Managed aquifer recharge (MAR) to enhance groundwater resources for irrigation in a coastal agricultural catchment in the Crag aquifer, Suffolk

Research Summary 5: MAR scheme economic evaluation

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Background

Water resources in East Anglia are under pressure due to population growth, demand for irrigated crops and climate change. It is predicted that the dry year annual average spray irrigation demand will increase by 59-220 x 10^3 m^3/day by 2050 from a baseline of 190 x 10^3 m^3/day[1]. Matching growth with enhanced environmental protection requires innovative solutions. Managed aquifer recharge (MAR) offers the possibility of storing excess surface winter high flows underground for later abstraction during periods of peak demand. The Crag aquifer at Bucklesham in Suffolk (**Fig. 1**) was selected for a demonstration MAR scheme (**Figs 1, 2**) with the purpose of supplying additional irrigation water during periods of high summer demand. The outputs of the study enable the scheme to sufficiently inform a roadmap for similar MAR initiatives in the UK.

1. Water Resources East (2022). *Draft regional water resources plan for eastern England.* Water Resources East (WRE) Ltd, Norwich, 91 pp.

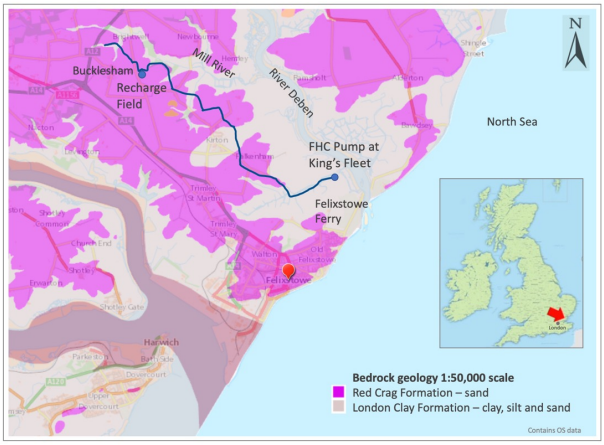

Fig. 1 Location map showing surface geology and the King's Fleet pumping station (FHC Pump) at Felixstowe Ferry and the MAR site at Bucklesham. The blue line shows the dual-pipeline to transfer water inland to farm reservoirs and the MAR site.

Design of the MAR scheme

Water is sourced from the King's Fleet at Felixstowe Ferry (**Fig. 1**), where the East Suffolk Internal Drainage Board pumps more than 1 x 10^6 m^3 m^3 of water each year into the River Deben. Following construction, water is transferred 14 km inland to participating farms where it is stored in reservoirs ready for irrigation and also to supply the MAR scheme at Bucklesham (**Figs 1, 2**).

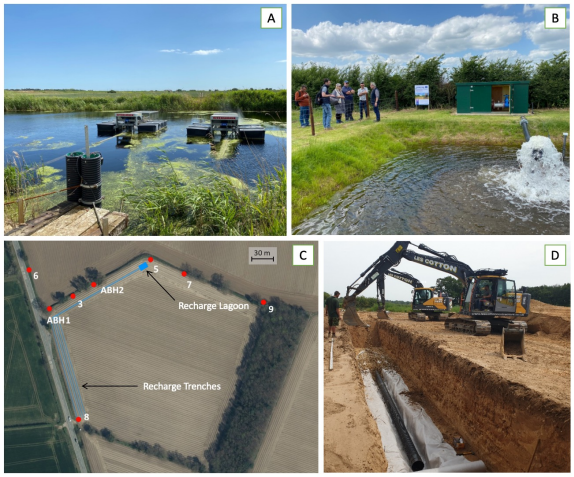

Fig. 2 A: Surface water abstraction location in the King's Fleet showing the eel-friendly, Riverscreen source-water pumps. B: Recharge lagoon at the Bucklesham MAR site in operation. C: Abstraction borehole (ABH1, ABH2) and observation borehole location plan, including the position of the recharge lagoon and layout of infiltration trenches. D: Recharge distribution trench under construction.

Further details

More information about the project is available at https://www.fresh4cs.eu. For specific enquires, contact Prof. Kevin Hiscock (email: k.hiscock@uea.ac.uk).

Economic aspects

The largest cost component of the scheme was for monitoring, data collection and permitting, which together accounted for approximately 57% of the total budget. Construction costs including the recharge field, abstraction boreholes and pumping systems accounted for 43% of the capital costs (**Fig. 3**).

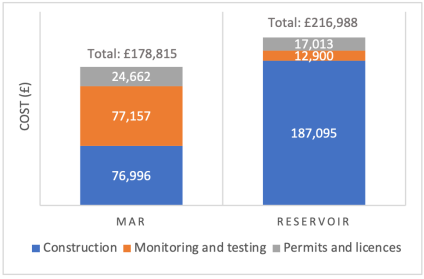

Fig. 3 Cost comparison of the MAR scheme *vs.* surface storage reservoir.

The cost of construction works for an equivalent surface storage reservoir account for up to 86% of the overall budget. Design, reservoir permitting, environmental assessment, fencing and landscaping costs typically come to only 20% of the total budget[2]. Construction costs for the MAR system were comparatively low but the high costs of data collection and securing regulatory permits brought the overall capital costs to within 10% of an equivalent storage reservoir (**Fig. 3**).

2. Weatherhead, K., Knox, J., Daccache, A., Morris, J., Groves, S., Hulin, A. and Kay, M. (2014). *Water for agriculture: collaborative approaches and on-farm storage.* Water for Agriculture (FFG1112) Final Report, March 2014. Cranfield University, Cranfield, 59 pp.

Summary

The higher data collection and permitting costs for the MAR scheme reflected the greater regulatory challenges. Aquifer recharge is relatively novel technique in the UK and the permitting regime is required to address potential impacts both on groundwater quality and water resources. In contrast, agricultural storage reservoirs have a long history of development and permit considerations and are limited to water resources impacts only. Water resources mitigation measures, such as protected minimum flows, are well understood and the licensing regime has matured to accommodate reservoir abstraction permits. It is likely, however, that if more MAR schemes are developed, the regulatory process will become more streamlined, reducing permitting overheads and making MAR more attractive to agricultural irrigators.