Briefing

A Systems Approach to Managing the Water Environment

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Contents

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About the Foundation for Water Research

The Foundation for Water Research (FWR) is an independent community of professionals from across the water sector and related scientific specialisms. The community comes together for deliberative discussion to support the development of interdisciplinary solutions to water challenges.

The FWR Community provides guidance and strategic thought leadership for the Institution of Environmental Sciences' (IES) water activities and collaborates with the wider IES family on issues related to land, air and policy implementation.

The FWR is led by a Committee, which is informed by three technical panels: Water Environment and Ecosystem Services, Water Resources and Quality, and Sustainable Wastewater Management. The Community has representatives from across the water sector, spanning industry, academia, consultancy, regulators and NGOs.

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Introduction

The importance of a systems approach to water management is gaining traction in the UK, with many across the sector calling for systems approaches to be embedded across practice and policy to ensure a sustainable water future. There are still many challenges in implementing a systems approach in practice, but this paper highlights some examples of how systems thinking can be applied to the water sector to deliver multiple, interconnected benefits for people and nature.

The recent publication of the UK's White Paper on water reform ('A New Vision for Water')[1] in January 2026, along with the Independent Water Commission's final report,[2] have highlighted the need for a more systemic approach to water. In order to achieve these ambitions in practice, it is essential that legislation is developed that is aligned with a systems approach and dismantles barriers to its implementation.

Although further detail is expected in the government's upcoming Transition Plan, proposed elements of the White Paper outline key changes that indicate a move towards a systemic approach: in particular, the shift to regional water planning and the focus on a long-term strategic view for water.

For these ambitions to be realised, it is essential that focus now shifts to effective implementation. This FWR paper is designed to support water professionals in considering what a systems approach is and how it applies to the water sector, highlight examples of systems approaches in the sector, and provide reflection on how insights from these projects can help to dismantle barriers to systems approaches.

The importance of a systems approach in the water sector

The term 'system' refers to the interrelated components within ecosystems, economies, organisations, societal structures, and other complex networks, along with the interactions between them. A systems approach is one that recognises how social, economic and natural systems influence outcomes, adopting ways of working that address the dynamic and complex nature of systems to effect change and avoid unintended consequences.[3]

Fundamentally, the water cycle is a complex subsystem of the global socioecological system, touching on all environmental media and species including dimensions of human activities and wellbeing. It is therefore vital that water is respected as an integrated system to retain this vital functionality and its ramifications for multiple dimensions of the natural and human worlds.

As water interacts with virtually all dimensions of human wellbeing, a systems approach to the management of water resources is an essential thread of sustainable development; sustainability itself also constituting a systemic concept. Due to this systemic context, anthropogenic pressures on the water cycle are multiple and diverse. They range from climate change to pollution, unsustainable abstraction and loss of aquatic biodiversity, impacts of invasive species and insensitive land uses, amongst many other factors. Impacts arising from these pressures are also multiple and diverse — just some examples include reduced flood and drought resilience, contaminated water resources and fishery collapse — cumulatively undermining capacities to meet demand for water supply, food production, conservation of biodiversity and myriad other beneficial ecosystem services.

Managing water sustainably demands a systemic approach; an approach that recognises how social, economic and natural systems influence outcomes. It is essential that ways of working address the dynamic and complex nature of systems to effect change, rejecting historic approaches focussed solely or substantially on narrow issues.

Water resources do not respect jurisdictional boundaries. However, they are subject to a complex legislative and regulatory landscape.

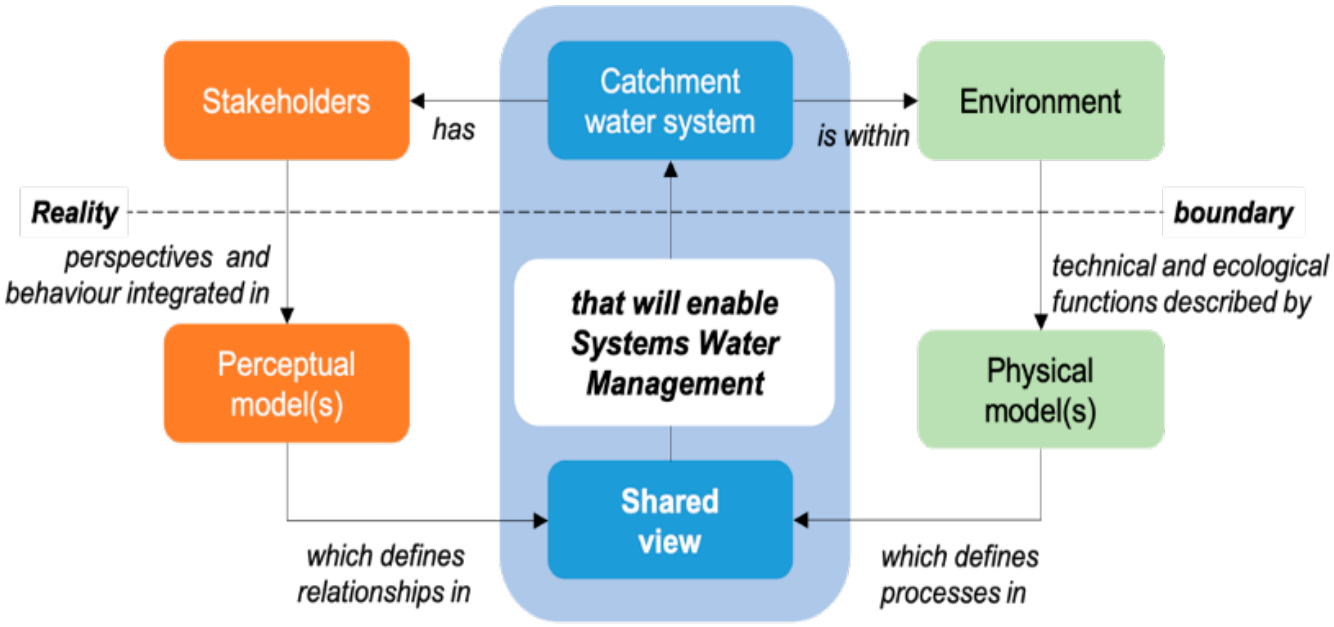
Interventions in different areas of a watercourse, including its catchment, can have diverse and often spatially and temporally distant impacts across and between both surface water and groundwater catchments. They can generate multiple outcomes, with a diversity of influences on intrinsically interconnected terrestrial and marine environments. Sustainable management therefore necessarily involves interactions and collaborations across multiple stakeholders, geographical regions, societal sectors and disciplinary interests, necessitating the need for a systems approach that takes these diverse factors into account and limits the potential for creation of unforeseen or unintended negative consequences. The CASYWat project developed a Systems Water Management (SYWM) framework to supports systems approaches to water management (see Box 1 and Figure 1).

There is wide acknowledgment of the need for systemic and transformative approaches to the issues facing the water environment, yet a legacy of narrow disciplinary and asset ownership approaches hampers systemic action. There is a pressing need to move away from more traditional sector-by-sector initiatives, towards approaches founded on systems thinking that support integration, collaboration and equity as robust underpinnings of sustainability.

Box 1. CASYWat Project

To support a systems approach to water management, the Systems Water Management Framework for Catchment Scale Processes (CASYWat) project developed a Systems Water Management (SYWM) framework,[4] which provides an overview of the many complex aspects of the water systems and their interactions. This can be used as a reference to support those working in the sector to understand and enable systems approaches and the delivery of solutions with multiple benefits. The CASYWat project was a result of a collaboration between the Environment Agency, the Royal Academy of Engineering and Dr Ana Mijic (Imperial College London) through a National Environment Research Council (NERC) Innovation Placement. The project's aim was to co-develop an innovative approach for systems-based understanding, structuring and analysis of relevant environmental, technical, and social processes in the context of catchment water management in the UK.

Figure 1. Conceptual representation of a catchment water management system. Contains Environment Agency information © Environment Agency and database right.



Current management of the UK water environment

The management of water resources in the UK is complex as it covers multiple disciplines including water supply, sewerage and wastewater services, drinking water quality, environmental protection, flood and drought protection and adaptation, fisheries, and conservation of aquatic biodiversity. Water legislation is therefore wide-ranging, covering both water resource management, such as flood risk management, abstraction and land drainage, as well as other areas of law that intersect with water management, such as environmental permitting and agricultural and nature conservation law.

Policy on water management is a devolved issue and, as such, is dealt differently across the UK's devolved nations. This section focuses on water management in England and Wales.

The legislative landscape is currently in flux with significant legislative change on the horizon. In January 2026, the UK government published the White Paper 'A New vision for Water',[1] setting out plans for reform in England and Wales. This paper followed publication of the Independent Water Commission's final report in July 2025,[2] which provided recommendations for reform to improve the regulatory system governing the water services sector. The Water Commission was launched jointly between the UK and Welsh Governments. The January 2026 White Paper will be followed by a 2026 Transition Plan and a Water Reform Bill.

The Welsh Government also published a Green Paper on water reform, 'Shaping the Future of Water Governance in Wales' in February 2026.[5]

Further FWR papers will be exploring the implications of the proposed reforms and recommendations for enabling a systems approach to water management.

Key current water legislation includes:

The Water (Special Measures) Act 2025 was developed to strengthen the power of the water industry regulator and ensure water service companies are better held to account. Measures introduced in the Act include blocking bonuses for executives of companies that pollute waterways, enabling automatic and severe penalties for wrongdoing, and ensuring monitoring of every sewage outlet.

The EU Water Framework Directive (WFD), which covers management related to surface water bodies, groundwater, estuaries and coastal waters, has been embedded in domestic legislation and is therefore retained across the UK post-Brexit. The Water Environment (Water Framework Directive) (England & Wales) Regulations 2017 provide a framework for managing the water environment, seeking to establish an integrated approach to the protection and sustainable use of the water environment with a primary focus on outcomes, including the attainment of the long-term goal of Good Ecological Status or, if infeasible in Heavily Modified Water Bodies (HMWBs) and Artificial Water Bodies (AWBs), achievement of Good Ecological Potential. To achieve this, the WFD requires the development of River Basin Management Plans (RBMPs), the setting of environmental objectives for groundwater and surface waters, and the implementation of 'Programmes of Measures' to meet those objectives, covering areas including ecological, geomorphological and chemical status.

Catchment Partnerships are included in RBMPs. They provide an opportunity for public bodies, partnership groups, voluntary groups, water companies, businesses and other institutions to collaborate to develop and implement catchment-based and local delivery plans. The Catchment Based Approach (CaBA) (see Box 2), introduced by Defra in 2013 to facilitate partnership working, is a community-led approach that aims to engage people and groups from across communities at a local level to help integrate efforts to improve water environments. There are CaBA partnerships working in all 100+ river catchments across England and cross-border with Wales. These partnerships are often led by conservation organisations or NGOs, and are supported by catchment coordinators at the Environment Agency and an independent CaBA National Support group. Reductions in budgets to the Environment Agency have raised resourcing challenges at the catchment level, with the third cycle of the RBMPs 2022-2027 being criticised for weakening progress made in the second cycle by focusing at the river basin district level, rather than the smaller catchment level.

Water is also a priority area under the Environment Act 2021, with targets outlined in the Environment Improvement Plan related to declining pollution, reduced water demand, increased water efficiency and improvement of aquatic ecology.

Some other key elements of domestic legislation pertaining to water management include:

- The Urban Waste Water Treatment (England and Wales) Regulations 1994:

  Implementing the EU Urban Waste Water Treatment Directive, this domestic legislation aims to protect the environment from the adverse effects of untreated urban wastewater including water from domestic and industrial premises and urban pollution from surface water run-off. The main requirements are the establishment of systems to collect wastewater from urban 'agglomerations', secondary treatment of wastewater, identification of sensitive areas and more stringent treatment of wastewater discharged to sensitive areas.

- The Flood and Water Management Act 2010:

  The aim of this Act is to help improve flood risk management and ensure the security of water supplies in England and Wales. The Act updates pre-existing legislation to provide better protection of property from flooding, manage water resources more sustainably including securing water resources during periods of drought, and improve public services.

- The Water Supply (Water Quality) Regulations 2016:

  The Regulations consolidate legislation concerning the quality of water supplies for human consumption in England.

- The Bathing Water Regulations 2013:

  These Regulations implement an EU Directive setting standards that designated bathing waters are required to meet, including faecal contaminants indicating the presence of sewage.

Alignment of current management practices with a systems approach

Despite legislation related to water management in the UK outlining the need for an integrated approach, this is often not delivered in practice. It is essential that further work is done to understand and address these barriers, particularly with significant water reform on the horizon. Transition plans must ensure that reforms are aligned with achieving a systems approach in practice and provide the appropriate legislative frameworks and regulatory powers and processes to support this. This includes addressing how a systems approach can be used to set long-term goals, along with plans for their associated implementation and regulation.

Systemic framings are often lacking when implementing measures to address narrow disciplinary outcomes and achieve specific siloed environmental and water targets. The associated assignment of funds based on narrow disciplinary grounds further limits scope for systemic investment. Competing or conflicting outcomes are frequently evident, for example between abstraction and river health, or between pollution control and flood resilience, as well as overlooking potential multi-beneficial solutions. There also needs to be greater support for practitioners and stakeholders to implement approaches that can unlock multiple benefits.

The myriad societal benefits of a connected and fully functional water system — often in practice not evaluated and understood when formulating management solutions — can therefore be undermined by segmented uses serving localised demands, rather than optimising net value by establishing systemic solutions seeking to optimise multiple benefits for people and nature.

An evolving uptake of catchment management approaches has helped incrementally to recognise interactions in catchment systems, yet conflicts remain due to competing demands, expectations, and narrowly framed or implemented regulations. Optimisation of ecosystem service outcomes to best serve the needs of all in society, critically including future generations and the ecosystems essential to support them, requires an overarching vision balancing catchment and water uses with conservation of the fundamental processes within the water cycle. Catchment approaches also need to be properly resourced to unlock the value that healthier catchments can provide, enabled

by a truly collaborative approach that breaks down siloes between key stakeholders and disciplines, and seeks to optimise overall beneficial ecosystem services.

Applying systems thinking approaches can also support the development of more effective legislation and regulation. For example, the UK could learn from approaches being used in the EU, particularly in relation to the recast of the Urban Wastewater Treatment Directive (entered into force January 2025). The Polluter Pays Principle and Extended Producer Responsibility are key elements, with a requirement for pharmaceutical and cosmetic manufacturers to cover at least 80% of the cost for advanced ('quaternary') treatment to remove micropollutants, with benefits across the water system. Considering how the water sector can contribute to wider environmental goals, such as embedding a circular economy and reducing carbon emissions, is also an essential part of embedding systems approaches to the water sector.

There is a need to progress, and to bring into the mainstream, analyses to promote greater understanding of mutual interests and priorities across different stakeholders sharing catchments. From this, systemic methodologies and approaches can be developed to harmonise currently competing priorities, establishing a framework for consensus and developing aligned, multi-beneficial solutions. Elevating the vision of legislation and its implementation into practical management can promote a progressively more holistic approach to water management, better meeting the needs of people and the health of supporting ecosystems.

Examples of systems thinking approaches for water management

There are some examples of a transition towards a systemic approach to water management, often still fragmented and exceptional, but representing steps towards systemic practice. A number of illustrative examples are given below:

United Utilities' Sustainable Catchment Management Programme (SCaMP)

United Utilities' Sustainable Catchment Management Programme (SCaMP) applied systems thinking to manage 57,000 hectares of land around reservoirs in Northwest England, focused on improving water quality and biodiversity through integrated land management. There were three phases: SCaMP 1 (2005–2010); SCaMP 2 (2010–2015), and SCaMP 3 (2015–2020). United Utilities collaborated with farm tenants, the RSPB, Natural England, the Forestry Commission, and regulators including Ofwat and the Environment Agency. The outcomes of the SCaMP 1&2 cycles, with over £22 million invested across 57 farms, included restored moorlands, improved farm infrastructure, protected watercourses, and enhanced habitats. Challenges and key learnings included that balancing agricultural practices with ecological restoration required stakeholder trust, adaptive management, and long-term commitment to land-use change. Since it first started in 2005, SCaMP has now evolved into the Catchment Systems Thinking Approach (CAST). This programme was driven primarily by the water utility's need to protect raw water quality but took a deliberately multi-functional approach in collaboration with all potential beneficiaries.

UK Rivers Trust Movement

The establishment and evolution of the UK Rivers Trust movement, beginning with the founding of the Westcountry Rivers Trust in 1994 and the subsequent progressive establishment of local catchment-based Trusts, culminated with the establishment of The Rivers Trust as a national overarching body in 2004. The Rivers Trusts emerged organically, responding locally to needs to manage rivers holistically using catchment-based approaches rooted in systems thinking. Beyond founding interests, local communities, farmers, environmental NGOs, regulators (such as the Environment Agency and Natural England) and academic partners have all played key stakeholder roles. The Rivers Trust movement has since grown to over 60 Trusts, delivering

catchment-scale restoration, pollution mitigation, and community engagement across the UK and often participating in or leading CaBAs (see **Box 2**). Over the years, challenges and key learnings have found that success depends on local knowledge, stakeholder collaboration, and adaptive tools such as SCIMAP[6] to target interventions effectively.

South West Water's Upstream Thinking Programme

South West Water's Upstream Thinking programme, initiated in 2007 to improve raw water quality and biodiversity through catchment-based, nature-led solutions in South West England, has contributed to a nature-based focus on delivering benefits for the water environment, its use and those that pay for water services. The programme aims to reduce the impact of agricultural practice on biodiversity and water quality through the use of nature-based solutions. Upstream Thinking was initiated by the regional water utility, South West Water, with the permission of the financial regulator, Ofwat, noting that raw water protection at source was more financially efficient than investment in infrastructure to clean up polluted water at downstream abstraction points.

Box 2. An overview of the Catchment Based Approach (CaBA)

The Catchment Based Approach (CaBA) is a community-led, collaborative framework for managing and improving the water environment across England and Wales. CaBAs were established by Defra in 2013. CaBAs bring together organisations from across civil society, government, business and local communities to work at river-catchment scale, recognising that effective water management must consider entire catchment systems rather than isolated sites. CaBA partnerships are actively working in all 100+ river catchments across England and cross-border with Wales. The partnerships involve more than 1,500 organisations, including Government, NGOs, water companies, local authorities, landowners, academia, business, angling groups and community organisations. CaBA partnerships champion integrated management of land and water to support the delivery of multiple benefits. These partnerships collectively pool evidence, develop shared visions, and deliver targeted actions to improve water quality, enhance biodiversity, reduce flood risk and strengthen climate resilience. CaBAs also have a role in supporting key priorities within the UK Government's 25-Year Environment Plan, such as sustainable land management, nature recovery, pollution reduction and connecting people with the environment. The integrated and cross-cutting structure of CaBAs — which provide a globally unique, whole-catchment community framework — builds partnerships, empowers local stakeholders, supports cost-effective delivery, helps leverage additional funding for local environmental projects, and drives practical, evidence-based action to improve rivers, landscapes and community wellbeing.

The Westcountry Rivers Trust was a key NGO partner working with local farmers to implement water improvement or protection plans. Further support came from Devon and Cornwall Wildlife Trusts, Exmoor National Park Authority, Natural England, and the Environment Agency. Over £20 million has been invested since 2007, contributing to measures that have reduced agricultural runoff, restored peatlands, planted trees, improved farm infrastructure, enhanced biodiversity and lowered water treatment costs. Challenges and key learnings include that success requires long-term collaboration, trust-building with farmers, and adaptive management to balance ecological goals with agricultural productivity.

Anglian Water's Integrated Constructed Wetlands

Since 2022, the regional water utility Anglian Water has invested over £50 million in multifunctional Integrated Constructed Wetlands (ICWs) as part of its nature-based water treatment strategy under the AMP8 programme. Key stakeholders include Anglian Water, support from the Norfolk Rivers Trust and RM Wetlands and Environment Ltd, @one Alliance, Solutions By Nature (Binnies–Salix JV),[7] VESI Environmental, local communities and regulators. To date, 26 ICWs are planned for delivery by 2030 to treat wastewater naturally, removing nutrients like phosphates and ammonia, but co-beneficially also producing wetland ecosystem services enhancing biodiversity, reducing carbon emissions, buffering treated wastewater flows and improving water quality before discharge into rivers. Challenges and key learnings include that designing ICWs requires deep ecological understanding, stakeholder collaboration, and balancing engineering with landscape integration. Long-term monitoring and adaptive management are also essential.

Rapid Assessment of Wetland Ecosystem Services (RAWES)

The Rapid Assessment of Wetland Ecosystem Services (RAWES) framework was developed by Rob McInnes and Mark Everard to support implementation of commitments under the Ramsar Convention, providing a cost-effective, systemic but, above all, rapid and practical method for recognising the multiple benefits provided by wetlands. Key stakeholders involved in the roll-out of RAWES include the Ramsar Convention, the Ramsar Regional Center – East Asia, and the Ministry of Environment (Republic of Korea). RAWES enables rapid, inclusive assessments of ecosystem services across spatial scales, supporting wetland conservation, planning and regenerative development, and has resulted in extensive pan-global uptake since it was adopted by Ramsar in October 2018. Challenges and key learnings from RAWES implementation include that effective use requires stakeholder engagement, integration of local knowledge, and balancing simplicity with ecological complexity. It supports a shift from ‘do less harm’ to seeking a systemic approach to ‘net environmental gain’ and associated linked societal benefits.

Case study: Using systems approaches in 'Understanding the Wye'

The River Wye flows through an Area of Outstanding Natural Beauty and has long been popular for tourism. But the river is not in good health, and its conservation status has been downgraded to unfavourable declining.[8] Water quality and biodiversity have deteriorated for numerous reasons predominantly relating to agriculture, wastewater discharges and climate change. Wye salmon numbers are at an all-time low and algal blooms are now an annual event.

A systems approach can help to understand complex catchments and assess potential opportunities and trade-offs. The Environment Agency supported Mott MacDonald to work with the Wye catchment partnership to develop a two-step project known as 'Understanding the Wye'.

In the first step, Participatory System Mapping (PSM) was used to pool the collective insights of local experts and show conceptually how the catchment functions as a system. This technical understanding of catchment complexity in terms of the challenges, opportunities and trade-offs was captured in a system map. The systems map was used to identify the interconnected results chains and identify suitable metrics as a basis for an integrated plan. Work on the integrated catchment plan is now being taken forward. A high-level summary of the system map is shown on this website. The map was analysed to create a system planning diagram which indicates interventions, system changes, outcomes and benefits to use in the catchment plan. The map also informed the design of the integrated modelling done on the project. The process made links across social, environmental, and economic benefits that could be achieved with a well-integrated plan.

The second step was to undertake integrated modelling of the catchment. Mott MacDonald is working in partnership with Imperial College London, applying their Water System Integrated Model (WSIMOD). This provided a high-level assessment of catchment performance across water quality, water resources and flooding unlike many other models which only assess single outcomes. Guided by the catchment partnership, the project ran different combinations of options in the model to assess what could be achieved to manage water quality, high and low flows. Options included actions such as reducing nutrient inputs, improving soil health and increasing tree cover.

The project has set a useful precedent for the application of participatory systems methods in a catchment with complex trade-offs and challenges. As well as providing an analytical basis for subsequent planning, the work brought the partnership together as people increased their understanding of the multi-faceted nature of the challenge. As the chair of the Wye and Usk Foundation put it: “Your work took us from the storming phase to the norming phase”. Participatory System Mapping gave the opportunity for all voices and positions to be heard and reflected back in the analysis underpinning the new catchment plan.

You can find out more about the project in the 'Understanding the River Wye' final project report.[9]

by Kate Rice, Mott MacDonald

Challenges in applying systems thinking to the water environment

A fundamental obstacle to application of systems thinking is the fragmentation of interests in water and associated catchment land use including, for example:

- Siloed legislation, prescriptive targets, and remits of regulatory bodies framing a narrow disciplinary approach, often enforcing conflicts with other dimensions of the water cycle;
- Consequent restrictions on budgets in terms of what water-regulated sectors (water industry, transport infrastructure, town planning, etc.) are permitted to evaluate as beneficial, excluding optimisation of potential synergistic societally beneficial outcomes;
- Market structure, which rewards immediate commodity outputs (intensive farming of catchment landscapes, water abstraction, etc.) driving unsustainable land and water uses;
- Entrenched property rights empowering asset owners to maximise private profit, largely blind to ramifications for publicly beneficial (or negative) outcomes generated by the assets they exploit; and
- Resources and skills to support implementation of systems approaches, including systems thinking and interdisciplinary collaboration skills.

There is undoubtedly a skills deficit across sectors with respect to what a systems approach practically means and, critically, how to consider and generate 'systemic solutions'. Moreover, systems approaches can seem daunting to professionals working in technical aspects of water management and adjacent sectors. Supporting professionals with the tools and methods to support application of systems thinking is therefore critical to ensure that people in the sector feel confident in using them. Central to this is building an understanding of how to conceptualise the water system and then identify appropriate scales and boundaries for the project. Systems thinking methodologies, such as the iceberg model, rich pictures, systems mapping, and theory of change approaches, should be encouraged to support professionals in the practical application of systems thinking (see Box 3 and Figure 2).

Funding may appear to be an obstacle, but the reality is that substantial private and public expenditure is already directed to outcomes on a fragmented basis; reconceptualising this investment in a systemic manner directed at optimally beneficial outcomes across all ecosystem services, and hence multiple beneficiaries, would constitute wiser investment of this money. Consideration of systemic investment should also include analysis of how privatisation impacts investment in new assets/infrastructure and maintenance of existing assets/infrastructure, the potential constraints this places on embedding systems approaches, and how they can be overcome through alternative approaches/business models.

Box 3. Systems thinking example methodologies

There are many examples of tools and methodologies that can support systems thinking, with varying levels of complexity and accessibility. The type of tool or methodology that is most appropriate will depend on the type of project. Different tools may also be useful at different stages of a project. Below are a few examples of potential tools/methods that can be used:

Iceberg Model

The Iceberg Model is a simple, accessible systems thinking tool which uses the metaphor of an iceberg to illustrate how the surface-level events we react to are underpinned by less visible patterns, structures, and beliefs.[10] It is a highly accessible tool that can support understanding of different perspectives and help to identify less visible aspects of a system.

Rich Pictures

Rich Pictures is a technique to identify the different parts of a system and how they interact, by drawing the system free-hand collaboratively with a group.[11] Members of the group can use whatever drawings they like to represent components of a system and relationships between them. It is a highly accessible tool that can be particularly useful at the start of a project to identify key issues and support development of a collaborative understanding and goals.

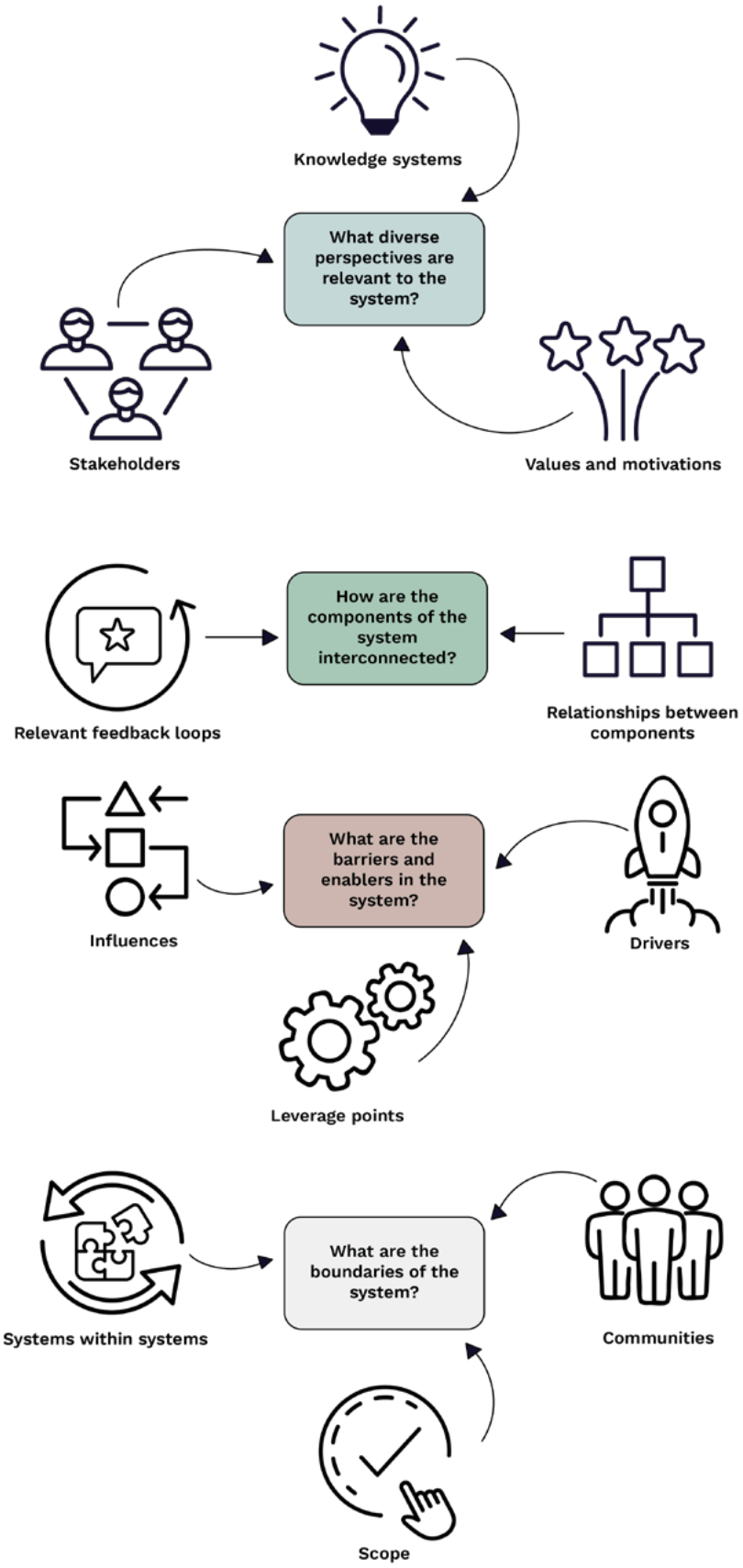
Theory of Change (ToC)

This is a framework to support a group in understanding how their activities can lead to their desired impact.[12] It is done backwards: you start with defining the desired impact of the project, then the outcomes that would be needed to achieve that impact, the outputs needed to achieve the outcomes and finally the activities that need to be done to produce those outputs. ToC can help identify underlying assumptions of how a proposed impact or goal is linked to a problem via a set of activities, outputs and outcomes. It is a more complex tool and is often iterative and participatory in nature. This tool is useful for identifying pathways to impact, articulating outcomes, and undertaking gap analysis.

Participatory Systems Mapping

This is a participatory approach where a group of stakeholders develop a causal map of an issue.[13] This process is often more complex and iterative and can involve multiple workshops where participants revisit map creation, and analyse and reflect on the issue. This supports its use as a tool for discussion and decision-making. It can facilitate a greater understanding of enablers and barriers, and identify potential leverage points for action within a complex system. This tool is useful for identifying and analysing specific interventions and activities in a project.

Figure 2. Key questions to ask to support a systems understanding



Enabling systems thinking approaches in the water sector

On the basis that demonstration is more powerful than merely identifying problems, a multi-pronged approach based on nascent and established positive examples and their extension is likely to be the most effective strategic approach. This includes:

- Demonstrating the cumulative societal benefits of the case studies cited previously in this paper, whilst also acknowledging barriers (regulatory, financial, etc.) yet to be revised, with recommendations for how they may be beneficially reformed, to facilitate wider uptake.

- Making the business case for a 'systemic solutions' approach, demonstrating net societal value (and conversely net societal disbenefit if siloed approaches are perpetuated). For example, articulation of the multiple ecosystem services values generated by floodplains in a semi-naturally functional state in comparison to their conversion for intensive maize cropping.[14]

- Supporting upskilling in systems literacy across professionals working in the water sector. This includes developing skills in interdisciplinary collaboration and facilitating opportunities for interdisciplinary knowledge exchange and solutions co-development, recognising the need for greater connection across those working in land, air and water sectors.

- Developing data and monitoring approaches that support a systemic approach, for example developing a set of water system baseline indicators.[15] Application of systems thinking will also need to be supported by complex systems analytics, so that it can be properly embedded within water planning and support long-term asset development best practice. Ofwat published guidance in 2022[16] on how systems thinking and systems analytics need to be used in asset planning to support delivery and manage risk in the longer term, and this should be used alongside complex systems analytics to manage information gaps and ensure future risk (such as regulatory risk and climate risk) are properly embedded within asset management plans, delivery and maintenance.

- Moving catchment management from a largely 'paper exercise' to a forum for co-creativity between government and other institutions to refocus planning on net optimal societal benefit, rather than

narrow disciplinary outcomes in isolation, recognising the great potential for win-win solutions.

- Changing the remit of statutory actors and regulated sectors to prioritise the wider values of nature (as for example already rhetorically committed both in the 2011 White Paper 'The Natural Choice', as well as signatories of the Convention on Biological Diversity) as an underpinning for sustainable resource use.

- Requiring that public investment affecting in the water environment, often today addressed in narrow disciplinary terms, is subject to systemic appraisal concerning how best to optimise benefits for all beneficiaries of ecosystem functioning including its support for the longer-term health and resilience of the water environment.

Next steps

This briefing paper sets out the importance of applying a systems approach to water management, and outlines some of the key challenges and opportunities this presents. Drawing on examples of systemic approaches in practice, it reflects on key enablers to supporting the wider adoption of a systems approach.

As reform across the water sector continues, the FWR will be building on the themes discussed in this paper with a particular focus on regional water planning and data and monitoring to support the implementation of a systems approach to water management.

To stay up to date on the work of the FWR, sign up for the free FWR newsletter. You will be the first to hear about new analysis, events and activities, including opportunities to engage and help shape workstreams.

Further reading

- White paper – Water reform: "A new vision for water", UK Parliament
- Report – Independent Water Commission: review of the water sector, GOV UK
- Briefing Paper – Building the evidence base for regional water planning, Imperial College London
- Working paper – Systems approaches to regional water planning, Imperial College London
- Report – A systems-based approach to catchment water management, Environment Agency
- Article – Water White Paper: An upstream glimmer of change? Institution of Environmental Sciences
- Briefing paper – Water policy: Horizon scanning briefing 2026, Institution of Environmental Sciences
- Briefing Paper – Future of water resources, Foundation for Water Research
- Article – Enabling nature-based solutions in the water sector, Foundation for Water Research
- Guidance – An introductory systems thinking toolkit for civil servants, GOV UK
- Article – Dialogue Between Disciplines: Navigating a path through the Borderlands, Institution of Environmental Sciences
- Guidance – PR24 and beyond: Final guidance on long-term delivery strategies, Ofwat

References

[1] **UK Government (2026)** A new vision for water: white paper**. https://www.gov.uk/government/publications/a-new-vision-for-water-white-paper** (Accessed: 13 May 2026)

[2] **UK Government (2025)** Independent Water Comission: review of the water sector**. https://www.gov.uk/government/publications/independent-water-commission-review-of-the-water-sector** (Accessed: 13 May 2026)

[3] **Institution of Environmental Sciences (2025)** Our shared Mission for Sustainable Wellbeing**. https://www.the-ies.org/resources/our-shared-mission-sustainable** (Accessed: 13 May 2026)

[4] **Environment Agency (2021)** A systems-based approach to catchment water management: Chief Scientist's Group report summary. **https://assets.publishing.service.gov.uk/media/6093cee9d3bf7f6d65602c6b/A_systems-based_approach_to_catchment_water_management_-_summary.pdf** (Accessed: 13 May 2026)

[5] **Welsh Government (2026)** Green Paper: Shaping the Future of Water Governance in Wales. Consultation. **https://www.gov.wales/green-paper-shaping-future-water-governance-wales** (Accessed: 13 May 2026)

[6] **Scimap (no date).** Home page. **https://scimap.org.uk/** (Accessed: 13 May 2026)

[7] **Binnies (2026)** Solutions By Nature progresses in Anglian Water's wetlands programme**. https://binnies.com/news/solutions-by-nature-progresses-in-anglian-waters-wetlands-programme/** (Accessed: 13 May 2026)

[8] **Natural England (2023)** Assessing the health of the River Wye and its catchment. **https://naturalengland.blog.gov.uk/2023/05/30/assessing-the-health-of-the-river-wye-and-its-catchment/** (Accessed: 13 May 2026)

[9] **Environment Agency & Mott Macdonald (2024)** Understanding the Wye Catchment: Project Final Report**. https://wyecatchmentpartnership.org/wp-content/uploads/2024/07/Understanding-the-Wye-Catchment_Project-Final-Report_July24.pdf** (Accessed: 13 May 2026)

[10] **Think NPC (no date)** The Iceberg Model**. https://www.thinknpc.org/resource-hub/systems-practice-toolkit/the-iceberg-model/** (Accessed: 13 May 2026)

[11] **UK Government (2023)** An introductory systems thinking toolkit for civil servants**.** Guidance. **https://www.gov.uk/government/publications/systems-thinking-for-civil-servants/toolkit** (Accessed: 13 May 2026)

[12] **Think NPC (no date)** Thinking big: How to use theory of change for systems change. **https://www.thinknpc.org/resource-hub/thinking-big-how-to-use-theory-of-change-for-systems-change/** (Accessed: 13 May 2026)

[13] **Cecan (no date)** The Participatory Systems Mapping Toolkit**. https://www.cecan.ac.uk/resources/toolkits/the-participatory-systems-mapping-toolkit/** (Accessed: 13 May 2026)

[14] **Everard, M. et al (2022)** Reassessing the multiple values of lowland British floodplains. **DOI: https://doi.org/10.1016/j.scitotenv.2022.153637/** (Accessed: 13 May 2026)

[15] **Imperial College London (2026)** Building the evidence base for regional water planning. **https://www.imperial.ac.uk/grantham/publications/briefing-papers/building-the-evidence-base-for-regional-water-planning.php** (Accessed: 13 May 2026)

[16] **Ofwat (2022)** PR24 and beyond: Final guidance on long-term delivery strategies. **https://www.ofwat.gov.uk/wp-content/uploads/2022/04/PR24-and-beyond-Final-guidance-on-long-term-delivery-strategies_Pr24.pdf** (Accessed: 13 May 2026)

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