Modelling the effects of water injection dredging on water quality

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Some estuaries around the world have historically been subjected to unregulated releases of industrial effluent and untreated sewage. Contaminants associated with these discharges have a tendency to adsorb to the natural mud particles in suspension which themselves tend to flocculate and sink rapidly to the bed. As a result, estuary deposits can contain high levels of pollutants.
An example of this problem is the Mersey Estuary (UK) which in recent years has undergone an extensive programme of regeneration to the docks and infrastructure. In the latest phase of works, the regeneration of old ship berths close to the mouth of the estuary was proposed to facilitate a new container terminal. The sediments in the Mersey are highly contaminated with heavy metals and Polycyclic Aromatic Hydrocarbons (PAHs). Dredging of these deposits is therefore tightly regulated, requiring the material to be removed to designated landfill sites. The potential cost of the operations to the developer has led to other dredge methodologies being considered.
This paper describes a study undertaken to assess the feasibility of using Water Injection Dredging (WID) to clear the berths. This method offers considerable saving in terms of efficiency and cost but, since it introduces the contaminants back into the water column, raises concerns over water quality. In the assessment, a fully coupled 3D hydrodynamic, sediment transport and newly developed water quality model of the Mersey Estuary is described. This TELEMAC model simulates the advection and dispersion of dredged material and includes the process of partitioning of contaminants to and from adsorbed (particulate) and dissolved (water) phases. The effect of flocculation on settling velocity of the suspended particulates is included in the model using a recently developed model (Soulsby *et al.*, 2013) which is found to improve the calibration against *in situ* ADCP derived sediment flux measurements (Land and Jones, 2001).
Results for four locally significant contaminants are described, with two heavy metals (mercury and lead) and two polycyclic aromatic hydrocarbons (anthracene and naphthalene) being considered. After due consideration of the findings of the study the statutory regulators and other stakeholders permitted the use of WID for the dredging of the berths, thus highlighting the usefulness of the methodology.

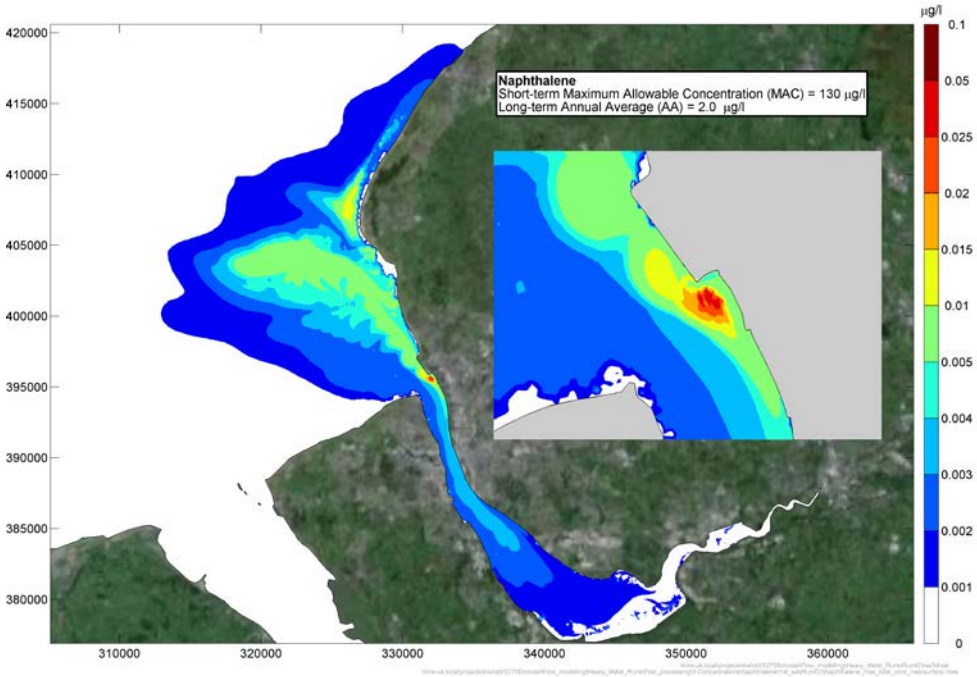

Fig. 1. Maximum predicted concentrations of dissolved Napthalene released during 4 weeks of dredging in the Mersey Estuary.

References

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