British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

Groundwater: site scale, catchment scale, basin scale

Stephanie Bricker, John Bloomfield, Daren Gooddy, David Macdonald and Rob Ward

Introduction

There are significant groundwater resources in the Thames Basin (Figure 1) supporting approximately 40 per cent of public water supply. Additionally many of the rivers in the catchment are supported by groundwater from the underlying aquifers. Effective management of both groundwater resources and groundwater-dependent ecosystems requires a good understanding of how our aquifers behave. We must also consider how these systems will respond to future changes, in particular climatic variability, land-use change and continued urban development. Our poster presents a few examples of how we are working to improve our understanding of groundwater systems in the Thames Basin, in particular we look at flooding in Oxford, groundwater–surface water interactions in the Chalk and the response of groundwater to a changing water cycle.

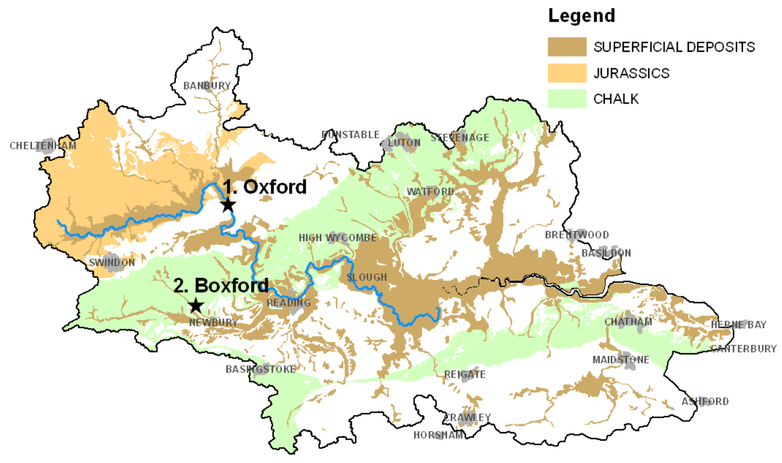


Figure 1 An overview of groundwater systems in theThames Basin.

Oxford observatory

A series of nationally important studies are being undertaken by the British Geological Survey (BGS) within the River Thames floodplain in Oxford (Figure 2). These are helping to understand the natural environment and its interaction with human settlements. Upstream of Oxford, a state-of-the-art, high-density, wireless network of underground sensors is being installed to help understand how nutrient input, water accessibility and the flood regime within an ecological site determines the health of a sensitive plant community. This will have relevance to the design of flood mitigation measures being considered to protect the urbanised floodplain located downstream, which may involve changing the upstream flooding regime.

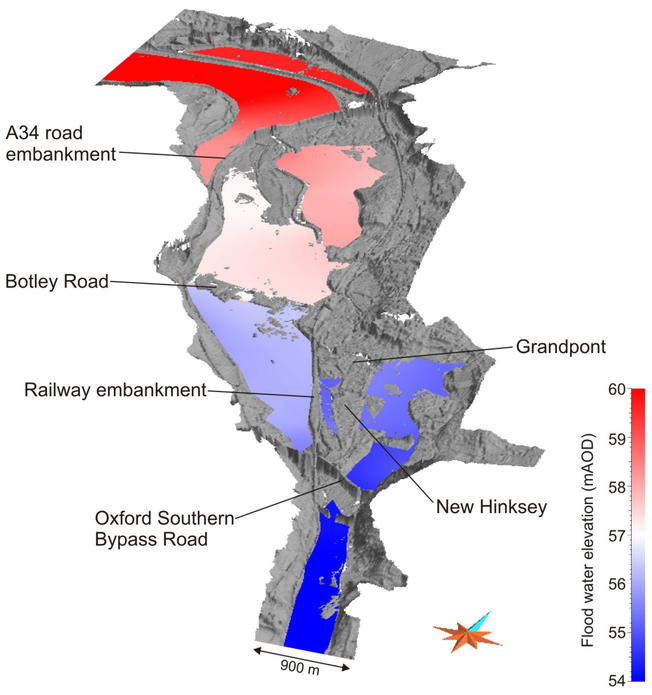


Figure 2 Flood water elevation in Oxford (July 2007).

As well as river flooding, Oxford suffers from groundwater flooding as water upwells from underlying permeable rocks. A BGS study is looking at the factors that control where and when it occurs. There are many historic waste dumps on the Thames floodplain in Oxford and a further BGS study is examining how natural processes in the underlying sediments are reducing pollutants in groundwater emanating from the dumps, which could be discharging into the River Thames.

Boxford observatory

Flow in the river Lambourn, like many rivers in the south-east is supported by groundwater from the underlying aquifer. Boxford Observatory is used to understand the mechanisms of the groundwater–surface water interaction for the effective management of water resources and for the protection of sensitive ecosystems.

Investigations of the hydraulic system have involved boreholes, riparian (river margin) and river-bed piezometers and have employed a combination of hydrophysical and hydrochemical techniques. A 3D geological model (Figure 3) of the site was constructed, based on a combination of surface geology and borehole logging data. The river at Boxford flows over river gravels underlain by Chalk.

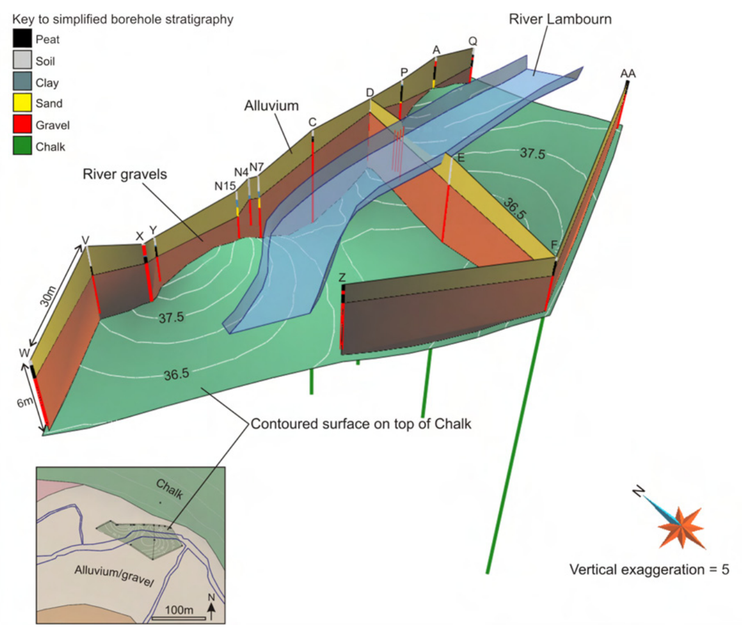
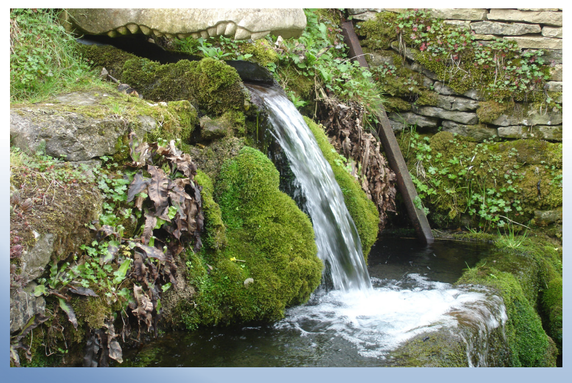


Figure 3 A 3D geological model for Boxford.

The model provided a framework for the ensuing conceptual hydrogeological model, which utilised physical hydraulic and hydrochemical data. Investigations at the site have indicated a complex pattern of interaction between groundwaters and surface waters. This may have implications for the way such systems are studied and for the implementation of regulations such as the European Water Framework Directive.

Changing water cycle (CWC)

The BGS are embarking on a four-year NERC funded project to investigate the effects of climatic extremes on groundwater systems in collaboration with Imperial College London, the University of Reading and University College London.Three contrasting hydrogeological settings will be assessed as part of the project including two in theThames Basin, these being the Jurassic limestones of the Cotswolds and the Chalk of the Berkshire and Marlborough Downs and the Chilterns.



The project aims to:

- exploit current climate science and statistical methods to improve and enhance projections of potential change in hydrological parameters over a time-scale of 10 to 60 years, in particular extremes of heavy precipitation and drought
- build on the analysis of historical data to improve scientific understanding and develop innovative methods for the modelling of extremes and non-stationarity in the hydrological response to climate variability
- improve the representation of hydrological processes in land-surface models, in particular, the enhanced modelling of unsaturated zone and groundwater processes on land–atmosphere feedbacks

Basin-wide datasets

The Groundwater Science team at BGS has developed a series of national thematic maps and datasets which cover the Thames Basin in its entirety. These datasets are valuable resource for characterising groundwater systems and developing conceptual models.

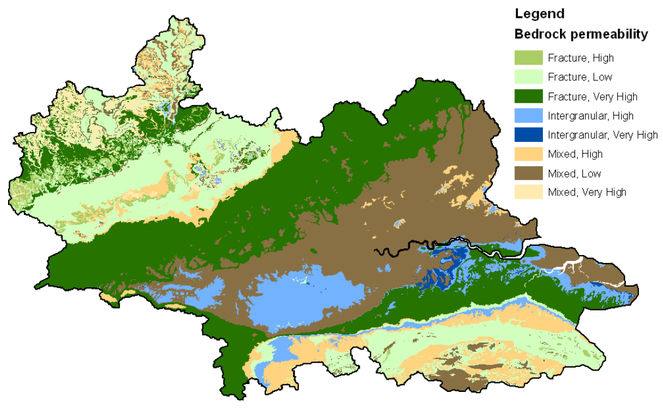


Figure 5 Aquifer (bedrock) permeability.

Current datasets include:

- groundwater flooding susceptibility
- aquifer permeability
- depth to water table

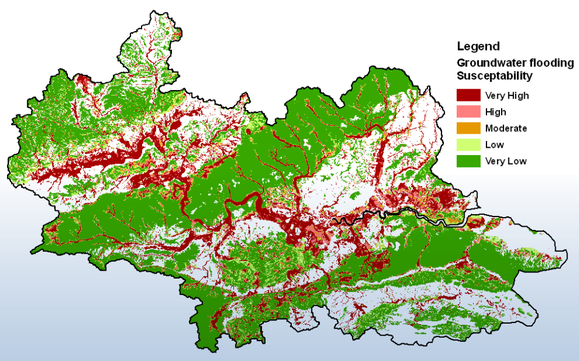


Figure 4 Groundwater flooding susceptability.

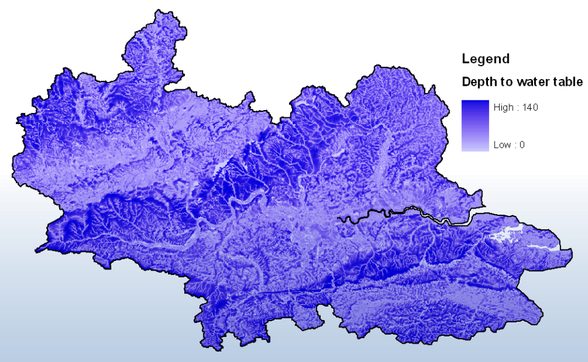


Figure 6 Depth to water table.

Contact information

John Bloomfield www.bgs.ac.uk /research/groundwater/waterResources/thames/home.html email: jpb@bgs.ac.uk