

# Evidence

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## Understanding the performance of water supply systems during mild to extreme droughts

Project summary SC120048

This project assessed the performance of different types of public water supply systems in England and Wales in a range of droughts, including those that are more severe than the worst droughts in the historical record. This information was used to identify the relative sensitivity of different supply systems under stress. The results of these 'stress tests' will help to improve our understanding of water supply system sensitivity to drought.

Nine case study water supply systems were selected to represent the diverse range of system infrastructure, geology and climate found across England and Wales. Simplified water system models were developed for each case study. To simulate system performance under drought conditions, system performance was simulated through a range of possible droughts. This gave results that characterised the relative sensitivity of each system to drought.

The approach explored systematically a range of drought scenarios with varying rainfall deficit, duration and seasonality. This allowed a rigorous and consistent comparison of drought impacts. The sensitivity of the water supply system to drought was summarised using supply-demand performance metrics, which were presented as drought 'response surfaces'. The response surfaces from all the case studies were analysed to identify similarities or differences in the systems' performance to the same range of drought scenarios.

The results show that the case study water supply systems typically fall into three groups. Those that:

- experience rapid failure;
- experience progressive failure;
- exhibit low sensitivity or high resilience to drought.

Systems that experience rapid failure typically fill every winter but can lose water very quickly. These systems tend to be resilient to a wide range of different droughts, but in severe droughts, winter refill is interrupted and the systems empty quickly.

Systems exhibiting progressive failure typically store enough water to last more than one summer. These systems are sensitive to both drought duration and intensity. They experience a gradual decline in water availability through successive years of longer droughts.

Supply systems with low sensitivity systems often have several different sources, often having a mix of groundwater and surface water supply. In these systems, supply deficits can occur but remain limited for all but the most severe droughts. These systems are not affected significantly by either drought duration or intensity.

The results suggest that systems that draw on different sources of water, sometimes referred to as conjunctive use systems, tend to be more resilient than systems based on a single source of water. The most resilient systems tested tended to be where reservoir or groundwater resources were supplemented by abstractions from large rivers with flows that are supported by natural catchment storage or artificial river regulation.

Although the case study results imply that some distinctions can be made for supply system sensitivity, it was not possible to generalise the drought response based on the characteristics of the water supply systems. This is in part because of the small sample from which to draw conclusions and partly because a system's response is the result of a complex interplay of many different system-specific characteristics. A much more comprehensive analysis across a multitude of system combinations would be required to determine whether the development of a generalised typology is possible.

The drought sensitivity framework approach developed for this project has a wide range of potential applications in water resources planning, including the following:

- as an options appraisal tool to look at the relative benefits of drought management options;

- to assess the impact of infrastructure changes or changes in abstraction licence conditions on the system drought resilience;
- as a screening tool to estimate a water supply system's response to droughts that have not previously been experienced.

This summary relates to information from project SC120048, reported in detail in the following output(s):

**Report:** SC120048/R

**Title:** Understanding the performance of water supply systems during mild to extreme droughts

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**Project manager:** Stuart Allen, Evidence Directorate

**Research Contractor:** Dr Steven Anderton, Amec Foster Wheeler, Partnership House, Gosforth, Newcastle. NE3 3AF

**Research Contractor:** Dr Ralph Ledbetter, HR Wallingford, Howberry Park, Wallingford, Oxfordshire. OX10 8BA

**Research Contractor:** Prof Christel Prudhomme, Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire. OX10 8BB

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E: [enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk).

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