NERC is investing £10 million in the LOCAR programme between 2000 and 2006. To see which organisations are involved in the programme, visit www.nerc.ac.uk/locar

The international picture

The intensive, detailed groundwater monitoring LOCAR provides is unique within UNESCO's International Hydrological Programme - Hydrology for the Environment, Life and Policy (HELP). The study sites are well equipped for experimental hydrology and set high standards in meeting the science needs of water-land management and water policy development.

LOCAR is a large collaborative programme that depends on many people and organisations. We are particularly grateful to the farmers and landowners who have given permission for research on their land, to the Environment Agency for data and for additional funds, and to Defra for additional funds.

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NATURAL ENVIRONMENT RESEARCH COUNCIL

The hydrology and ecology of Lowland Water Catchments

The Lowland Catchment Research Programme (LOCAR)

Water resources are under pressure

Water resources are under pressure, particularly in the Midlands and south of England. An increasing population, with more households and greater wealth, needs more and more water.

Over the past 50 years the widespread use of agricultural chemicals has also carried pollutants into our aquifers (water-bearing rock strata), threatening drinking water quality and river ecosystems.

Climate change may alter the environment more. Hotter summers could dry out headwater streams. Prolonged winter rains may cause more frequent groundwater flooding as water tables rise.

People are increasingly aware of the valuable services water ecosystems provide to society and nature. Changes in the way water resources are regulated are placing new emphasis on creating and maintaining a healthy ecological environment. The Lowland Catchment Research Programme (LOCAR) is helping us understand how water catchments function.

Understanding how water moves through the environment

We need to accurately understand how rainfall – and the material it carries – recharges groundwater stores, and runs off land into rivers and wetlands. The LOCAR programme is studying catchments in three areas of England where aquifers feed rivers. The Pang and Lambourn rivers in Berkshire are tributaries of the Thames. The Frome and Piddle in Dorset flow into Poole Harbour. The upper parts of these rivers are on chalk, with the lower parts a mixture of sand, clay and gravel. The Tern in Shropshire flows into the Severn downstream of Shrewsbury. This catchment is on sandstone. Throughout the catchments researchers have installed state-of-the-art instruments to measure rainfall, evaporation, soil moisture and – through a network of new boreholes – groundwater depth and chemistry. Scientists monitor changes in water flow and chemistry along the rivers. Each year we survey the habitats in the rivers and monitor changes in land use along river corridors. These basic measurements provide the background data for 12 major research projects, and several smaller studies. Each project is looking at a different aspect of the hydrology or ecology of one or more of the catchments. For a full list, see www.nerc.ac.uk/locar.

Areas of research

Most of the rain in the drier parts of Britain is evaporated back into the atmosphere through plants. We know much about how individual crops and large expanses of forest use water, but the landscape is a patchwork of fields, hedges and small woodlands. Little is known about evaporation from wet woodlands where the water table is close to the surface. LOCAR is measuring evaporation from all these components and from the landscape as a whole.

Because soil contaminants eventually affect water quality in rivers, LOCAR is investigating how water, and the chemicals it carries with it, infiltrates through the soil into the groundwater and then the streams.

Water movement through chalk is particularly complicated. Chalk has fine pores that transport water slowly, and fissures through which water moves relatively rapidly. LOCAR is establishing how much of the groundwater moves through the fissures and how much through the pores. We are also investigating how much groundwater seeps into the river as it flows through the catchment. The results will help to predict the impacts of long dry periods on springs and rivers, and the movements of contaminants from groundwater to the rivers.

Small tributaries and backwaters can be important refuges for freshwater fish when rivers are running high. One project is investigating the nature, timing and significance of these habitats for lowland river fishes during different hydrological and environmental conditions, and at different stages in the fishes' life history. The ultimate aim is to understand how river and catchment management plans affect lowland river fish populations.

Sediment also moves through the rivers and can transport chemicals and aquatic plant seeds. Researchers are measuring the quantity, pattern, quality and composition of sediment in river channels. This will help us understand the best ways to manage rivers and plan river restoration.

The catchment perspective

One way of combining the results from all these diverse studies is to use a computer model that maps how water moves across and through a catchment. Solar radiation, geology, soil, vegetation and man-made features all vary across the catchment, and all influence how water, and its contaminants, move. These influences can be mapped either from land-based survey or by satellite remote sensing. Researchers then draw up equations to represent the timing and route of water movement and the chemical and biological changes taking place. The overall model should predict how changes in one part or component of the catchment will affect the quantity and quality of water in another.

Preliminary modelling work on the Pang catchment has already shown how water resources are sensitive to changes in vegetation. Modelling demonstrated that aquifers under recently planted woodland in the south of the catchment would be recharged more slowly, and aquifers under land recently converted from pasture to arable farming in the north would be recharged faster.