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

Research Summary 2: Quantity of aquifer recharge and recovery

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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.

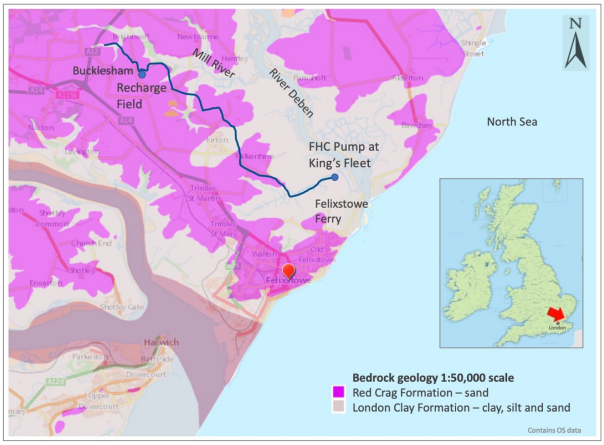

Fig. 1 Location map showing surface geology and the King's Fleet pumping station (FHC Pump) at Felixstowe Ferry and the MAR site at Bucklesham. The blue line shows the dual-pipeline to transfer water inland to farm reservoirs and the MAR site.

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 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**).

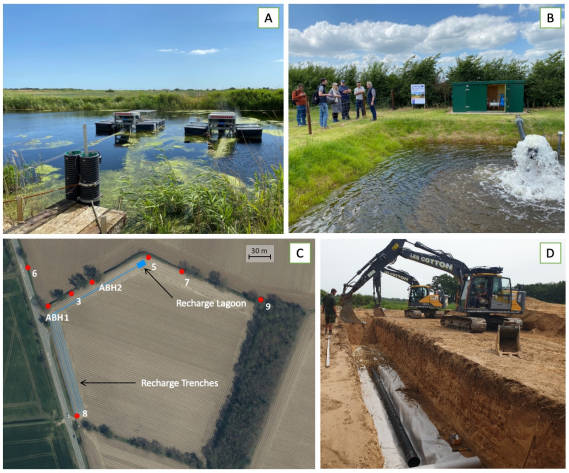

Fig. 2 A: Surface water abstraction location in the King's Fleet showing the eel-friendly, Riverscreen source-water pumps. B: Recharge lagoon at the Bucklesham MAR site in operation. C: Abstraction borehole (ABH1, ABH2) and observation borehole location plan, including the position of the recharge lagoon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

Between 9-20 June 2022, 12,262 m^3 of source water were recharged to the aquifer (**Fig. 3**). During this period, 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} on 20 June, below the threshold value of 165 mg L^{-1} set by the Environment Agency. The recharged water was successfully abstracted from the Crag aquifer from 18 July to 10 September 2022, augmenting surface storage irrigation reservoirs during an exceptionally dry period.

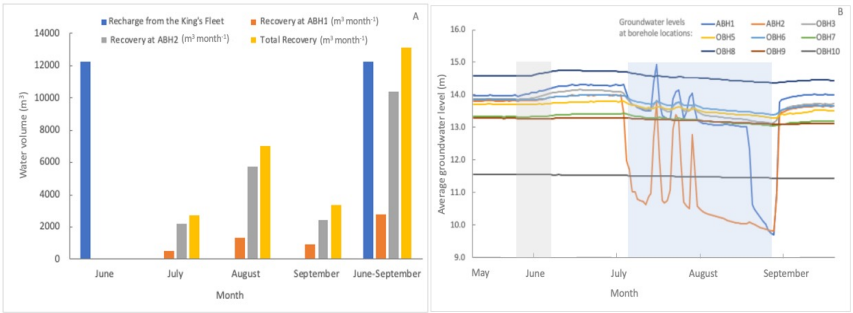

Fig. 3 A: Cumulative volumes (m^3) of recharged surface water and re-abstracted groundwater during the MAR recharge trial, June–September 2022. B: Daily average groundwater levels at abstraction and observation boreholes (ABHs and OBHs, respectively) recorded during the period May–October 2022. Grey and blue panels indicate recharge and recovery periods, respectively. Peaks in water levels (ABH1, 2) show pump power supply outages.

Summary

The MAR scheme proved technically feasible under current groundwater regulations but the Crag aquifer hydraulic conductivity at the Bucklesham site was found to be a limiting factor. Although it is relatively easy to recharge the aquifer, the combined abstraction rate from the two abstraction boreholes (250 m^3/day consented maximum) restricted the yield from the scheme. However, installing additional boreholes to increase abstraction has the disadvantage of making the MAR scheme economically less viable, as too does the cost of water quality sampling and analysis for complying with groundwater regulations.