand and shingle along beaches (Motyka and Brampton, 1993; Bray et al., 1995). These cells form the basis for shoreline management plans in England and Wales (Cooper et al., 2001, 2002; Cooper and Pontee, 2006; Nicholls et al., 2013).

In Australia, the concept of the coastal sediment compartment was introduced by Davies (1974). He recognised the nature of sediment compartments and a hierarchical structure of these around the Australian coast (Davies, 1977, 1980), where significant quantities of sand are transported northwards along both west and east coasts (Short, 2010). Efforts were made to understand the sediment budget for the Gold Coast (Chapman, 1981), and these concepts were applied along New South Wales (NSW) in a monograph focused on coastal management (Chapman et al., 1982). Searle and Semeniuk (1985) proposed a natural sectors approach that guided overall management of large-scale coastal works in southern Western Australia.

As indicated above, there is no standard usage nor definition of the terms cell and compartment, with littoral or sediment cell, coastal cell, sediment compartment and coastal compartment all utilised to define a section of coast (Cowell et al., 2003; McGlashan et al., 2005; Woodroffe et al., 2012; Eliot, 2013; George et al., 2015; Tecchiato et al., 2016). The terms are sometimes used interchangeably and at other times may mean somewhat different things. Despite the use of the term sediment cell in the UK and USA, general Australian usage prefers the term cell employed at a smaller spatial scale than compartment. In Western Australia, both cell and compartment terms and concepts have been used, with the smaller cells nested with larger compartments. For instance, Eliot et al. (2011) focus on compartments defined by broad scale

structural elements. This contrasts with more recent reports by Stul et al. (2012, 2015) which place emphasis on transport processes at a finer scale and use the concept of cell to reflect connectivity of mobile sedimentary features. Much depends on the purpose of the investigation. In this study undertaken at a continental scale, it was agreed to use the term sediment compartment within a much broader hierarchical classification.

In 2012, the Australian Government supported a project to better understand coastal dynamics for the entire continent including consideration of potential climate change impacts. The project was seen as providing a method for assessing present and future natural hazards and impacts to coastal assets at risk from extreme events and climate change. The approach is based on an understanding of Australia's coastal geomorphology and sediment pathways using geologic frameworks for understanding movements of sediments and shorelines at present-day and future time scales. The approach and definition of the hierarchical coastal sediment compartments are provided in section 3 and section 5.2 identifies some key compartment characteristics relevant to assessing hazards.

The project built on previous recent work supported by the Australian Government, which assessed climate change risks to Australia's coasts (Harvey and Woodroffe, 2008; DCC, 2009; Harvey and Caton, 2010). It involved a *First Pass National Assessment* and incorporated a detailed shoreline classification termed *Smartline* (Sharples et al., 2009). In 2011, the Australian Government agreed that steps should be undertaken to assess risk through the application of the nationwide sediment compartment approach, especially given its initial

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