



Review

An argument for probabilistic coastal hazard assessment: Retrospective examination of practice in New South Wales, Australia



D.J. Wainwright^{a,b,*}, R. Ranasinghe^{c,d,e}, D.P. Callaghan^a, C.D. Woodroffe^f, P.J. Cowell^g, K. Rogers^f

^a School of Civil Engineering, University of Queensland, St Lucia, QLD 4072, Australia

^b Whitehead and Associates, Cardiff, NSW, Australia

^c Civil Engineering and Geosciences, Delft Univ. of Technology, PO Box 5048, 2600 GA Delft, Netherlands

^d Dept. Water Science Engineering, UNESCO-IHE, PO Box 3015, 2601 DA Delft, Netherlands

^e Harbour, Coastal and Offshore Engineering, Deltares, PO Box 177, 2600 MH Delft, Netherlands

^f School of Earth and Environmental Science, University of Wollongong, Australia

^g School of Geosciences, University of Sydney, Australia

ARTICLE INFO

Article history:

Available online 4 May 2014

ABSTRACT

Determination of coastal hazard lines is a key task for coastal engineers worldwide. While current practice differs from country to country and even within countries, in many coastal hazard assessments three main components of coastline recession are taken into account: episodic recession due to storm erosion, long term recession due to an imbalance in sediment transport, and recession due to sea-level rise. In Australia, the state of New South Wales has a well-established procedure for the definition of coastal hazards that has evolved since the 1970's. Accepted practice in NSW is intentionally conservative, due to uncertainties and a limited understanding of physical processes. This article (i) provides an historical perspective on the development of the established methodology; (ii) discusses the various components of coastal hazard considered, and (iii) examines the way in which these components can be combined. Suggestions are subsequently provided for a way forward that better suits emerging risk-based coastal management/planning frameworks. The article also considers the advantages and practicalities associated with assigning numerical probabilities to hazard lines as part of risk-based coastal management.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

A key task for coastal practitioners is the assessment of coastal hazard extents to inform the appropriate location of development near the coast. This requires appropriate knowledge, care and skill, particularly considering the degree of uncertainty associated with coastal processes, the extent of existing development within exposed areas, and ongoing coastal development pressures. While this study focusses on practice in New South Wales (NSW), similar methods have been adopted at other locations internationally, such as New Zealand (Gibb, 1983) and the United States (Komar et al., 2002). New South Wales (Fig. 1), located along the southeast coast of Australia is the most populous state in the country.

Authorities in NSW have a longer history, compared to other Australian states, of systematically assessing coastal hazards to guide development. Permanent residential development in proximity to beaches along the NSW coast was not widespread until the 1960's, coinciding with a post-World War II shift of the population towards the coast. Prior to that, government engineers had focussed on the creation of safe harbours and navigation channels, when shipping was the primary means of long distance transport (Coltheart, 1997).

During the late 1960's and 1970's, focus shifted toward beach management for two primary reasons: (i) concern for the protection and enhancement of the beach environment; and (ii) extreme storms during the 1970's (particularly 1974) which caused significant erosion and adversely affected development (NSW Government, 1990). Enhanced funding for research into coastal processes resulted in the establishment of a coastal data collection network and the first detailed coastal process and hazard study in NSW (Gordon et al., 1978). Subsequently, numerous studies were

* Corresponding author. School of Civil Engineering, University of Queensland, St Lucia, QLD 4072, Australia.

E-mail address: d.wainwright2@uq.edu.au (D.J. Wainwright).

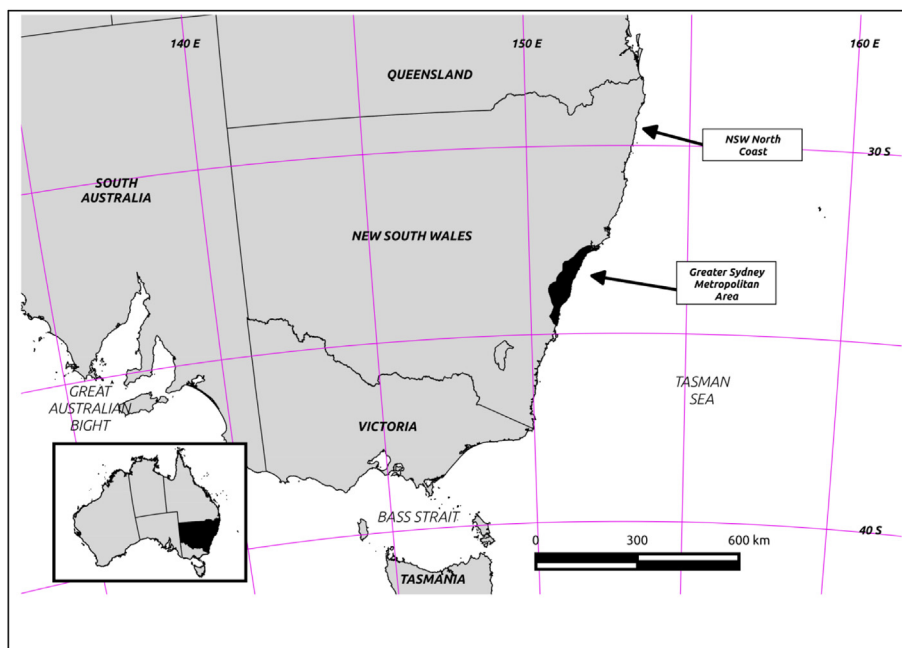


Fig. 1. Southeastern Australia showing the location of NSW. Historically, coastal development was concentrated within the Greater Sydney Metropolitan Area, although in recent decades notable pressure has developed in more regional areas, particularly the NSW North Coast.

undertaken and the understanding of coastal processes in NSW improved (Chapman et al., 1982). Accepted practice for the derivation of coastal hazard extents developed during that time, culminating in the NSW Government's Coastline Management Manual (CMM) (NSW Government, 1990). While improvements in numerical modelling, gradual lengthening of the available data records, and new methods of analysis have arisen during the past two decades, accepted practice has not changed markedly from that outlined in the CMM.

In recent decades, there has been a significant increase in development pressures, much associated with the life-style 'sea change' phenomenon particularly along the northern coast (Gurran and Blakely, 2007). Interestingly, NSW has relatively few residential buildings located in areas inferred to be at risk from coastal erosion compared to other Australian states. NSW has 3600 residential buildings located within 110 m of 'soft' shorelines and 700 buildings within 55 m, compared to values of 15 200 and 5400 in Queensland respectively (Department of Climate Change (2009)).

Under a future scenario of 1.1 m sea-level rise, it was recently estimated that between 40 000 and 60 000 existing residential buildings would be exposed to inundation during extreme storm surge events in NSW, including inundation around estuaries (Department of Climate Change (2009)). The contemporary replacement value of those residential buildings was estimated at between 12 and 19 billion Australian dollars. 'At risk' properties are generally clustered around the greater metropolitan area of Sydney, stretching northwards from Wollongong to Newcastle (Fig. 1). A significant and increasing proportion of the NSW population (~20% presently) resides on the coast outside of this area and the risk in those areas is increasing.

2. Historical perspective

The 1974 storms were the catalyst for a concerted effort towards a better understanding of coastal processes in NSW (Lord and Kulmar, 2000; McLean et al., 2010; Watson and Lord, 2005, 2001). The erosion at that time arose from a series of storms, with three

distinct periods of high energy waves on 27 May, 4 June and 13 June (Bryant and Kidd, 1975). The two larger events (27 May and 13 June) had significant wave heights of around 6.5 m at Port Kembla (near Wollongong), although the waves offshore of Sydney may have been significantly higher (Foster et al., 1975). Damages caused by these storms were exacerbated by high astronomical tide elevations.

Other notable erosion events occurred in 1967 and 1978 (Callaghan and Helman, 2008; Gordon, 1987; Thom, 1968). This cluster of storms was part of what is now remembered as a relatively stormy period for the east coast of Australia, between the 1950's and 1970's (McLean et al., 2010; NSW Government, 1990; Thom, 1968) although robust data to confirm (or disprove) this impression is not available. The 1980's through to the present are, conversely, considered to have been relatively calm. It is vitally important that lessons from this earlier period are not lost to later generations of coastal engineers, scientists, planners and politicians.

Following 1974, the NSW government focussed on better understanding coastal hazards. Efforts were initially channelled through the Public Works Department (PWD) via the Coastline Hazard Program and the Manly Hydraulics Laboratory. The first such study was undertaken for the Byron–Hastings Point Coastline (Gordon et al., 1978). At the time, global warming and sea-level rise were already a concern for some scientists, but the view was not as widely accepted as today. Nevertheless, the historical data analysed included a number of anomalies which could not be easily explained at the time, and this was acknowledged in deriving the hazard lines (Gordon, A, 2012, pers. comm., 23 November). The main concern along the Byron–Hastings Point shoreline related to understanding long-term shoreline recession trends. Previously established "buffer zones" of 50–100 m, had been completely eroded since the mid-1800's when that study area was originally settled. The long-term trend was subsequently assessed using available aerial photography and desktop scaling, a process made possible by the prominence of actively eroding scarps and vegetation lines on aerial photographs in the region (Lord, D, 2012, pers. comm., 10 October). The acquisition of stereo photogrammetric equipment by the PWD in the early 1980's and a commitment to

Download English Version:

<https://daneshyari.com/en/article/1723745>

Download Persian Version:

<https://daneshyari.com/article/1723745>

[Daneshyari.com](https://daneshyari.com)