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

Research Summary 3: Quality of source water and Crag groundwater

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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.

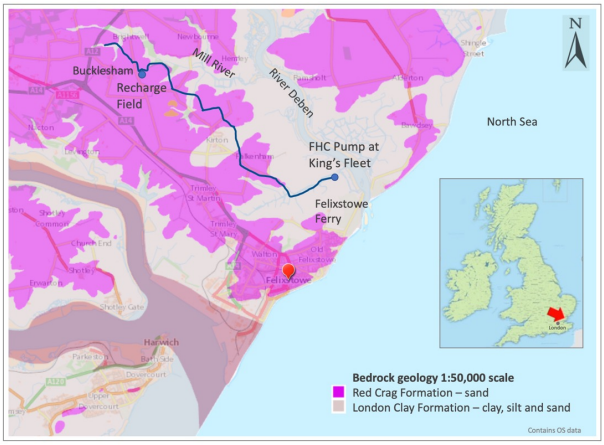

Fig. 1 Location map showing surface geology and the King's Fleet pumping station (FHC Pump) at Felixstowe Ferry and the MAR site at Bucklesham. The blue line shows the dual-pipeline to transfer water inland to farm reservoirs and the MAR site.

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**).

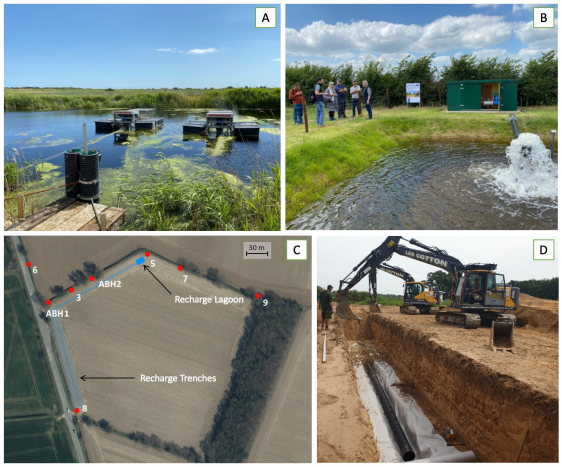

Fig. 2 A: Surface water abstraction location in the King's Fleet showing the eel-friendly, Riverscreen source-water pumps. B: Recharge lagoon at the Bucklesham MAR site in operation. C: Abstraction borehole (ABH1, ABH2) and observation borehole location plan, including the position of the recharge lagoon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

Water quality aspects

Groundwater in the receiving aquifer at the MAR site was monitored for major ions during the period November 2021–September 2022 (**Table 1**). The Crag groundwater composition is typical of the area. Apart from nitrate-N concentrations, no exceedances of regulatory limits were observed in the groundwater samples during the monitoring period. During the recharge period of the MAR trial, the source water quality was stable with a mean electrical conductivity value of 673 µs cm^{-1} and mean chloride of 123 mg L^{-1}, reaching a maximum of 126 mg L^{-1}, within the threshold value of 165 mg L^{-1} set by the EA.

Table 1 Mean values of key water quality determinants measured for surface water and groundwater quality monitoring of the MAR scheme.

	Mean value	
Determinant	Surface water	Groundwater
Conductivity at 20 °C (µS cm^{-1})	890	900
Dissolved oxygen (mg L^{-1})	9.26	7.36
Total organic carbon (mg L^{-1})	7.42	3.00
Sulphate (mg L^{-1})	102	114
Chloride (mg L^{-1})	134	117
Nitrate-N (mg L^{-1})	3.00	29.5

Summary

The risks of other contaminants are considered low in the case of the Suffolk MAR scheme. The source water was monitored 13 times over 18 months for over 590 compounds of potential concern and none was found to be problematic. Overall, the MAR scheme demonstrated that water quality and water resource requirements were successfully met, and that the MAR system could be managed to augment water resources for irrigation in addition to providing an alternative means of storing high surface flows.