Water injection dredging – monitoring leads to effective planning

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Water Injection Dredging (WID) can provide a cost effective means of clearing unwanted sediment from docks, harbours and marinas, and can be particularly effective where complicated berth infrastructure or pontoons make conventional dredging difficult. In addition, WID is considered to be beneficial to sediment management as it can retain sediment within the local system. Much debate has surrounded the fate of material mobilised by WID methods, including the relative contribution to suspended material at the immediate dredge location, wider increases in background sediment load and the dispersive ability and fate of the dredge plume.

ABPmer, a recognised provider of capital and maintenance dredge support services, recently carried out the consultation, marine licensing, project planning and monitoring in support of WID operations in Portsmouth Harbour.

To carry out the dredge on behalf of marina operators within Portsmouth Harbour, consent was required from the Queen’s Harbour Master (QHM) Portsmouth as Harbour Authority. As a condition of local Harbour Act consent, QHM required sediment quality sampling followed by pre and post dredge monitoring to understand the likely fate of WID material, and to ensure the mobilised sediment was not contaminated. The WID operation was conducted by Van Oord, using specialist dredge plant designed to operate in small marinas and confined dock areas.

Licensing changes

Currently, under the present licensing regime of Food and Environment Protection Act (FEPA) and Coast Protection Act (CPA), the act of dredging is not licensable. The Marine and Coastal Access Act 2009 has introduced definitions for dredging, describing this as ‘including use of any device to move any material (whether or not suspended in water) from one part of the sea or sea bed to another’.

Defra has recently consulted on new secondary legislation for England to be brought in under the Act, which will introduce a new ‘Marine Licence’ to replace a number of existing consenting regimes that apply to dredging including FEPA (environment protection) and CPA (navigational safety). Under the secondary legislation, any form of dredging within the UK will be licensable. It is anticipated that this secondary legislation will include dredging methods such as WID within the wider consenting regime. Exemptions to the Marine Licence have been written into the Marine and Coastal Access Act allowing Harbour Authorities to licence their own dredging activities where local powers exist under Harbour Acts. This change in licensing regime will present new challenges to the industry, not least in managing project timescales to accommodate previously unlicensed activities.

WID sediment monitoring

ABPmer operates a near-shore survey team that undertakes hydrographic and field investigations in support of maintenance dredging. The company’s equipment pool includes an extensive range of instrumentation for bathymetric surveying, 2D and 3D
flow monitoring, water levels, multi-parameter water recording and grab sampling.

ABPmer’s monitoring uses a pre-defined set of analysis techniques to compare the pre, post and dredge conditions within the water column, at numerous fixed locations on the seabed. These results, combined with a continuous fixed station monitoring site and dual-frequency echo sounder tracking of sediment plumes, has allowed observation of the movement of dredge material within the harbour and surrounding area, which can now be used to plan future dredge campaigns.

The interaction between the sediment plume, which acts like a near-bed high density ‘cloud’, and the surrounding physical environment has been the principal monitoring consideration during the research. Successive years of monitoring have confirmed that the density plume retains most of the mobilised material, which stays relatively close to the seabed, creating virtually no turbidity higher in the water column.

The WID operation was planned to operate on the ebb tide commencing at high water. In advance of the marina dredge, a sediment flow channel was cut from each marina to the main fairway to convey material into the outgoing harbour tidal flow. Transects of the main fairway were monitored by dual-frequency echo sounder to confirm that material moved out with the tide.

The monitoring work confirmed the quantity of material mobilised, and provided the Harbour Authority with confidence that the material did not enter deep berth pockets up-estuary of the dredge site, nor did it enter enclosed harbour areas where other harbour users had expressed concerns over the potential for increased sedimentation.

The monitoring has allowed the design of the dredge to best use the natural tidal flow state and bathymetry of the harbour entrance to encourage material mobilised by WID methods out of the harbour and into the wider Solent. The results of the monitoring have highlighted that elevated sediment levels can be detected within the immediate vicinity of the marina dredge sites during the dredge operation. However, sediment concentrations reduce to background levels within a short distance from the dredge operation.

Monty Smedley, Senior Marine Scientist at ABPmer said, “The monitoring exercise showed that the movement of vessels, tidal range and weather conditions play a significant role in raising background suspended sediment loads over the whole harbour. It was found that natural variability contributes significantly to sediment concentration, to levels that compare to that of the dredge operation. The research concluded that with careful pre-dredge planning, WID operations can be designed and carried out to control the flow of material and maximise the use of the natural environment to aid dispersal.”