Contamination of Coastal Sediments from Historic Landfills: A ticking time-bomb

F.T. O'Shea[1], K.L. Spencer[1]

[1]School of Geography, Queen Mary University of London, Mile End Road, London, E1 4NS, United Kingdom

Phone: +44-(0)-207-882-5555 (+4868)
E-mail: f.t.oshea@qmul.ac.uk
E-mail: k.spencer@qmul.ac.uk

Introduction: Historically, waste has frequently been placed on low-lying land with little or no value, within the inter-tidal zone. Without the legislation and management requirements of modern sites, waste was in direct contact with surrounding coastal sediments e.g. saltmarshes. As leachate percolated from the landfill, any heavy metal contamination was rapidly associated with surrounding fine grained coastal sediment through natural attenuation.

Climate change predictions state that both the frequency and intensity of high energy storm events will increase within the next 50 years [1]. Therefore, the erosion and re-distribution of these contaminated sediments could present a secondary contaminant source putting local ecosystems at risk.

As the pressures from local authorities and governments call for tighter and more comprehensive coastal management, the requirement to understand fully the nature and extent of contamination within the coastal zone has never been so great.

To date, the magnitudes and extent of heavy metal contamination from historic landfills within the coastal zone has not been addressed. The aim of this research is to establish the spatial extent and magnitude of sediment contamination surrounding landfills within South East England.

Methods: Historic landfills in SE England were identified using publically available spatial data (fig. 1). 8 sites were identified which were > c. 50 years old and adjacent to saltmarshes, containing either inert (3 sites) or commercial/household waste (5 sites).

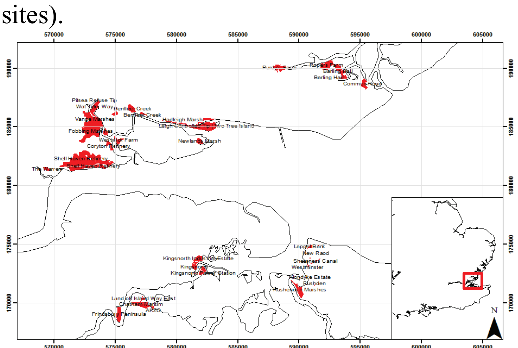

Fig.1: Historic landfills within the coastal zone in SE England.

2 m sediment cores were extracted within a few metres of site boundaries and analysed *in-situ* using field portable XRF (Niton XL3t) providing immediate screening level data. This informed further on-site sampling decisions. Moisture content was later measured in the laboratory and XRF data adjusted for field sediment moisture content [2].

Results: Sediment core data from the commercial/household landfills show enrichment factors of 3, 21 and 7 for As, Pb and Zn respectively at depth directly adjacent to the landfill. This enrichment decreased with distance from the landfill and could not be identified > 15m from the site boundary. There was no enrichment in sediments adjacent to inert sites.

Discussion: Potential contaminated sites for investigation were rapidly identified using publically available spatial data. I*n-situ* XRF allowed data to be acquired in the field, informing sampling strategy and reducing analytical time. From initial desk study to a completed data set took less than 1 month.

The spatial distribution of metals suggests that commercial/household waste is a source of contamination in these sediments. Maximum concentrations of 55, 335 and 495 mg kg^{-1} for As, Pb and Zn respectively each exceed the Probable Effect Level (PEL) for metals within marine sediment, suggesting the potential to cause ecotoxicological risk [3]. Under scenarios of climate change, these coastal sediments are likely to present a secondary source of contamination, through their erosion and subsequent redistribution of heavy metal contamination.

The use of *in situ* XRF provides a rapid and cost effective tool for the identification of sediment contamination resulting from historic coastal landfills. This will be of use within coastal planning and risk assessment of this emerging contaminant issue.

References: [1] Solomon *et al* (2007). *Climate Change 2007* 996p; [2] O'Shea et al (*in prep*) *Water, Air and Soil Pollution*; [3] Buchman (2008) *NOAA Screening Reference Tables.* 34p.