West Country Water Resources

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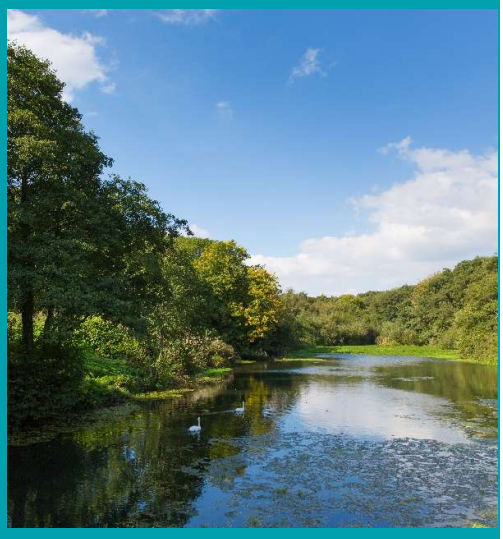
West Country Water Resources Group

# Environmental Destination

## Annex E: East Devon pilot catchment plan to increase future water supply and low flow environmental resilience



Wood Group UK Limited – January 2022

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## Draft report disclaimer

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# Contents

# 1. Overview

This document is one of five technical annexes that lay out plans for holistic measures that may be implemented in five WCWR pilot catchments to increase water supply and environmental low flow resilience. These set out steps towards an Environmental Destination for 2050 in each catchment, in response to the water resources-related 'Environmental Ambition' challenge set by the Environment Agency as part of its National Framework for Water Resources (March 2020).

## 1.1 This pilot catchment plan

This trial catchment plan sets out the measures best suited to achieve future water resources resilience and improvement in the **East Devon Catchment**, in response to the challenge to meet environmental flow objectives, even as flows are expected to fall due to climate change

Full details of the project context, scope, data sources and stakeholder engagement are given in the main report.

## 1.2 Contents of this annex

After this introduction,

- **Section 2** provides a summary of the catchment and the pressures on it.
- **Section 3** details the EA-suggested Environmental Ambition abstraction reductions that may be needed to improve river flows. It also provides an indication of how the flow regime is projected to change as the climate shifts into the future.
- **Section 4** describes the current projects underway in the catchment and summarises the strategic action plan of water company measures that could be implemented in a phased approach to increase water supply resilience. Projects currently focused on land management, habitat creation, restoration, re-wilding and diffuse water quality improvements are also included because these should improve ecological resilience through droughts, even though they will not make much difference to the flow regime.
- References are given in **Section 5.**

Figures are provided as a slide pack at the back of this Annex in **Section 0 (filename '807434-WOOD-WRG-ED-FG-OW-0001_S0_P01.1.ppt')**.

# 2. Catchment summary

The East Devon catchments are dominantly rural and underlain a mix of impermeable bedrock with low groundwater reserves to the north and west, greensands and chalks to the east, and a major sandstone aquifer in the Otter valley. The catchment includes the city of Exeter where there is anticipated population growth. This section describes the catchment context with respect to the rivers that drain it, the interaction of surface water with groundwater, the pressures from abstraction, and diffuse and point sources of pollution.

## 2.1 Why the East Devon pilot?

The WCWR scoring and consultation process for pilot catchment selection is presented in the main report.

In **East Devon** there is a focus on the impacts of abstraction in the Otter catchment, water quality in the River Axe and on public supply operations associated with Wimbleball reservoir in the Exe catchment:

- Wimbleball release patterns can affect sediment and fish, as well as supporting flow regulation for downstream abstraction from the River Exe.
- In the Otter catchment there is significant groundwater abstraction from Sherwood Sandstone (South West Water) and ongoing studies into Wessex Water Otterhead Lakes abstraction at the source of the river. Mitigation measures being looked at include tree planting for runoff, sediment and nutrient control in the clay-dominated upper catchment, groundwater modelling to support investigations and options to improve low flows around Otterton and the nearby Lower Otter Restoration Project (LORP) looking to restore floodplain connectivity around the lower transitional reaches.
- The River Axe is designated at a European level as a Special Area of Conservation (SAC). In this catchment water quality and sediment are of greater concern than abstraction.

The combination of existing surface reservoirs, flow regulated rivers and groundwater storage within East Devon offers some potential for smarter management options which may be able to deliver improved resilience of both low flows and public supplies. However, climate change projections suggest that moderate to low flows are expected to fall significantly whatever water resource or catchment land management measures are carried forward.

## 2.2 The current state of the catchment

### Geography, geology, rivers and environmental designations

The East Devon catchment area shown in **Figure E2.1** stretches from Exmoor in the north down to the southern coast at Exmouth, and east to Axminster. The main rivers are the Clyst, Clum, Exe, Otter, Sid and Axe. The East Devon catchment encompasses the city of Exeter, and the towns of Credition, Tiverton, Cullompton, Exmouth, Dawlish, Honiton, Ottery St Mary, Sidmouth, Lyme Regis and Axminster, however, much of the catchment is rural, and undeveloped. The Catchment Based Approach[1] website outlines that the area as predominately agricultural with lowland cattle and sheep farms constituting 38% of the farming practice.

The East Devon catchment is underlain by a variety of different geological strata from sandstones which provide significant groundwater, to marls and mudstones which have no groundwater bearing capabilities resulting in rapid run-off. Those catchments which are underlain by sandstones, greensands and chalk are important for storing and slowly releasing groundwater (e.g. the lower Otter and the Axe)., and are more resilient to periods of low rainfall than those which are underlain by the mudstone, argillaceous sandstones and clays (e.g. the upper Otter, Sid and Exe) which have very flashy catchments and little storage (EA, 2012b). The long-term average annual rainfall across East Devon is around 1100 mm/a and rainfall across the area varies with higher totals over Dartmoor and Exmoor (EA, 2017).

Designated sites in the catchment include Special Areas of Conservation (SAC), Special Sites of Scientific Interest (SSSI) and Ramsar sites (**Figure E2.2**) as well as a number of other protected areas. As well as being of high ecological importance, the East Devon catchment also encompasses the Exmoor National Park and the East Devon, Dorset and Blackdown Hills AONB.

### Abstraction pressures

The largest abstractions in the catchment are from surface water sources and are licensed for water supply, hydroelectric power generation and aquaculture, as well as surface water abstractions for agricultural and industrial use (**Figure E2.3**). A large proportion of the surface water abstractions are non-consumptive or have low consumptiveness (e.g. hydroelectricity power generation). When considering consumptiveness (**Figure E2.4**), the largest abstractions are for public water supply (e.g. Wessex Water from Wimbleball Lake and South West Water from the River Exe).

Groundwater abstraction is focussed to the east of the catchment, where the geology allows, with a large proportion of abstraction licensed for public water supply (particularly from the lower Otter sandstones). Abstractions also support a range of industrial, agricultural and environmental uses as well as some transfer between sources (**Figure E2.3** and **Figure E2.4**).

As recorded in **Figure E2.2**, there are drinking water safeguard zones along the River Otter (Otterton and Colaton Raleigh, Dotton, Harpford and Greatwell boreholes), two smaller zones located near the River Exe estuary in the Creedy and Exe catchment (Vennbridge and Duckaller) and another at Beer (Bovey Lane).

[1] Catchment Based Approach (Accessed August 2021), https://catchmentbasedapproach.org/get-involved/east-devon/

## Water resource availability

Environment Agency published maps of water body water resource availability at a range of flows are shown in **Figure E2.5** (Cycle 2, Environment Agency 2021[2]). Green indicates where there is more water that required to meet the needs of the environment, yellow indicated where licensed flows fall below the Environmental Flow Indicators (EFI) or there is no more water available for licensing at these flows and red indicates where there is no more water available under any flow conditions. The last abstraction licensing strategy for the East Devon was published in 2012.

The Environment Agency has indicated that under high and moderate flow conditions, there is no water available in the Haddeo River catchment (Q30 and Q50) and Barle and Creedy catchments (Q50) (**Figure E2.5**). Under low flows (Q70), much of the Exe, Clyst and Otter catchments have restricted water available, with no water available in the Creedy and Barle catchments. The results under Q95 low flow conditions indicate no water available in the Otter, Creedy, Barle and Dart catchments and restricted water available in the Exe catchment.

## Flood risk

The East Devon CFMP (catchment flood management plan) covers the Otter, Sid, Axe and Lim catchments and the Exe CFMP also shows that these rivers have a history of fluvial and tidal flooding. In the upper reaches of the Exe, Otter and the Sid catchments the main cause of flooding is the impervious bedrock, compacted soils and steeper catchments causing rapid run-off and a flashy response is characteristic. Beneath the Axe and the Lim there is a much slower response to rainfall due to the presence of Chalk and Greensand (Environment Agency, 2012).

## Water quality pressures

South West Water operates the sewage treatment works from many towns and villages across East Devon which return mains water to the river network (e.g. larger works at Crediton, Tiverton, Cullompton, Honiton and Axminster) or the sea (e.g. Exmouth and Sidmouth). Waste water from the city of Exeter is treated and discharged to head of the Exe estuary at Countess Weir. These discharges are consented and regulated by the Environment Agency. Considerable improvements in discharge water quality have been achieved over the past 30 years and investment is ongoing as clean-up standards continue to be tightened. As the sewer systems often combine household effluent with urban drainage runoff, occasional storm overflow of untreated water remains a focus for improvement.

Other consented discharges from industry and dairies (e.g. to the upper Axe) are also tightly regulated to reduce pollution risks.

The agricultural land use which dominates East Devon has led to water quality issues including sediments, nutrients and nitrates. Additionally, there are issues relating to sewage storm overflows and runoff from urban areas. These water quality pressures have led to much of the East Devon being designated as a priority catchment under DEFRA's Catchment Sensitive Farming Programme.

[2] https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/WaterResourceAvailabilityAndAbstractionReliabilityCycle2&Mode=spatial

## Future population pressures

Future population growth is forecast in urban and suburban areas particularly around Exeter. Devon Council are planning for approximately 10% increase in population in East Devon by 2033 (DCC, 2022).

## Water Framework Directive (WFD) status

A map of the overall WFD (Cycle 2, 2019) status of water bodies across the catchment is shown on **Figure E2.6**. This combines both the chemical and ecological status reported by the Environment Agency for the water bodies. The recent recognition of new types of pervasive pollutants which affect many rivers across the country is tending to dominate overall WFD status, so when focusing on water resources, abstractions and river flows it is more helpful to consider ecological status.

River flow and morphological condition (i.e. the naturalness of channel profiles, the existence of weirs and barriers etc.) are considered as supporting elements in the assessment of ecological status - which is primarily based on monitoring the health, diversity and abundance of plants, bugs and fish in rivers, lakes and estuaries. The WFD water body ecological status of East Devon water bodies (Cycle 2, 2019) is mapped on **Figure E2.7.**

A large proportion of the catchments in the East Devon have moderate overall status; there are no catchments with good status. The Lower Creedy and Halberton Stream catchments have bad water body status and 17 of the catchments have poor water body status [Middle Barle, Ford Stream and Ford Brook catchments (Exe); Polly Brook, Aylesbeare Stream, Ken Stream, Grindle Brook and Sheldon Stream (Clyst and Culm); Colebrook, Kenn, Upper Creedy and Holly Water (Creedy and West Exe); Wolf (Otter), Lower and Middle River Otter and River Tale (Otter); and Forton Brook (Lim and Axe)]. These failures are not related to abstraction pressures, but instead are associated with fish and biological quality elements, ecology, phosphate, physico-chemical quality elements, macrophytes, phytobenthos combined with invertebrate monitoring indicators.

Environment Agency catchment data[3] are summarised in Error! Reference source not found. for selected water bodies of particular interest to this plan which is focused on future water resource resilience. In these water bodies the Environment Agency's Environmental Ambition modelling has predicted river flows could fall below regulatory thresholds by 2050 so the impacts of public water supply abstraction may need to be reduced, taking account of the ongoing need for public supplies – in particularly from reservoirs constructed for this purpose. The Environment Agency calculations incorporate projections of future changes in river flows expected due to climate change, plus the potential impacts of fully licensed abstraction, as discussed further in **Section 3**). The focus water body locations are labelled on **Figures E2.6** and **E2.7.** The abstraction points include the surface water abstractions from Otterhead Reservoir (Otter) and Wimbleball Lake (Exe) as well as the groundwater abstractions at Aller Springs (Lowman) [Exe], Greatwell Boreholes, Harpford Boreholes, Dotton Boreholes and Colaton Raleigh (Lower River Otter) [Otter],Tatworth Wells (Kit Brook) and Hooke and Cotley Springs (Forton Brook) [Axe].

[3] https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3140 accessed 09/11/21

Table 2.1 2019 (Cycle 2) EA Catchment Data for selected water bodies of particular water resources interest in the catchment[4]

| Water body | Ecological status | Biological quality | Physico-chemical quality | Hydrological Regime | Chemical substances | RNAG |
|---|---|---|---|---|---|---|
| **Forton Brook (GB108045014830)** | Poor | Poor (Fish) | Moderate (Phosphate) | Supports good | Fail (Mercury & PBDE) | Physical modification: barriers – ecological discontinuity |
| **Kit Brook (GB108045014820)** | Moderate | Moderate (Fish, invertebrates, macrophytes and phytobentos) | Good | Supports good | Fail (Mercury & PBDE) | Diffuse sources: poor livestock, nutrient and soil management |
| **Lower River Otter (GB108045009170)** | Poor | Poor (Fish, macrophytes and phytobentos) | Moderate (Phosphate) | Supports good | Fail (Mercury, PFOS & PBDE) | Flow: GWAbs Point sources: sewage discharge Diffuse sources: poor livestock and soil management |
| **Otterhead Reservoir (GB30845271)** | Moderate | Not assessed | Not assessed | Does not support good | Fail (Mercury & PBDE) | Flow: SWAbs |
| **Wimbleball Lake (GB30844471)** | Good | Good | Good | Good | Fail (Mercury & PBDE) | N/A |
| **Lowman (GB108045015030)** | Moderate (Phosphate) | Good | Moderate | Supports good | Fail (Mercury & PBDE) | Diffuse sources: poor nutrient, soil and pesticide management, and riparian/ in-river activities. Point source: sewage discharge (continuous). |

RNAG Reasons for not achieving good, PDBE Polybrominated diphenyl ethers, Perfluorooctane sulphonate (PFOS)

## 2.3 Existing water company water resource management planning (WRMP) options in the East Devon

South West Waters and Wessex Waters previously published strategies both centre on demand management, as presented in the Water Resource Management Plan (South West Water, 2019 and Wessex Water, 2019). This includes a reduction in distribution losses/ management of leakage in both water company plans. South West Water's Wimbleball Resource zone covers the western side

of the East Devon catchment. Wessex Water has just one resource zone which covers a smaller portion to the very north and eastern part of the East Devon and also draws from Wimbleball Reservoir. Preferred options for both companies are detailed in **Table 2.2**.

A number of feasible supply-side options have also been explored by the water companies for this catchment, including new distribution and production management and new resource schemes. These have not? been taken forward as preferred options at this stage, as detailed in **Table** 2.3 but they may be required in the future. It should be noted that there are additional options considered in the Wessex Water and South West Water WRMPs however, only those considered to be located within, or within close proximity of the East Devon area have been added in **Table 2.3**. however, where water resources are connected, schemes outside the catchment may impact the East Devon.

Other feasible demand-side options have also been explored but have not been taken forward as preferred options at this stage, as detailed in **Table 2.4**.

Table 2.2 Preferred options in the 2019 WRMP, relevant to the East Devon catchment (from South West Water and Wessex Water, 2019)

| Option | Code | Type of option | Earliest potential start date | WAFU Ml/d | Detail |
|---|---|---|---|---|---|
| **South West Water** | | | | | |
| **Innovation Wimbleball WRZ** | LW1-LW4 | Reduce distribution losses | 2020-21 | 4.4 | Schemes supporting ALC - reduction in leakage by 15% |
| **Wessex Water** | | | | | |
| **Final Planning Scenario - 15% leakage reduction in 5 years** | ALY | Other leakage control | 2020-21 | 18.6* | Infrastructure renewal, active leakage control, pressure management, improved data analysis, and DMA improvements |
| **Met uplift optional** | M1a | Metering optants | 2020-21 | 0.4 | Enhanced metering |
| **Home Check** | WE1 | Household water audit | 2020-21 | 3.7 | Home advice and device fitting visits |
| **Dashboard** | WE2 | Customer education / awareness | 2020-21 | 1.3 | Customer engagement dashboard |

WAFU – water available for use
*Covers the whole of the Wessex Water Resource Zone which extends beyond the East Devon

Table 2.3 Supply-side options reviewed (but not preferred) in the development of the 2019 WRMP, relevant to the East Devon catchment (from South West Water, 2019 and Wessex Water, 2019)

| Option | Code | Type of option | Earliest potential start date | WAFU Ml/d | Detail |
|---|---|---|---|---|---|
| **South West Water** | | | | | |
| **Increase Pynes WTW & Intake to 67 Ml/d** | W1 | Production management | 2024 | 2.1 | |
| **Re-commissioning of Stoke Canon & Brampford Speke boreholes** | W2 | Production management | 2024 | 4.5 | |
| **East Devon new source** | W3 | Resource Scheme | 2024 | 2.0 | |
| **Wessex Water** | | | | | |
| None in Wessex Water area | | | | | |

WAFU – water available for use

Table 2.4 Demand-side options reviewed (but not preferred) in the development of the 2019 WRMP across water company supply zones South West Water, 2019 and Wessex Water, 2019)

| Option | Code | Type of option | Earliest potential start date | WAFU Ml/d | Detail |
|---|---|---|---|---|---|
| **South West Water** | | | | | |
| **Customer Side options** | Cu20, CU21, CU26, CU54, CU60, CU62 and CU66 | Reduce water demand | 2020-21 | 20.8* | Retrofit and advice service. Metering and leaky loos, social housing refit, holiday home rental water efficiency, reduced infrastructure charge, community incentives, social norms feedback on bills and non-household retailer water efficiency. |
| **Countess Wear** | CU65g | Reduce water demand | 2020/2021 | 0.2 | WWTW final effluent re-use |
| **Wessex Water** | | | | | |
| **Options to reduce distribution losses (leakage)** | - | 10 further options to | 2020-21 | 32.5** | Active leakage management, mains replacement (not trunk |

| | | | | | |
|---|---|---|---|---|---|
| | | manage and control leakage | | | mains), pressure management etc |
| **Options to reduce the demand for water** | - | 3 metering options | 2020-21 | 19.8** | Reduction in demand through improved metering |

*Calculation for the SWW supply area which only covers part of the East Devon.
**Covers the whole of the Wessex Water Resource Zone which extends beyond the East Devon

There is a potential demand reduction across the WRZ's that cover the East Devon catchment of 28.4 Ml/d utilising the preferred options considered in the WRMP. The not preferred supply side options total 8.6 Ml/d, with the not referred demand side options potentially saving 73.3 Ml/d which could benefit the East Devon catchment.

Mains leakage reductions in the Exeter area would be expected to reduce demand on public supply abstractions from the Exe but may be partly offset by population growth unless significant reductions in per capita consumption can be realised. It should also be noted that some of the water from leaking mains in Exeter is currently expected to end up in the River Exe, so reduced mains leakage will reduce these returns to the lower reaches of the river.

# 3. Environmental Ambition challenge

This section summarises the predicted 2050 flow environmental deficits and surpluses in the catchment and the potential future reductions in public water supply abstraction impacts highlighted by the Environment Agency's Environmental Ambition screening modelling, as set out in the National Framework for Water Resources (March 2020).

The Environment Agency's modelling indicates the additional water that may be needed by 2050 to meet:

- environmental river flow targets based on existing (Business as Usual, BAU) or enhanced (ENH) thresholds; and
- future predicted (FP) demands for public water supply and other water uses, and also worst-case, fully licensed (FL) demand assumptions
- in the context of natural Q95 low flow conditions which have been simply factored down from current estimates for 2050 based on a climate change projection.

The Environment Agency provided the WCWRG with WFD river water body scale National Framework estimates of 2050 environmental flow surpluses or deficits to highlight the water bodies of concern (as summarised in **Section 2** and presented in more detail below). An indication of the individual abstraction reductions which might be needed to meet the 2050 existing or enhanced environmental flows was also tabulated for the regional water resources groups and water companies to consider.

Whilst the main theme of the Environmental Ambition challenge is therefore framed in terms of 'potential abstraction reductions needed to meet river flow targets' and improve environmental low flow resilience, this implies that alternative sources of water will need to be found from elsewhere to maintain public supply resilience. At the same time, water companies must demonstrate that their demand suppression and supply systems are robust enough for a 1 in 500-year drought event.

**Section 3.1** presents mapped and tabulated summaries of the water bodies with Environment Agency projected flow deficits. The climate change assumptions made in these projections are reviewed based on the latest suite of UKCP18 modelling data in **Section 3.2** which suggests that significant low and median flow reductions should be expected throughout the century. The potential licence reductions being scrutinised according to the Agency's analysis are listed in **Section 3.3**, and compared with published water company WRMP options in **Section 3.4.**

## 3.1 Predicted 2050 flow deficits and surpluses

Environmental Flow Indicator (EFI) targets are defined by the Environment Agency to indicate the river flow required to support Good Ecological Status under the EU Water Framework Directive (WFD). The EFI allows a percentage deviation from natural flows at a specific location, defined based on the Abstraction Sensitivity Band (ASB) of the site.

The predicted fully licensed 2050 flow surpluses and flow deficits for East Devon catchment water bodies under Q95 low flow conditions are mapped in **Figure A3.1**, under the EA's **enhanced** 2050 scenario, which is 'worst case' for planning purposes. However, Business as Usual default sensitivity has been assumed for both the Exe (ASB3 upper, ASB2 lower) and Otter (ASB3) catchments.

In the enhanced scenario, increased environmental protection (i.e., a more stringent CSMG 'ASB4' flow target) is assigned to the River Axe SAC. It is unclear why tributaries to the designated Axe main channel have also been assigned the enhanced CSMG targets.

It can be seen from **Figure E3.1** that for the majority of the water bodies within the East Devon catchment, flow surpluses or flows close to the enhanced environmental flow target are predicted (mapped in green with Q95 flow surpluses labelled in Ml/d).

However, 2050 Q95 flow deficits are predicted by the Environment Agency modelling for four water bodies, relating to both non-PWS and PWS abstraction:

- Lower Barle (GB108045015100)
- Lower River Otter (GB108045009170)
- Middle Creedy (GB108045009090)
- Kit Brook (GB108045014830)

Further detail regarding those water body flow deficits linked to PWS abstraction is given in **Table** 3.1 below and a summary of their current ecological status catchment data has been presented in **Table 2.1**. Specifically, those abstractions previously identified for potential reductions include the surface water sources from Otterhead Reservoir (Otter) and Wimbleball Lake (Exe) as well as the groundwater abstractions at Aller Springs (Lowman catchment) [Exe], Greatwell Boreholes, Harpford Boreholes, Dotton Boreholes and Colaton Raleigh (Lower River Otter catchment) [Otter], Tatworth Wells (Kit Brook catchment) and Hooke and Cotley Springs (Forton Brook catchment) [Axe].

This provides the surpluses and deficits at different flow percentiles, and also compares with the same outputs for the '**Business as Usual'** (BAU) scenario which is less stringent than the Enhanced (ENH) scenario only in the tributary water bodies within the River Axe catchment.

Table 3.1 East Devon Predicted Fully Licensed 2050 Environmental Flow Surplus or Deficit (Water body outflow, Ml/d), for water bodies where potential PWS abstraction reductions are highlighted by the Environment Agency

| **Flow Condition** | **Q30** | | **Q50** | | **Q70** | | **Q95** | |
|---|---|---|---|---|---|---|---|---|
| **(Ml/d)** | BAU | ENH | BAU | ENH | BAU | ENH | BAU | ENH |
| Otterhead Reservoir (GB30845271) | -0.51 | -0.51 | -1.32 | -1.32 | -1.78 | -1.78 | -2.13 | -2.13 |
| Wimbleball Lake (GB30844471)** | -40.58 | -40.58 | -19.36 | -19.36 | -6.76 | -6.76 | 6.56 | 6.56 |

| Flow Condition | Q30 | | Q50 | | Q70 | | Q95 | |
|---|---|---|---|---|---|---|---|---|
| Upper River Otter (GB108045015120) **[Otterhead Reservoir]** | | 14.2 | | 5.0 | | 1.3 | | -0.9 |
| Upper River Haddeo (GB108045020900) **[Wimbleball Lake]** | | -40.3 | | -19.3 | | -6.7 | | 6.6 |
| Lowman (GB108045015030) | 19.4 | 19.4 | 7.2 | 7.2 | 1.9 | 1.9 | -0.4 | -0.4 |
| Lower River Otter (GB108045009170) | 34.8 | 34.8 | 2.2 | 2.2 | -11.8 | -11.8 | -19.4 | -19.4 |
| Kit Brook (GB108045014830) | 5.07 | 1.05 | 1.06 | -0.38 | -0.38 | -0.86 | -1.25 | -1.54 |
| Forton Brook (GB108045014820) | 4.58 | 1.24 | 1.67 | 0.20 | 0.55 | -0.15 | -0.23 | -0.64 |

*BAU - Business as Usual; ENH – Enhanced Scenario
** Wimbleball Lake is Heavily Modified for Water Resources purposes so closure of these environmental deficits is not required.

## 3.2 How do the Environment Agency's estimates of flow reductions due to climate change compare with updated UKCP18 for the East Devon?

The Environment Agency's National Framework predictions of natural flows for 2050 were based on one of the eleven UKCP09 Future Flows projections known as 'afixK', as available at the time. This projected relatively more marked falls in flow over time compared with the remaining 10 'equally likely' suite of UKCP09 models. At the end of 2021, CEH and a consortium of associates working with the Meteorological Office have delivered the UKCP18 successor to the Future Flows data which includes 12 'equally likely' projections of river flows and groundwater levels from 1982 to 2080 using a variety of alternative modelling approaches. These Enhanced future Flows and Groundwater (eFlaG) data will soon be available online[4] but an early release has been used to compare against the Environment Agency's assumptions for East Devon and provide stakeholders with a clear picture of how flows are expected to change to 2050 and beyond.

**Figures E3.2 and E3.3** plot rolling 18 year flow percentile statistics in Ml/d derived from modelled daily flow projections for Otter at Dotton – just upstream of the tidally influenced reach at the bottom of the catchment. Plots are included to show how high (Q1 'floods'), median (Q50), low (Q95) and very low (Q99 'droughts') flows are predicted to change through the 21st century. There are lines for each of the 12 'equally likely' UKCP18 regional climate models (RCM) provided from eFlaG compared with the projection for the same location from UKCP09 Future Flows, as included in the Environment Agency's calculations.

[4] https://eidc.ac.uk/

On the right of each percentile time series, an area plots indicates how many of the 12 UKCP218 eFlaG models show increases or decreases in flow, how big that projected change is relative to the start of the century (2000), and how the differences evolve past 2050 and on to 2080.

These plots indicate that highest flood event flows (Q1 and above) are expected to be steady or change only slightly with time according to most of the projection models. These increases or decreases are very modest – within 10% by 2050. The increases in flood flows which were a feature of the previous UKCP09 projections are less apparent based on the updated UKCP18 work in this area.

**Figure E3.2** flow predictions are based on the most reliable of the eFlaG gauge-calibrated models (the Probability Density Model PDM) and indicate how flows calibrated against the historical gauged record (i.e. including the influence of upstream abstractions and discharges) may change due to climate shifts in rainfall and potential evaporation. Projected falls in median (Q50), low (Q95) and very low(Q99) flows are similar to or greater than the UKCP09 afixK dashed black line. i.e. the Future Flows scenario which was considered worst case now appears reasonable or perhaps optimistic. By 2050, most of the eFlaG models are predicting more than 10% reductions in median flows, with falls of 20 or even 30% predicted by several models under drier conditions.

The **Figure E3.3** plots for the same Otter at Dotton location are based on the natural flow projections of the national 'Grid to Grid' model using the same RCM climate inputs, but no gauged record calibration. Although less well adapted to the gauged local flow responses and probably less reliable, these projections are included for comparative purposes because they ignore any abstraction or discharge influences on the gauged record, Highest flood flow projected changes are similar, but median and lower flow falls are much steeper.

In order to more confidently understand future flow shifts in all the water bodies within the Otter catchment it is recommended that the UKCP18 climate projections are run through the regional groundwater and river flow model available for this area – to distinguish the different hydrological responses in the upper (flashier) and lower (sandstone baseflow) catchments. However, **Figures E3.2 and E3.3** confirm that low flows are expected to fall significantly to 2050. Even though the Environment Agency will therefore need to allow EFI regulatory flow thresholds to evolve downwards with time, the proportion allowed for abstraction will be squeezed.

**Figures E3.4 and E3.5** are the equivalent future flow projections for the River Exe at Thorverton – upstream of Exeter. Both gauge-calibrated PDM and natural G2G projections indicate steeper potential declines in median and low flow percentiles in comparison with the Otter at Dotton where hydrological responses are buffered by groundwater storage in the sandstone aquifer. The less permeable, flashier Exe catchment is naturally more susceptible to climate change. The existence of the Wimbleball Reservoir provides some opportunity for smarter management associated with pumped storage and flow regulation to adapt as the climate shifts in ways that are not reflected in the projections from either the Environment Agency's National Framework or the eFlaG modelling. However, this still affects a relatively small proportion of the total Exe catchment flow which, whatever changes are made to public supply operations, can therefore be expected to follow declining trends related to ongoing climate change.

This forward look adds real urgency to the need to consider options which will boost storage and low flows support on the supply side, beyond the current demand-side and leakage focus of WRMP options. It also highlights the need for riverine and wetland habitat restoration and active management to enhance ecological resilience to dry periods which are becoming and will continue

to become more frequent and longer. Broader re-wilding, soil and environmentally sensitive farm land management initiatives are also vital to improve water quality, but they will not change the projected decline in low flows. As the climate warms, the higher temperatures will result in more evapotranspiration and less water in our rivers regardless of any 'nature-based solutions' implemented upstream.

## 3.3 Licences highlighted by the Environment Agency for potential abstraction reductions (or other low flow support)

If the flow deficits identified in the Environment Agency's 2050 Environmental Ambition projections need to be fully addressed, having accounted for the water resources purpose of the 'heavily modified' reservoir-related operations, licence reductions may be required for one Wessex Water and several South West Water groundwater licences. Licence details for these abstractions which are 'at risk' are given in **At this** first draft report stage, no review of the implications of the Environmental Ambition challenge has been possible for the surface water abstractions associated with the current or potential future operation of the reservoirs, of which Wimbleball is by far the most significant (Error! Not a valid bookmark self-reference.**c**.) Whilst annual and daily licence limits may not change, the imposition of tighter compensation release or hands-off-flow constraints may still affect drought period deployable output for public supply.

Table 3.2**a-b.**

At this first draft report stage, no review of the implications of the Environmental Ambition challenge has been possible for the surface water abstractions associated with the current or potential future operation of the reservoirs, of which Wimbleball is by far the most significant (Error! Not a valid bookmark self-reference.**c**.) Whilst annual and daily licence limits may not change, the imposition of tighter compensation release or hands-off-flow constraints may still affect drought period deployable output for public supply.

Table 3.2a Details of Groundwater PWS abstractions for which potential abstraction reductions have been flagged by the EA (Exe and Axe catchments)

| Abstraction Information | ALLER SPRINGS | TATWORTH WELL (NO. 1-3) | HOOK SPRINGS | COTLEY SPRS |
|---|---|---|---|---|
| **Licence Number** | 14/45/002/0083 | 14/45/000/0521 | 14/45/000/0676 | 14/45/000/0676 |
| **Water company** | South West Water Services Ltd | Wessex Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd |
| **Fully Licensed** | 0.934 | 1.371 | 0.864 | 0.864 |
| **Recent Actual** | 0 | 0.701304 | 0.226 | 0.226 |
| **Surface water/ Groundwater** | Groundwater | Groundwater | Groundwater | Groundwater |
| **WFD Waterbody** | GB108045015030 | GB108045014820 | GB108045014830 | GB108045014830 |
| **Investigations** | | AMP4 (2006 – 2010) Impact of abstraction not significant – no licence changed required. | | |
| **Environmental Ambition Conclusion** | A 30% reduction in licenced quantity has been recommended for the Aller Spring groundwater abstraction, as this will mitigate the Q95 deficit in this waterbody. Alternatively, this waterbody only has a deficit at the Q95 it may be possible to incorporate stream support rather than licence reduction. | The Tatworth Wells abstractions impact the Forton Brook waterbody which has a deficit in the BAU and Enhanced scenarios at the Q95 and a small deficit at the Q70 in the Enhanced scenario. Licence reductions have been suggested in both scenarios which would address this deficit, however given that it is a springs abstraction it may be possible to apply a HOF, or low flow support which would reduce the scale of the licence reduction. | The Hooke and Cotley Springs abstractions impact the Kit Brook waterbody which has deficits at the Q95 and Q70 in the BAU and Enhanced scenarios and a small deficit at Q50 in the Enhanced scenario. Licence reductions have been suggested in both scenarios which would address this deficit, however given that it is a springs abstraction it may be possible to apply a HOF, or low flow support which would reduce the scale of the licence reduction. | |

| Abstraction Information | ALLER SPRINGS | TATWORTH WELL (NO. 1-3) | HOOK SPRINGS | COTLEY SPRS |
|---|---|---|---|---|
| **BAU Scenario** | Licence not in use – therefore no action suggested. Licence reduction would be suggested if licence were in use. | 45% licence reduction OR Q95 HOF if connection between flows and abstraction is close | Abstraction off OR Q95 HOF, 50% reduction at Q70 if connection between flows and abstraction is close | Abstraction off OR Q95 HOF, 50% reduction at Q70 if connection between flows and abstraction is close |
| **BAU Licence Reduction** | 0 | 0.61695 | 0.864 | 0.864 |
| **ENH Scenario** | Licence not in use – therefore no action suggested. Licence reduction would be suggested if licence were in use. | 15% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close | 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close | 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close |
| **ENH Licence Reduction** | 0 | 0.20565 | 0.6048 | 0.6048 |
| **Reasonable Scenario** | Licence not in use – therefore no action suggested. Licence reduction would be suggested if licence were in use. | 15% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close | 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close | 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close |
| **Reasonable Licence Reduction** | 0 | 0.20565 | 0.6048 | 0.6048 |

Table 3.3b Details of Groundwater PWS abstractions for which potential abstraction reductions have been flagged by the EA (Otter catchment)

| Abstraction Information | Greatwell NO. 1,2,3 | Greatwell BH NO.5 | Greatwell BH NO 4B (NEW) | Greatwell BH 6P | Colaton Raleigh | Harpford BHs | Dotton No.4/5 | Dotton No.1-3/7 |
|---|---|---|---|---|---|---|---|---|
| **Licence Number** | 14/45/001/0426 | 14/45/001/0505 | SW/045/0001/008 | SW/045/0001/014 | 14/45/001/0478 | 14/45/001/0518 | 14/45/001/0520 | SW/045/0001/016 |
| **Water company** | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd | South West Water Services Ltd |
| **Fully Licensed** | 4.359 | 1.689 | 1.142 | 1.351 | 2.59 | 4.699 | 0.63 | 8.902 |
| **Recent Actual** | 3.597 | 1.05 | 0.685 | 1.178 | 1.925 | 3.637 | 0.439 | 10.726 |
| **Surface water/ Groundwater** | Groundwater | Groundwater | Groundwater | Groundwater | Groundwater | Groundwater | Groundwater | Groundwater |
| **WFD Waterbody** | GB108045009170 | GB108045009170 | GB108045009170 | GB108045009170 | GB108045009170 | GB108045009170 | GB108045009170 | GB108045009170 |
| **Investigations** | None | None | None | None | None | None | None | None |
| **Environmental Ambition Conclusion** | The Otter is not classified as an enhanced catchment and ASB3 has been applied in all scenarios. There are two distinct abstraction groups in this catchment – the Wessex Water surface water abstraction from Otterhead reservoir in the headwaters and the dense network of South West Water groundwater abstractions in the lower catchment.<br><br>With respect to the reservoir abstraction it has been assumed that no licence reduction will be required and the small downstream deficit can be addressed through changes to the compensation release.<br><br>The groundwater abstractions in the lower catchment have resulted in deficits at the Q95 and Q70. The Q95 deficit is approximately 70% of the Fully licenced quantity and the Q70 deficit is 45% of the FL quantity. A 60% reduction of all groundwater abstractions has been recommended to address this deficit (as 10% of the deficit should have been solved upstream through changes to the Otterhead reservoir compensation release), alternative options could be expansion of the Otterhead reservoir to provide more compensation release at low flows, reducing the groundwater impact. | | | | | | | |

| Abstraction Information | Greatwell NO. 1,2,3 | Greatwell BH NO.5 | Greatwell BH NO 4B (NEW) | Greatwell BH 6P | Colaton Raleigh | Harpford BHs | Dotton No.4/5 | Dotton No.1-3/7 |
|---|---|---|---|---|---|---|---|---|
| **BAU Scenario** | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction |
| **BAU Licence Reduction** | 2.6154 | 1.0134 | 0.6852 | 0.8106 | 1.554 | 2.8194 | 0.378 | 6.4356 |
| **ENH Scenario** | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction |
| **ENH Licence Reduction** | 2.6154 | 1.0134 | 0.6852 | 0.8106 | 1.554 | 2.8194 | 0.378 | 6.4356 |
| **Reasonable Scenario** | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction | 60% reduction |
| **Reasonable Licence Reduction** | 2.6154 | 0.8106 | 0.378 | 0 | 1.6986 | 3.7176 | 0.6558 | 6.4356 |

DATA REF NEEDED

Table 3.4c Details of Surface Water PWS abstractions for which potential abstraction reductions have been flagged by the EA

| Abstraction Information | Wimbleball Reservoir | Otterhead (Royston Water) |
|---|---|---|
| **Licence Number** | 14/45/002/2021 | 14/45/001/0002 |
| **Water company** | Wessex Water Services Ltd | Wessex Water Services Ltd |
| **Fully Licensed** | 40.869 | 2.491 |
| **Recent Actual** | 29.947 | 1.063 |
| **Surface water/ Groundwater** | Surface Water | Surface Water |
| **WFD Waterbody** | GB30844471 | GB30845271 |
| **Investigations** | WINEP3 (2020-2025) Options Appraisal | WINEP3 (2020-2025) |
| **Environmental Ambition Conclusion** | No change has been recommended for the Wimbleball Reservoir abstraction as it is assumed that the reservoir compensation release pattern can be changed to compensate for downstream flows. | With respect to the reservoir abstraction it has been assumed that no licence reduction will be required and the small downstream deficit can be addressed through changes to the compensation release. |
| **BAU Scenario** | No change – assume change in compensation flow of reservoir to support higher flow deficits as required | No change – reservoir abstraction, assume change in compensation release |
| **BAU Licence Reduction** | 0 | 0 |
| **ENH Scenario** | No change – assume change in compensation flow of reservoir to support higher flow deficits as required | No change – reservoir abstraction, assume change in compensation release |
| **ENH Licence Reduction** | 0 | 0 |
| **Reasonable Scenario** | No change – assume change in compensation flow of reservoir to support higher flow deficits as required | No change – reservoir abstraction, assume change in compensation release |
| **Reasonable Licence Reduction** | 0 | 0 |

DATA REF NEEDED

The EA's suggested Fully Licensed abstraction reductions based on the enhanced ambition scenario are as follows:

- **Lowman catchment. Aller Springs. No reduction**. Licence not in use – therefore no action suggested.
- **Forton Brook catchment. Tatworth Well. Q95 HOF. 0.21 Ml/d.** 15% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close.
- **Kit Brook catchment. Hook and Cotley Springs. 1.21 Ml/d.** Hook Springs: 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close. 0.6048Ml/d and Cotley Springs: 70% reduction in licence quantity OR Q95 HOF if connection between flows and abstraction is close. 0.6048Ml/d.
- **Lower Otter catchment. Greatwell, Harpford and Dotton BHs. 14.76 Ml/d.** Greatwell (Combined): 60% reduction. 5.1246Ml/d. Harpford Bhs: 60% reduction. 2.8194Ml/d. Dotton (Combined): 60% reduction. 6.8136Ml/d.
- **Wimbleball Reservoir: No reduction**. No change – assume change in compensation flow of reservoir to support higher flow deficits as required. 0Ml/d.
- **Otterhead (Royston Water). No reduction.** No change – reservoir abstraction, assume change in compensation release. 0Ml/d.

The total licence reductions across the catchment for South West Water flagged by the Environment Agency could potentially therefore be **16.0 Ml/d.** There is currently only one reduction for Wessex Water flagged by the Environment Agency due to planned changes to the compensation release at Wimbleball and Otterhead reservoirs. The flagged Wessex Water reduction is at Tatworth Wells (**0.2 Ml/d**).

## 3.4 Potential 2050 supply loss compared to published WRMP options

Options explored in the water company WRMPs include demand reductions and leakage savings to reduce the future supply required (see **Section 2.3**). In this catchment, no options are currently being taken forward to boost supply.

If the EA's 2050 abstraction reductions were implemented, then, this would represent:

- **23% of South West Water's recent actual abstraction from the East Devon catchment (16.0 Ml/d reduction from a total of 68.6 Ml/d).**
- **0.3% of Wessex Water's recent actual abstraction from the East Devon catchment (0.2 Ml/d reduction from a total of 62.2 Ml/d).**

**Table 3.3** puts into context the scale and magnitude of the potential 2050 abstraction reductions against the current licensed and recent actual abstraction from the catchment, and WRMP options.

It is clear that these are major Environmental Ambition challenges which demand measures well beyond the options published in existing WRMPs. Potential options for better region-wide enhancement and connection of reservoir storage will be associated with large financial and carbon costs and could take around 25 years to complete. But the Environmental Destination plan can be phased so that incremental benefits can be effectively realised along the way, for example by the

enhanced use of groundwater augmentation to support low flows and maintain public supplies in the Otter catchment – as set out in **Section 4**.

Table 3.5 East Devon catchment: context of potential 2050 supply loss

| East Devon | Wessex Water* | South West Water** | Unit |
|---|---|---|---|
| Annual PWS licensed abstraction (catchment total) *SWABS and GWABS combined* | 86.8 | 125.8 | Ml/d |
| Annual PWS RA abstraction (catchment total) *SWABS and GWABS combined* | 62.2 | 68.6 | Ml/d |
| Water company total water into supply (WAFU) *Base year 2017/2018* | 408.9 | 90.5 | Ml/d |
| WRMP baseline WAFU 2045 | 384.3 | 89.4 | Ml/d |
| Catchment PWS RA as % of water company WAFU (Base Year 2017-18) | 15.2 | 75.8 | % |
| Total WRMP projected 2045 demand-side and leakage savings | 23.8 | 4.4 | Ml/d |
| 2045 demand reductions and leakage savings as % of current total water into supply | 5.8 | 4.9 | % |
| WRMP preferred additional supply-side options (catchment total) | 0.0 | 0.0 | Ml/d |
| EA 2050 potential abstraction reductions (catchment total) | -0.2 | -16.0 | Ml/d |
| **Potential 2050 catchment supply loss, reduced by the effect of proportional 2045 demand reductions and leakage savings** | 3.4 | -12.7 | Ml/d |
| **Potential 2050 catchment supply loss (% of abstraction)** | 5.5 | -18.5 | % |
| **Potential 2050 catchment water impact (2045 WAFU impact, abstraction impact plus effect of demand and supply options)** | -1.0 | -12.7 | Ml/d |
| **Potential 2050 catchment supply loss (% of recent actual PWS Abs)** | -1.5 | -18.5 | % |

*Wessex Water catchment summarised in this table is the one Wessex Water WRZ
**Southern Water catchment summarised in this table is the Wimbleball WRZ

Data sources:
Wessex Water (2019). Final Water Resources Management Plan
South West Water Bournemouth Water (2019). Final Water Resources Management Plan.

**NEED MORE COMMENTS ON OTTER AROUND WINEP, AIM SCHEME AND STREAM SUPPORT.**

**NEED MORE ON WIMBLEBALL AND EXE FLOW REGULATION – IS THE LOWER EXE POTENTIALLY A SOURCE WITH *RESOURCE AVAILABLE FOR INCREASED ABSTRACTION*?**

# 4. Environmental Destination catchment plan to increase future water supply and low flow environmental resilience

The Environmental Ambition challenge has highlighted the potential constraints to water resource availability in the 2050s. Adapting to the ongoing pressures of climate change and demographic change, combined with raised environmental ambitions will require holistic approaches to deliver sustainable resilience for both public supplies and low flow habitats.

This section sets the context of the relevant projects already underway or soon to be implemented in East Devon, that include measures which will improve the resilience of the water resource for both public supplies and the environment. It also summarises wider catchment soil, land management, drainage restoration and nature-based initiatives which are important for the real biodiversity and water quality benefits they can deliver but are not expected to significantly change the decline in river low flows as temperatures warm.

A catchment plan is documented to set out and prioritise the water company measures best suited to achieve future flow and supply resilience as part of improving biodiversity outcomes across the East Devon catchments.

## 4.1 Current projects in the area

There are several projects currently being undertaken across East Devon that may improve the water availability and the environmental resilience of the Exe, Otter and Axe catchments. The following sections provide a brief summary of the projects and the potential impacts to water resources resilience. As evident from the descriptions, the key drivers for many of these projects undertaken are other issues in the projects, for example water quality or catchment management and thus water resource improvements are a secondary benefit. The WRT have highlighted that whilst the primary driver for catchment management is usually related to water quality, water quantity is becoming more of a focus, both from drought and flood perspective.

A summary of current projects within East Devon is provided below.

### PROWATER

PROWATER is a cross border project which stands for 'protecting and restoring raw water sources through actions at the landscape scale'. It contributes to climate adaptation by restoring the water storage of the landscape via 'ecosystem-based adaptation measures', for example through forest conversion, natural water retention or restoration of soil compaction. Westcountry Rivers Trust are a key partner and it is anticipated that the interventions increase resilience against droughts and floods and benefit water quality and biodiversity. Alongside the development of a 'Payment for Ecosystem Services' model in which organisations that take measures to combat water scarcity can

receive compensation the project wants to close the information gap between policy and the water user, by developing a vision to tackle water scarcity and drought risks in the long-term.

## Connecting the Culm

The Connecting the Culm project is a project focussed on the Culm catchment and is focussed on working with nature and local communities to adapt to the increased risk of flooding and drought in the future as a result of climate change as well as improve water quality in the river and create a better place for wildlife and people. The project is led by Blackdown Hills AONB and is a partnership between Devon County Council, Environment Agency, Mid Devon District. Westcountry Rivers Trust and National Trust. The project uses nature-based solutions to improve the health and resilience of natural ecosystems alongside modelling work (JBA) and monitoring and includes funding is available for operations including:

- Relieving soil compaction and restoring soil structure to reduce run-off;
- Installing 'leaky dams' to slow flow on watercourses;
- Tree planting on floodplain and other land;
- Reconnecting channels and retention ponds on floodplains;
- Creating buffer strips and new hedgerows to slow water flow off the land;
- Creating earth bunds to hold water back; and
- Restoring bogs, mires and wetlands to help store water.

Further details are provided here: https://connectingtheculm.com/discover-the-culm/.

## Upstream Thinking - South West Water

The Upstream Thinking (UST) project is a South West Water initiative which is large scale catchment management programme undertaken in strategic partnership between South West Water, Westcountry Rivers Trust, Devon Wildlife Trust, Cornwall Wildlife Trust, SW Lakes Trust, Natural England, FWAG, Exmoor National Park Authority, South West Peatland Partnership and the University of Exeter. There have been two phases conducted to date the phase 1 UST (UST1) and phase 2 (UST2) and phase 3 (UST) is currently underway.

The UST 1 project worked with farmers to undertake various interventions to improve water quality. These interventions included works to establish new hedges and in-field and riparian buffer strips, minimise the volume of "dirty" water produced, farm track management, construct troughs with concrete bases, ensure manure heaps were stored on impermeable bases and collect effluent, and soil aeration.

The UST2 project works across the Fowey, Tamar, Exe, Dart and Otter catchments. The project continued the work from the UST1 project with the primary aim of improving the water quality across the South West Water area through consideration of land and water quality at a catchment scale, engaging with farmers to explain the issues and working with those farmers to plan appropriate water quality management strategies and explore funding opportunities. The Westcountry Rivers Trust note that the first round of UST aimed to improve water quality through nutrient and sediment reduction. The second round had a particular focus on reducing pesticide

pollution. It has successful project for vastly improving the water quality in the Upper Tamar Lakes catchment (UST1), and the wider Tamar catchment (UST2).

The next phase of the project, Upstream Thinking 3, is currently underway with ongoing schemes in the Stour, Otter, Exe, Fowey, Tamar and Dart catchments. Works in the Exe are undertaken by a working partnership with the South West Peatland Partnership, FWAG, Devon Wildlife Trust (DWT) and West Country Rivers Trust (WRT). In the Otter there is a partnership between SWT and WRT. The scheme remains multi-faceted, and the partnership continues supporting farmers to release money from grants to support projects which improve water quality and habitat enhancements, undertake soil aeration and to work with the farmers to undertake best practice. In the Exe this has been through meadow restoration, bank restoration, scrub clearance, clean and dirty water separation and pesticide drip tray installation. In the Otter the work lead by the partnership included a rainwater harvesting scheme and soil and manure assessments as well as discussions with landowners of bank protection and tree planting possibilities.

Whilst the UST thinking programme is primarily aimed at improving water quality there are secondary benefits for water supply resilience, for example:

- by slowing water to the watercourse during high flows (e.g. buffer strips, hedgerow planting, soil aeration), there is a slower release of water to the river reducing the amount of time the river experiences low flows;
- providing additional sources of water (e.g. rainwater harvesting) reduces the need for pumping from the river and or groundwater supplies during times of low flow.
- ensuring that the rivers are functioning well by improving water quality and in-stream geomorphology (e.g. stopping cattle access to river banks) so that during low flow events the aquatic habitat and rivers themselves may be more resilient.

The scheme is highly successful, and South West Water have commented that they anticipate the scheme will continue into the future.

### Mires on the Moors Projects

This project has been funded by South West Water and is a partnership between the Environment Agency, Natural England, Historic England, Dartmoor National Park and Exmoor National Park. The project is focussed on scientific enhancement and peatland restoration. Whilst there are some areas of very little change post-restoration, the most notable changes are in the deeper peats where restoration increased the permanent deep-water storage in the soil by 7.3 cm and increased average water table by 2.45 cm. In shallow peat, the water table responses to restoration were characterised as complex with the results showing that in the driest area, where drainage had the greatest effect pre-restoration, water tables rose by up to 4cm. The reporting (Brazier et al., 2020) notes that restoration can significantly alter rainfall run-off regimes in restored catchments reducing gully flow by up 66%.

In terms of water resource resilience, the University of Exeter (Brazier et al., 2020) highlight that peatland restoration has the potential to drive changes in water storage and base flow regimes, reducing flood risk and improving water security. In addition, the restoration will drive water quality changes, carbon stocks and fluxes, reducing in DOC loading, water colour and carbon cycling as well as alter habitat structure and function, enhancing priority habitats and delivering biodiversity and carbon sequestration benefits.

## South West Peatland Partnership

The South West Peatland Partnership was a three-year partnership programme which started in 2018 to restore damaged peatland on Bodmin Moor, Dartmoor and Exmoor. The programme impacted the East Devon catchment through works to improve the Exmoor national park. South West Water (2021) note that the partnership in the Exmoor area included the South West Water, Natural England, Environment Agency, Historic England, University of Exeter, Exmoor National Park Authority, Exmoor Society and other farming representatives.

The project sought to block ditches in order to enable re-wetting of extensive areas of damaged peatlands. The various ditch blocking techniques using sustainable materials (wood, peat, grass and heather) are being used on historic peat cuttings, drainage networks and eroding gullies to enable the re-wetting. The benefits of this programme for water supply resilience is the increase in water storage in the upper reaches and the reduction of run-off and poor water quality.

## Farming in Protected Landscapes (FItPL)

A new Farming in Protected Landscapes has been set up by DEFRA (2020)[5]. This is a time-limited funding programme that will help farmers and land managers adapt to future changes in agricultural support. The funding is targeted at management of the natural environment, cultural heritage and public access in ways which benefit nature, climate, people and place. Broadly, the scheme may improve water resources indirectly by support for farmers for delivering environment/landscape outcomes. Examples might include peat restoration, planting woodland, hay meadow restoration, creation of heathland and scrub, moorland management, enhancement of wetlands, and dry-stone wall repairs which may reduce run-off and retain more water in the catchments, improving water availability during low flow periods. The scheme is likely to be open 2021-2024 and the Environment Agency have indicated that the funds from this are being used to target nutrient run off.

## River Axe diffuse pollution and nutrient management plan

This plan was commissioned to identify options and approaches to reduce nutrient levels entering the River Axe, a river of significant nature conservation importance. Excess nutrient levels were identified as having unacceptable adverse impacts on water quality and there were concerns that an absence of means to reduce nutrient levels may result in refusal of planning permission for proposed new development, specifically including a large-scale strategic development site incorporating 850 new homes, to the east of Axminster. The River Axe diffuse pollution and nutrient management was not shared by the Environment Agency at the time of writing, but the EA's Emma Magee noted that this project was likely to be complimentary to an assessment of flows.

## Triple Axe Action Plan 2021-2026

The Triple Axe action plan is an integrated programme combining farming, nature and people to aid nature recovery goals. Much of the work is being undertaken on farms, and farmland to target

[5] DEFRA (2020), The Path to Sustainable Farming: An Agricultural Transition Plan 2021 to 2024 available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/954283/agricultural-transition-plan.pdf

phosphate reduction through farm business analysis, inspections, farm transformation plans, natural capital investment and monitoring. The project will also adopt some nature-based solutions through riparian tree planting and new wetland, reducing livestock pressures on the river bank and restore banks, retention of woody debris and development of gravel shoals, remove or lower in-channel structures and re-meander. At present this is directed to the Corry and Coly. These nature-based solutions may all have a secondary impact on water resilience during low flow period through improvements to the river habitat.

### Clinton and Devon Estates Land Management

At Clinton and Devon estate Westcountry Rivers Trust (WRT) have facilitated a test and trial on their behalf which includes landscape management plans based on what they work currently being undertaken in the area, and what works are required to improve on current activities. The work has ensured that all of the farmers who farmed land that fell in the safeguard zone have reduced their nitrogen applications by 50% and WRT have encouraged a range of nature-based solutions which has resulted in the following outcomes:

- 24.5 hectares of beaver habitat
- 288.9 ha of nitrate reduction
- 89.6 ha new woodland
- 6 ha of wetland
- 30 km pollinator strips
- 19km of enhance hedges
- 15 km of new hedges

The beaver trials on the land have been both hugely successful, and extremely popular in the media. The beaver activity has not only created 0.5ha of new complex wetland but has successfully caused a reduction of peak flows during flood events, positively impacted water quality and fish populations. Alongside the nature-based solutions undertaken across the Clinton and Devon Estates, the Estate has established its own conservation charity back in 2006, the East Devon Pebblebed Heaths Conservation Trust, to oversee the management of this site. The key projects currently being undertaken are summarised below.

### Lower Otter Restoration Project

The Lower Otter Restoration Project is a partnership programme working with local people to improve the downstream part of the River Otter, its estuary and its immediate surroundings and assist in future proofing the environment against future climate change. The LORP key aims of the project are multifaceted; and include some schemes to improve access and improvements to education and recreational facilities but in terms of the water environment the following objectives are being undertaken:

- Reconnecting the river to its floodplain allowing it to flood and drain naturally by breaching the embankments in several places.

- An increased area of rare inter-tidal habitat with significant biodiversity benefits, including for birdlife. The Environment Agency is seeking compensatory inter-tidal habitat for that lost to coastal squeeze in sites such as the Exe Estuary which are benefiting from new flood defence initiatives. The Lower Otter Estuary has been identified as an area which is suitable for such new habitat creation.
- Working with tenant farmers to adjust existing land use to allow livelihoods to be secured, water quality to improve and biodiversity to thrive.

A press release by the UK government highlights that the scheme will create 55 ha of mudflats, saltmarsh and other valuable estuarine habitats[6]. The project is a £12 million and the key funding mechanisms are the EU's Interreg France (Channel) England Programme as part of Project PACCo - Promoting Adaptation to Changing Coasts, European Regional Development Find (ERDF), Environment Agency and Clinton Devon Estates.

## Strategic Exe weirs

Westcountry Rivers Trust and The River Exe and Tributaries Association (RETA) are working together to improve access for migratory fish throughout the River Exe catchment. The project aims to enable free movement of native fish species in the River Exe by mitigating the cumulative impacts of multiple weirs in a changing climate. The project will improve the in-channel habitat for fish which should also improve water resilience during low flow periods.

## Small scale catchment schemes e.g. Farming on the Exe

It is widely accepted that water dependency needs reducing, however, catchment water use is needed. The Environment Agency note that there are smaller scale schemes such as the "Farming on the Exe" project which looks at small scale changes that can be made across the catchment, for example on a beef farm, if a farmer adds trees, the trees provide shade for the cows and they drink less, and this improves resilience of catchment.

## CaBA opportunity mapping

CaBA's opportunity maps from the '**Working with Natural Processes - Evidence Base'** project[7] identify the types of measure that may be effective in flood and coastal risk management (FCRM) and wider ecosystem service benefits (Environment Agency, 2018). These maps can be used to inform and prioritise future catchment measures.

**Figure E4.1** shows the opportunity mapping across the East Devon catchment for:

- Tree planting in riparian areas (identified everywhere along the river network).
- Countryside stewardship options (for example, buffer strips, wildlife strips, regeneration of habitats, livestock fencing, coppicing of bankside trees, hedgerows).
- Priority habitat creation projects (e.g. Devon Water Vole Recovery Project, River Otter Invasives Project, East Devon Fish Passage Improvements, tree planting on River Axe).

[6] https://www.gov.uk/government/news/environment-agency-submits-final-plans-for-otter-valley-project
[7] https://catchmentbasedapproach.org/learn/working-with-natural-processes-evidence-base/

Wider scale implementation of these CaBA opportunities will help to deliver biodiversity and water quality benefits. Local channel, drainage and floodplain habitat restoration projects will also provide a vital role in improving the ecological resilience to droughts and dry periods. However, neither catchment-wide nor local habitat initiatives are expected to make much difference to river low flows, or to change the projected environmental flow deficits in the water bodies with abstraction pressures highlighted by the Environmental Ambition challenge.

### Natural Environment Investment Readiness Fund

DEFRA have announced a £10 million Natural Environment Investment Readiness Fund (DEFRA, 2021a) which is being used to develop the projects to the point they can provide a return on investment by capturing the value of carbon, water quality, biodiversity and other benefits provided by natural assets such as woodlands, peatlands, catchments and landscapes. Funding has been awarded to environmental groups, businesses and local authorities to develop projects that protect and enhance nature while also demonstrating innovative approaches to generating revenues from the wide range of benefits that nature provides.

The East Devon District Council has received £99,163 to convert farmland to woodland in an area experiencing a growth in development, via an Environmental Impact Bond. This is a council driven project and will lead to the conversion of agricultural land to woodland. It will monetise revenue generation from voluntary carbon credits, biodiversity credits from new habitat recreation and the Community Infrastructure Levy (DEFRA, 2021a). It is not yet clear where the impact of this scheme will be.

## 4.2 Future planned projects

There are also plans to change the compensation scheme at Wimbleball and Otterhead Reservoirs which aims to impact improve flows in the Upper Exe and Upper Otter catchments. See section 3 for more details.

The majority of the current projects such as the South West Water led Upstream Thinking programme, Triple Axe and the Lower Otter Restoration Project will continue into the future which aims to provide resilience and improve habitats in the upper catchments.

## 4.3 WCWR East Devon action plan

As is evident, some work is already underway and planned by catchment stakeholders across East Devon catchment. These interventions may deliver small-scale improvements to low flow availability as well as providing water quality and biodiversity resilience, but they are unlikely to significantly improve low flow resilience in the face of climate change.

Consultation with WCWR during this project has contributed to the development of a **strategic action plan of water company measures that could be implemented in a phased approach.** This plan has been sketched out to add supply-side options to the existing preferred demand management and leakage reduction measures in order to support the environmental ambition challenge. However, these water resources measures would also work in synergy and holistically with the wider catchment projects, all building resilience for East Devon. A phased implementation should deliver incremental benefits along the way and would require step-wise changes in abstraction regulation.

South West Water are currently looking to deliver abstraction reductions through demand management but have considered a range of options over their Wimbleball WRZ that will impact East Devon that are currently not on their preferred list. Due to the scale of the reductions required in East Devon these options may need to be reconsidered in the medium and long term. The options presented by SWW are combined and summarised in **Table 4.1**. Similarly, Wessex Water are also looking to reduce demand in their WRZ.

In addition, Wood has included a number of potential options that should be considered in order to reach the environmental ambition flow targets in the East Devon catchments as seen in **Table 4.2**.

Schematic maps in **Figures E4.2** to **E4.4** show how the large-scale water company measures may be implemented over the short, medium, and long term.

Table 4.1 Water company phased water resources resilience action plan to 2050 for East Devon

| Category | Option category | Measure | Location | Issues being targeted | Short term 2030 | Medium term 2040 | Long term 2050 |
|---|---|---|---|---|---|---|---|
| **Changes to existing operations** | Wimbleball Lake | Alterations to Wimbleball Lake compensation release to improve flows downstream. | River Haddeo and Exe catchment | Improved flow regime and water quality | | | |
| **Changes to existing operations** | Otterhead Reseroir | Alterations to Otterhead Reservoir compensation release to improve flows downstream. | Otter catchment | Improved flow regime | | | |
| **Catchment Management** | Catchment Schemes<br><br>WINEP studies (Otterhead and Wimbleball Reservoirs, Countess Weir) | Continuation of Upstream Thinking initiative<br><br>Continuation of Catchment Management Programme | East Devon | Water Quality | | | |
| **AMP7 investments** | Customer side management options<br><br>Leakage reduction | Enhanced metering, reduce distribution losses, leakage innovations, customer education and continued investment. | East Devon | Demand reduction | | | |
| **Resource Scheme** | Re-commissioning of Stoke Canon and Brampford Speke boreholes | Utilises two drought sources north of Exeter and Pynes WTW. The Brampford Speke borehole has a licence to abstract 3.5 Ml/d all year round whilst the Stoke Canon source can pump at a peak rate of 4.5 Ml/d for up to 137 days. The recommissioning of these boreholes would enable them to provide up to 8 Ml/d for part of the year. The abstracted water would either | Exe catchment | Change to abstraction regime | | | |

| Category | Option category | Measure | Location | Issues being targeted | Short term 2030 | Medium term 2040 | Long term 2050 |
|---|---|---|---|---|---|---|---|
| | | be discharged to the River Exe for abstraction at Northbridge Intake or supplied directly to the Pynes intake if a suitable pipeline is installed. | | | | | |
| **Resource Scheme** | East Devon New Source | The option is to drill a new groundwater source in East Devon. It is envisaged that this could yield up to 2 Ml/d. A new treatment plant would be required although it is assumed at this stage that no major pipeline to connect the supply to the existing network would be needed. | East Devon | Change to abstraction regime | | | |
| **Enhancing existing supplies** | Pynes WTW capacity increase to 67 Ml/d | This will option will increase the maximum capacity of Pynes WTW up to its licensed maximum of 67 Ml/d thereby improving its ability to utilise the yield of the Wimbleball/River Exe resources system.<br>The raw water main currently restricts works output and therefore an additional main would be added from the intake. The expansion of Pynes will facilitate the transfer of water between the Wimbleball and Roadford WRZs. | Exe catchment | Increased output from Pynes. | | | |

Table 4.2 Additional solutions that could be considered as part of a phased catchment action plan: East Devon

| Category | Option category | Measure | Location | Issues being targeted | Short term 2030 | Medium term 2040 | Long term 2050 |
|---|---|---|---|---|---|---|---|
| **Catchment Management** | Catchment Schemes | Continuation of catchment management schemes including, but not limited, to woodland management and planting, oversight of riparian and in-river practices, farm management e.g. livestock and nutrient management), continuation of advice on soil management. Develop closer ties with the Devon Local Nature Partnership to release mutual benefits under Devon LNPs nature recovery network and the resilient rivers and coasts initiative. | East Devon | Water Quality | | | |
| **Natural Flood Management** | Slow and store water during higher flows to improve flow regime at low flows | Improve water availability and groundwater recharge by using NFM techniques within the catchment. Natural attenuation features and further storage options in the wider catchment such as SUDS, natural attenuation features, leaky dams and increased use of rainwater harvesting across catchment. Liaison with stakeholder to identify “easy wins”. Expect small gains. | East Devon | Low flow improvements | | | |
| **Extension of existing resources** | Enhance existing storage in catchment | Undertake environmental assessment and consider raising Wimbleball to improve storage here. | River Haddeo/ Exe catchment | Increased storage | | | |

| Category | Option category | Measure | Location | Issues being targeted | Short term 2030 | Medium term 2040 | Long term 2050 |
|---|---|---|---|---|---|---|---|
| | Enhance existing storage in catchment | Consider raising Otterhead or Squabmoor reservoirs to improve storage here. | Exe/ Otter catchments | Increased storage | | | |
| **Regional solutions** | New water resource | Consider locations for new reservoirs. | East Devon | Increased storage | | | |
| | Water Trading | Import from other water companies and other WRZ. Current economically unviable, but this may change in future if significant deficit remains. | | Water availability | | | |
| | Effluent Reuse | Further targeted assessment on the use of effluent reuse across the catchment | | Water available for use | | | |

# 5. References

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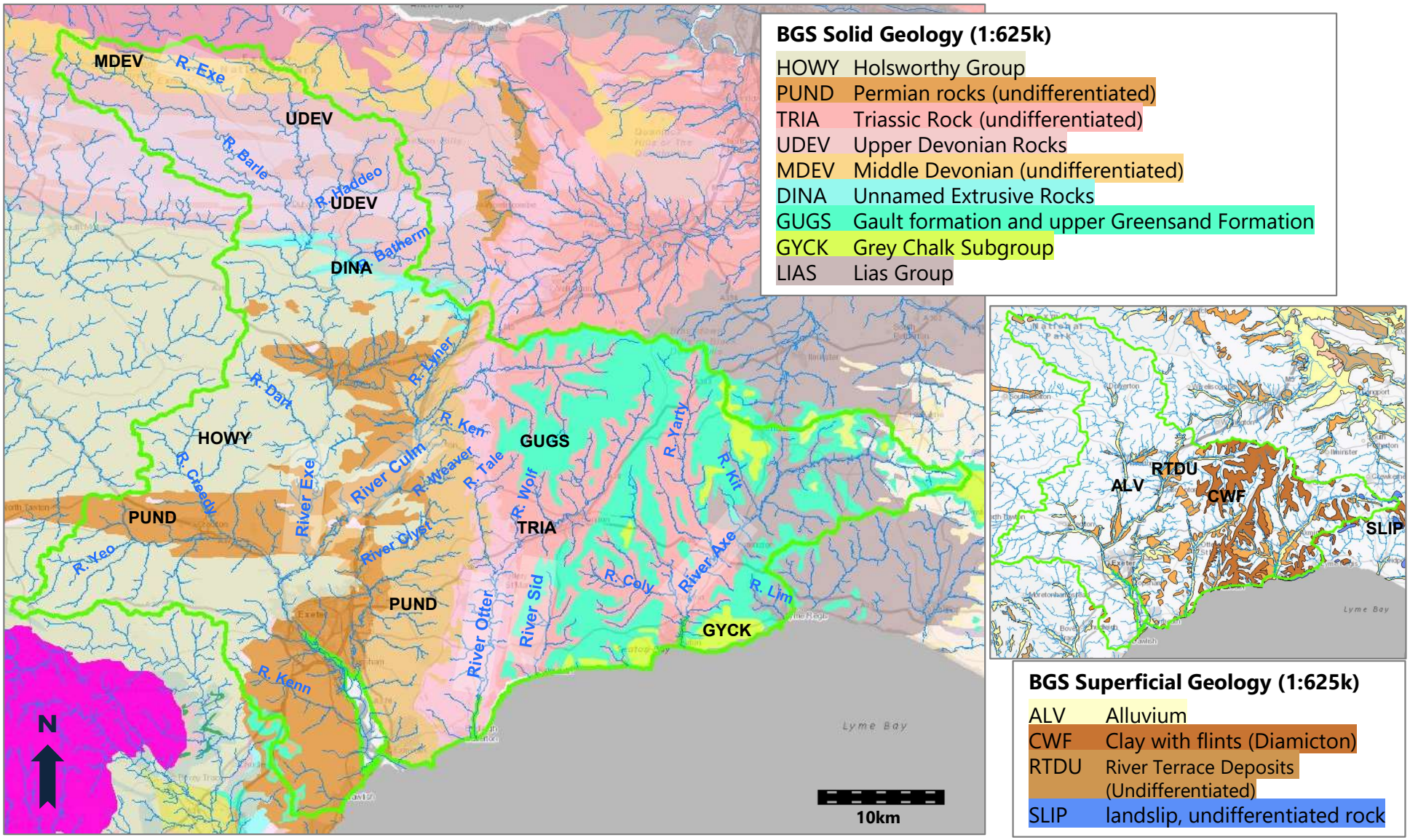
# Figures

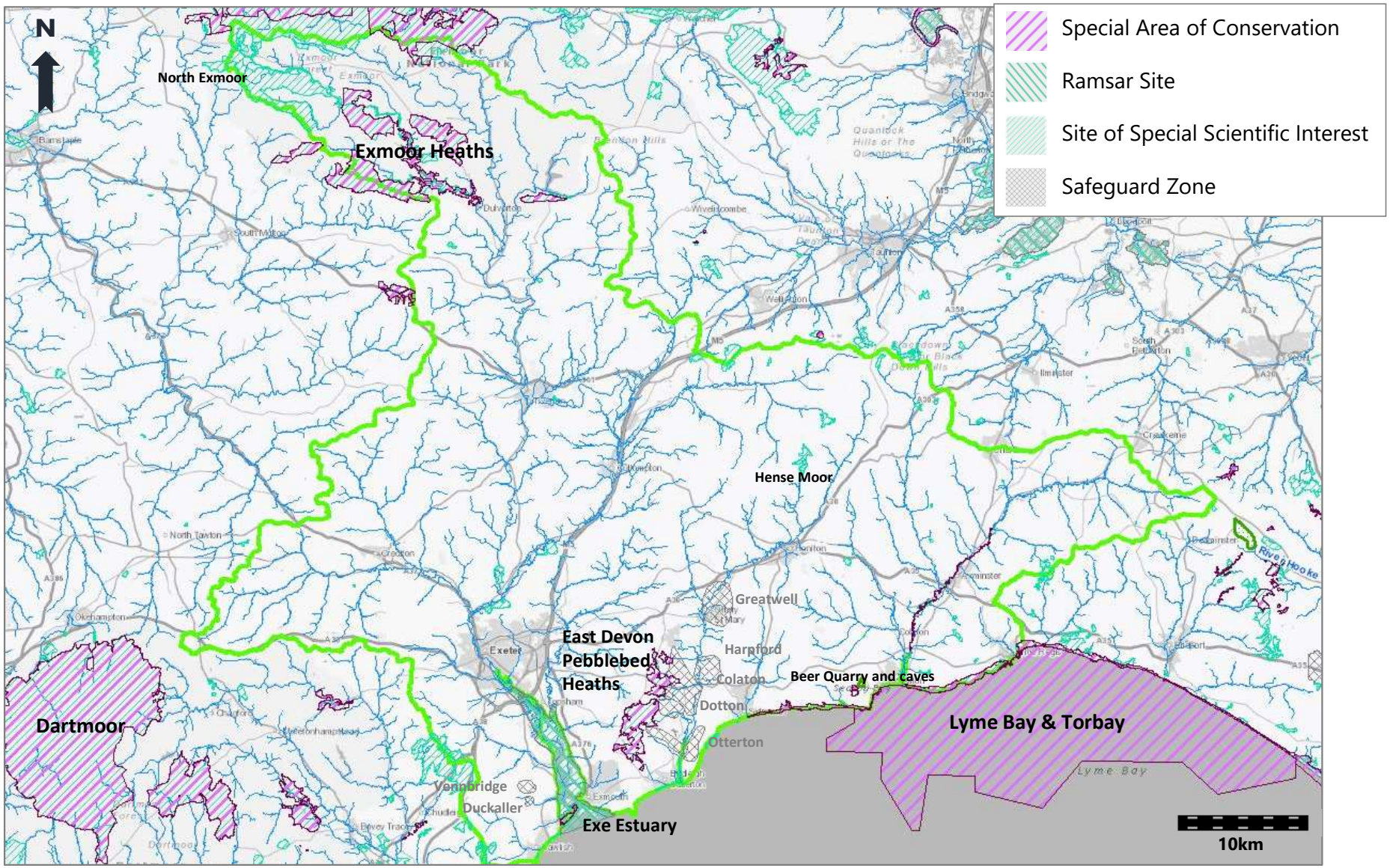
# Environmental Destination

## Figures accompanying Annex E: East Devon Pilot Catchment Plan to increase future water supply and environmental low flow resilience

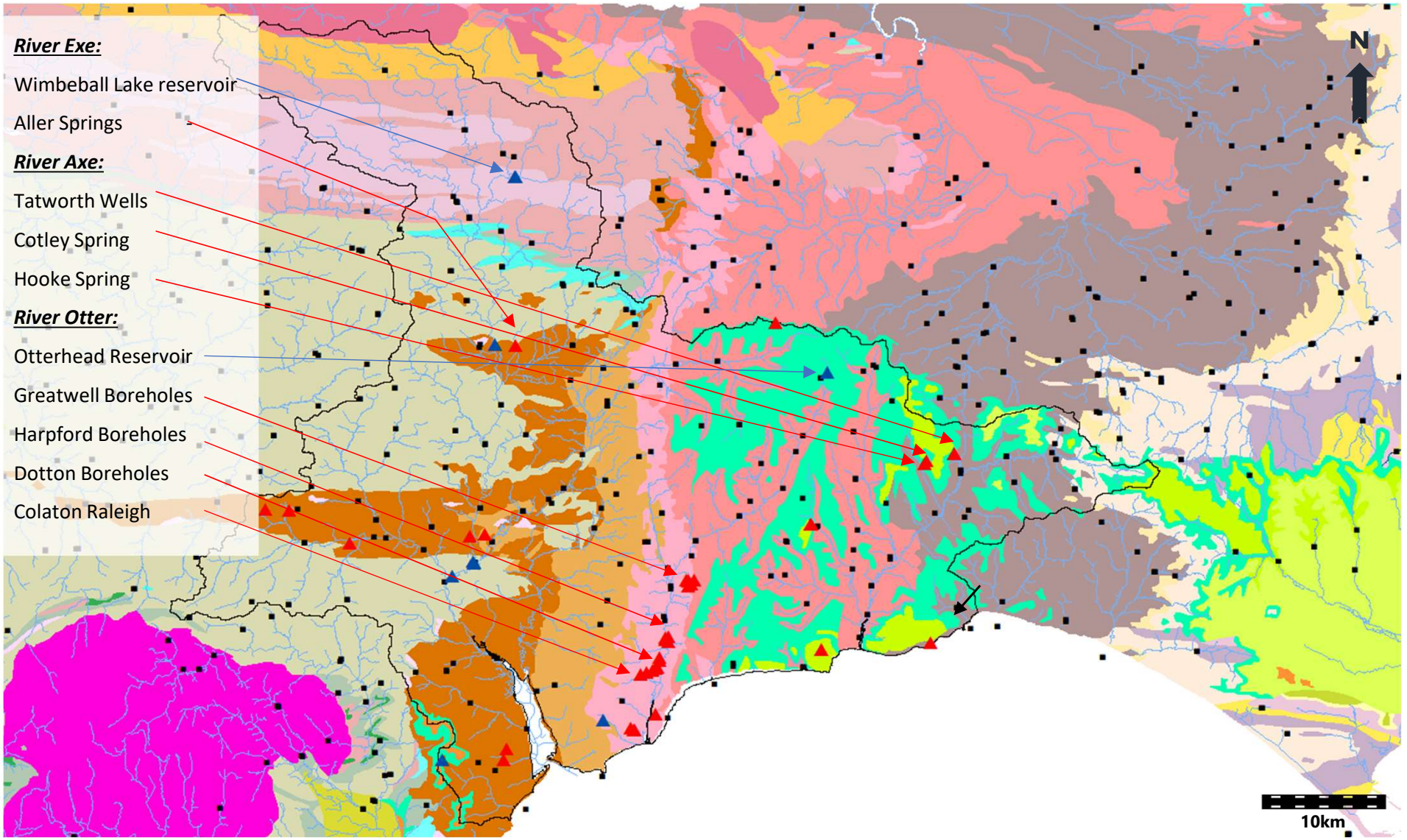
# Figure E2.1 East Devon catchments: Rivers and Geology



# Figure E2.2 East Devon catchments: Designated sites and Drinking Water Safeguard Zones



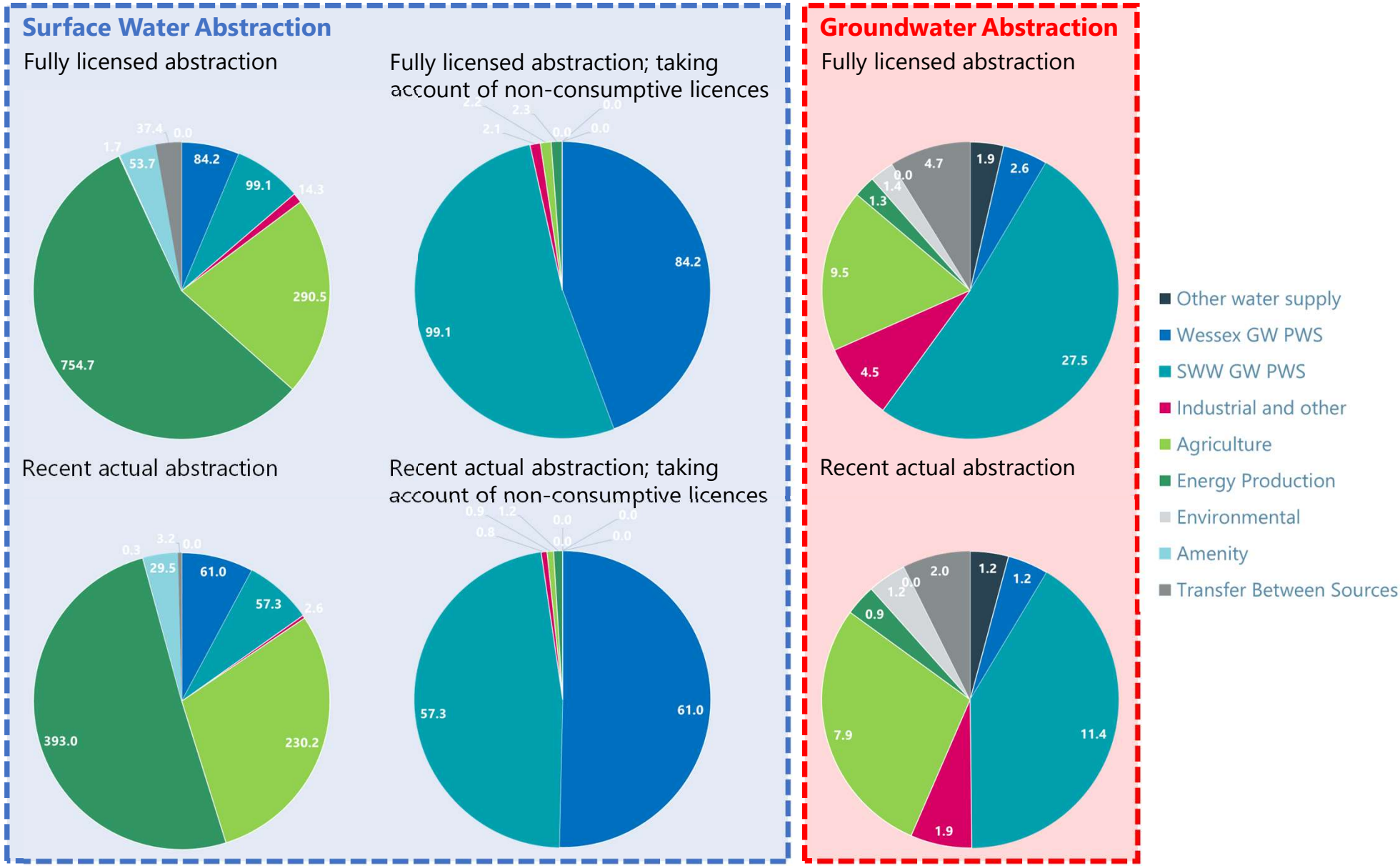
# Figure E2.3 East Devon catchments: PWS Groundwater abstractions, PWS Surface water abstractions, WwTW Surface water discharges





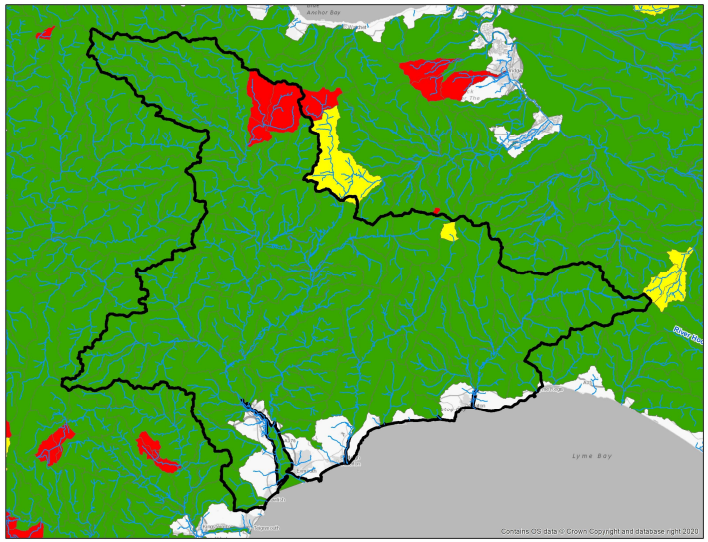
Abstraction data downloaded June 2021 from Catchment Based Approach Data Hub website

# Figure E2.4 East Devon catchments: Water Abstraction by Sector (total, Ml/d)

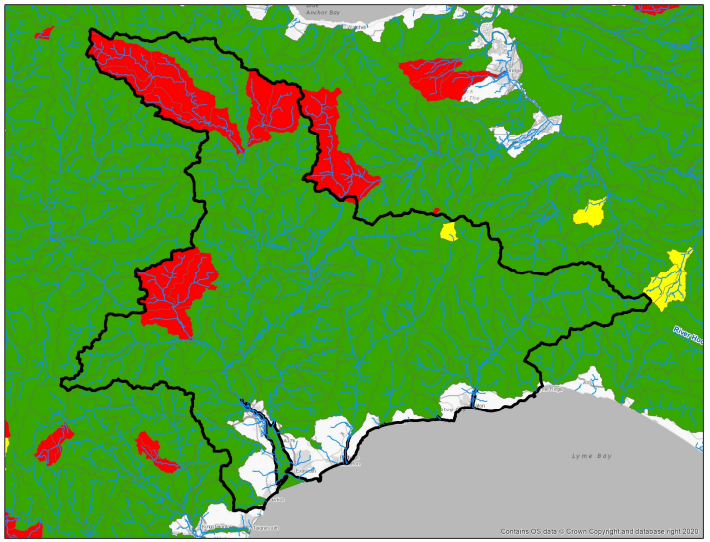


# Figure E2.5 Environment Agency water resource availability at Q30, Q50, Q70, Q95 (Cycle 2, last updated 16 April 2021)

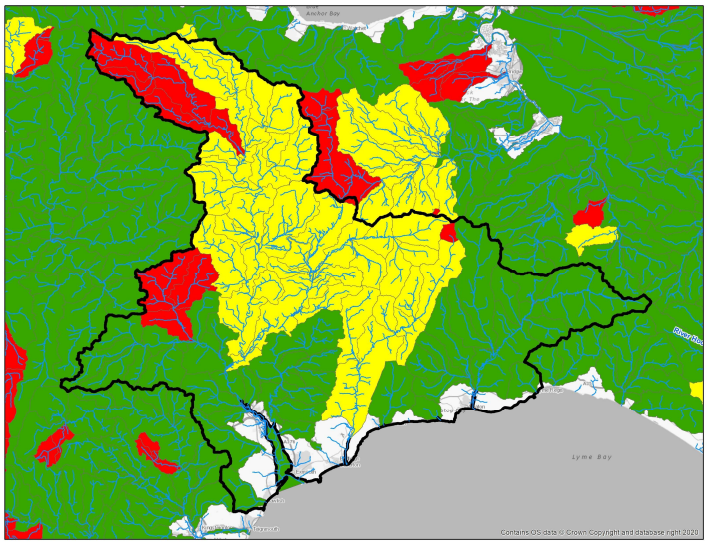
Availability at Q30 (high flows)



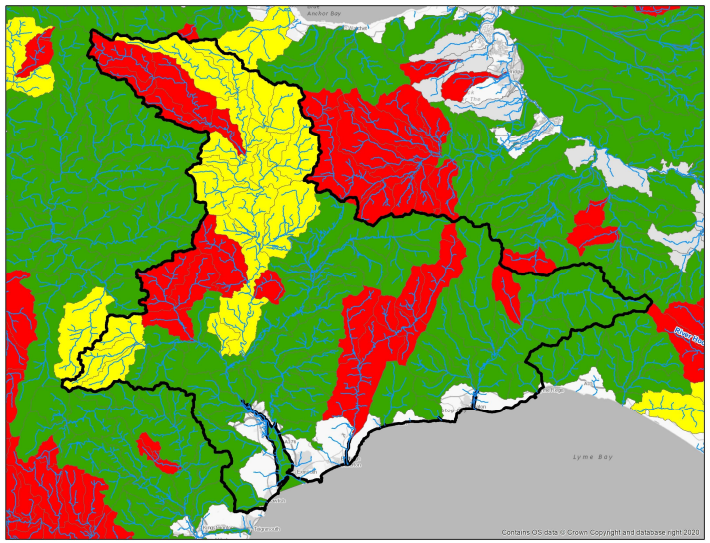
Availability at Q50 (moderate flows)

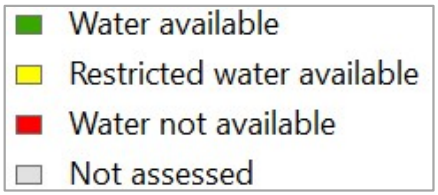


Availability at Q70 (low flows)

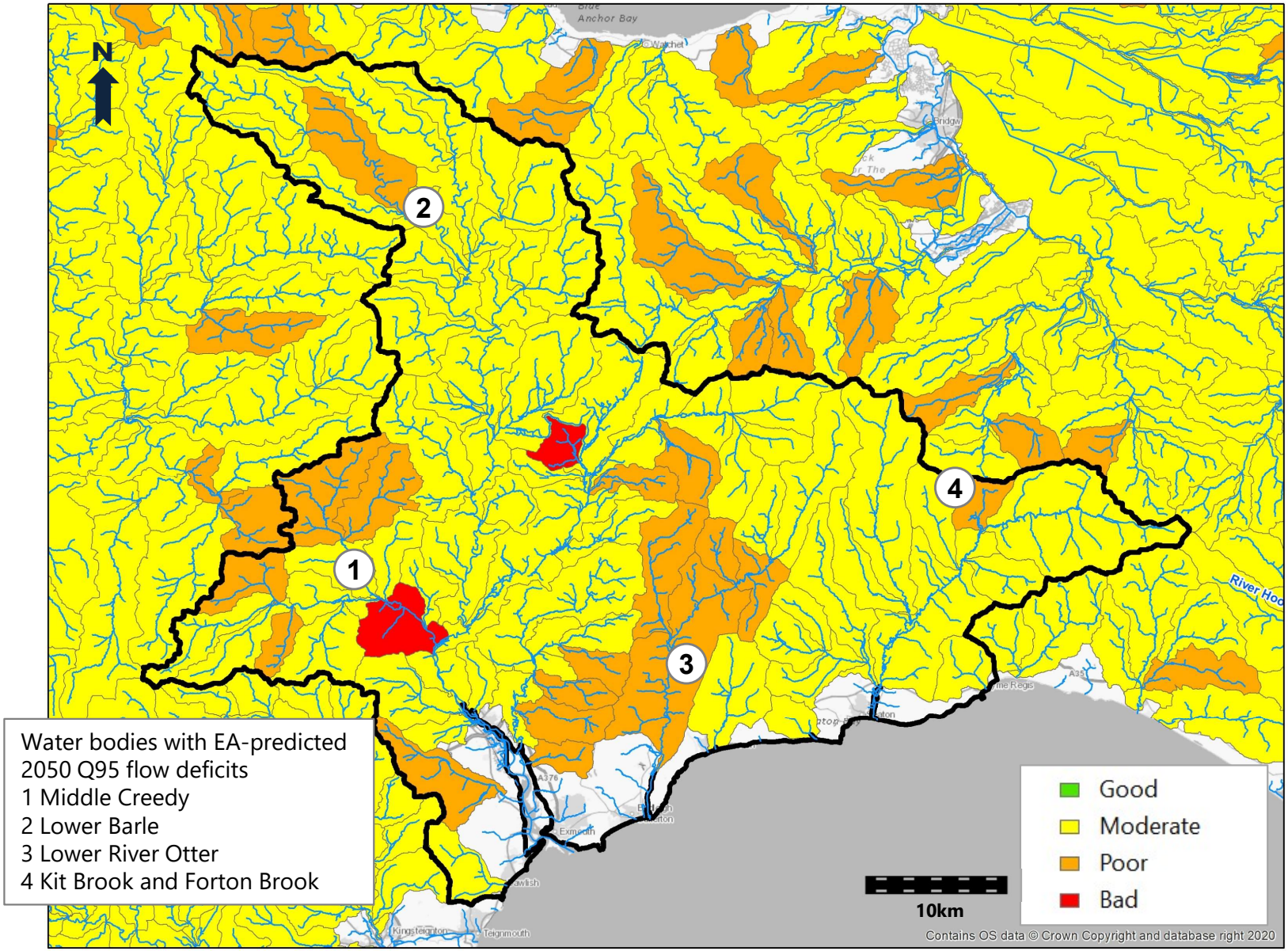


Availability at Q95 (very low flows)

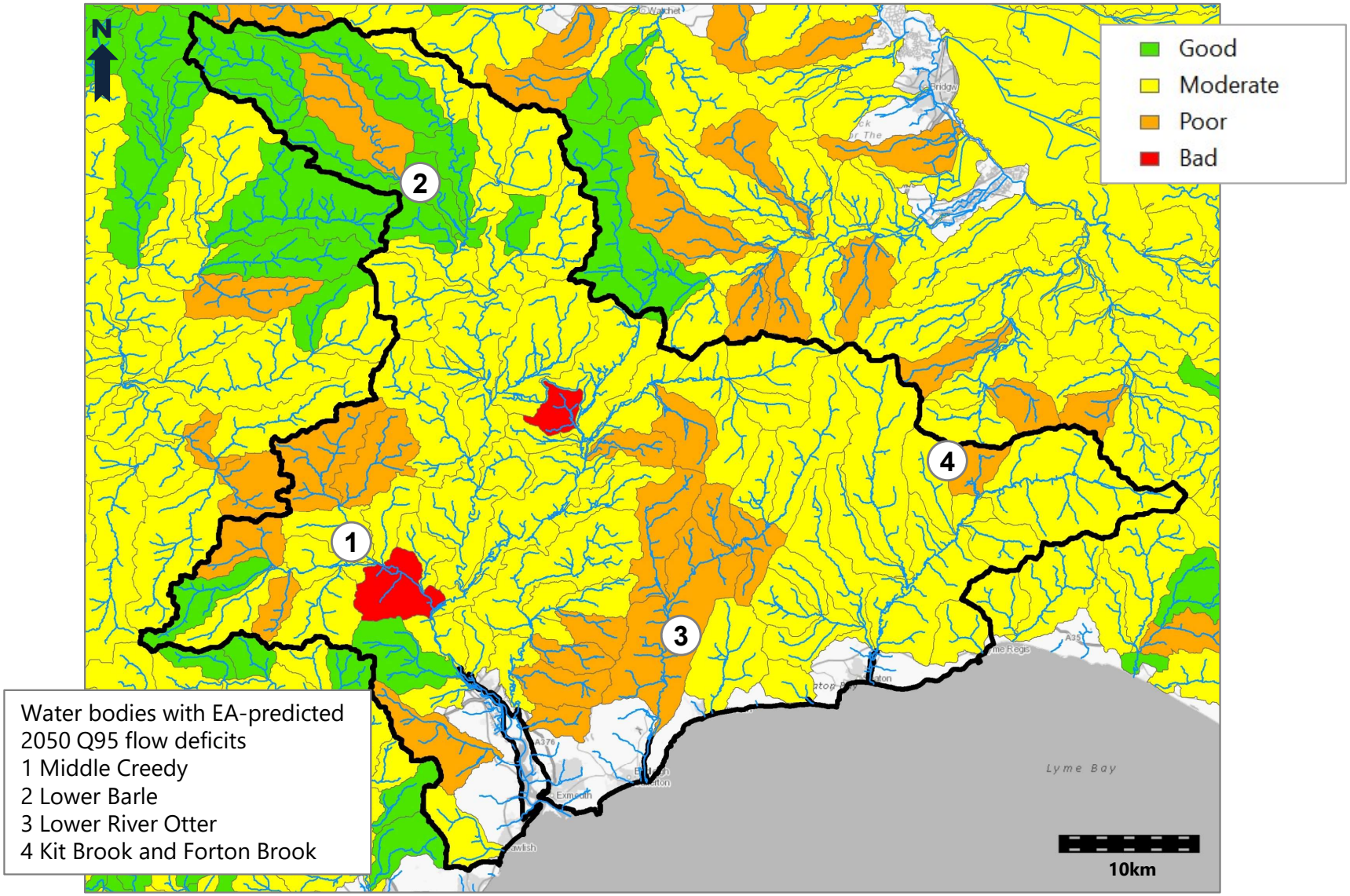




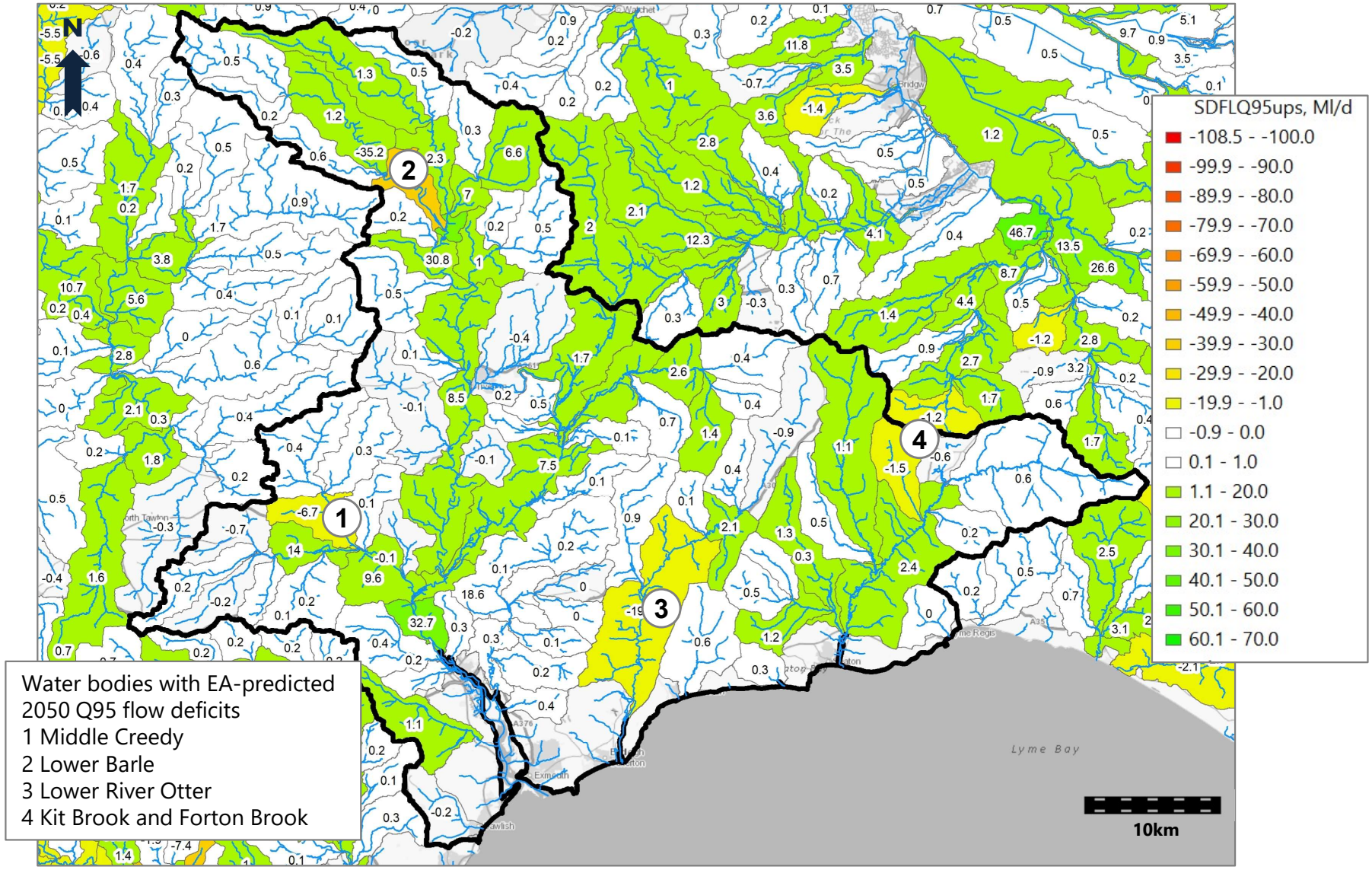
# Figure E2.6 WFD water body overall status (chemical + ecological, Cycle 2, 2019)



# Figure E2.7 WFD water body ecological status (Cycle 2, 2019)

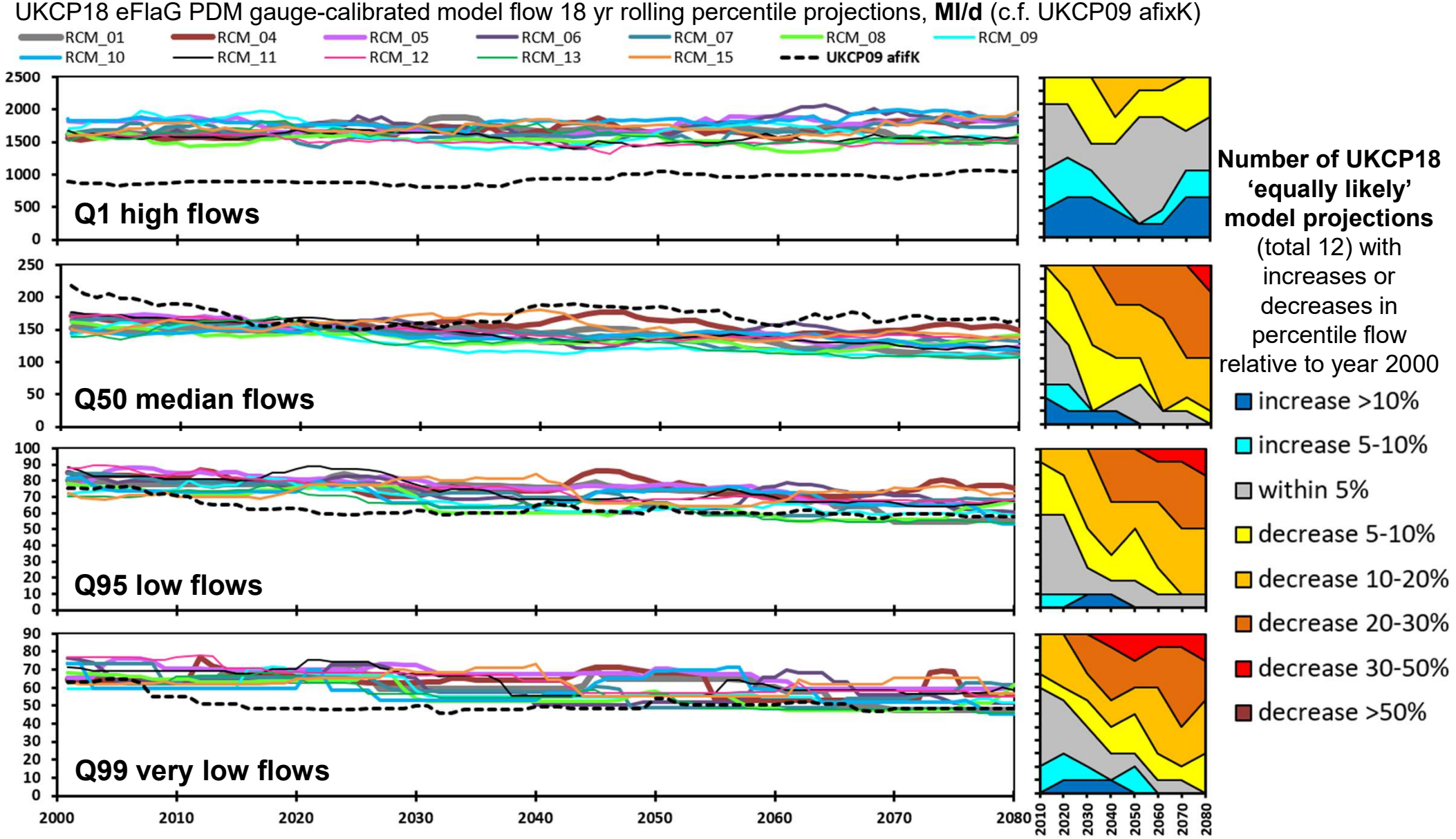


# Figure E3.1 EA predicted fully licensed 2050 flow surpluses and flow deficits (Ml/d) for water bodies under Q95 low flow conditions (enhanced scenario)



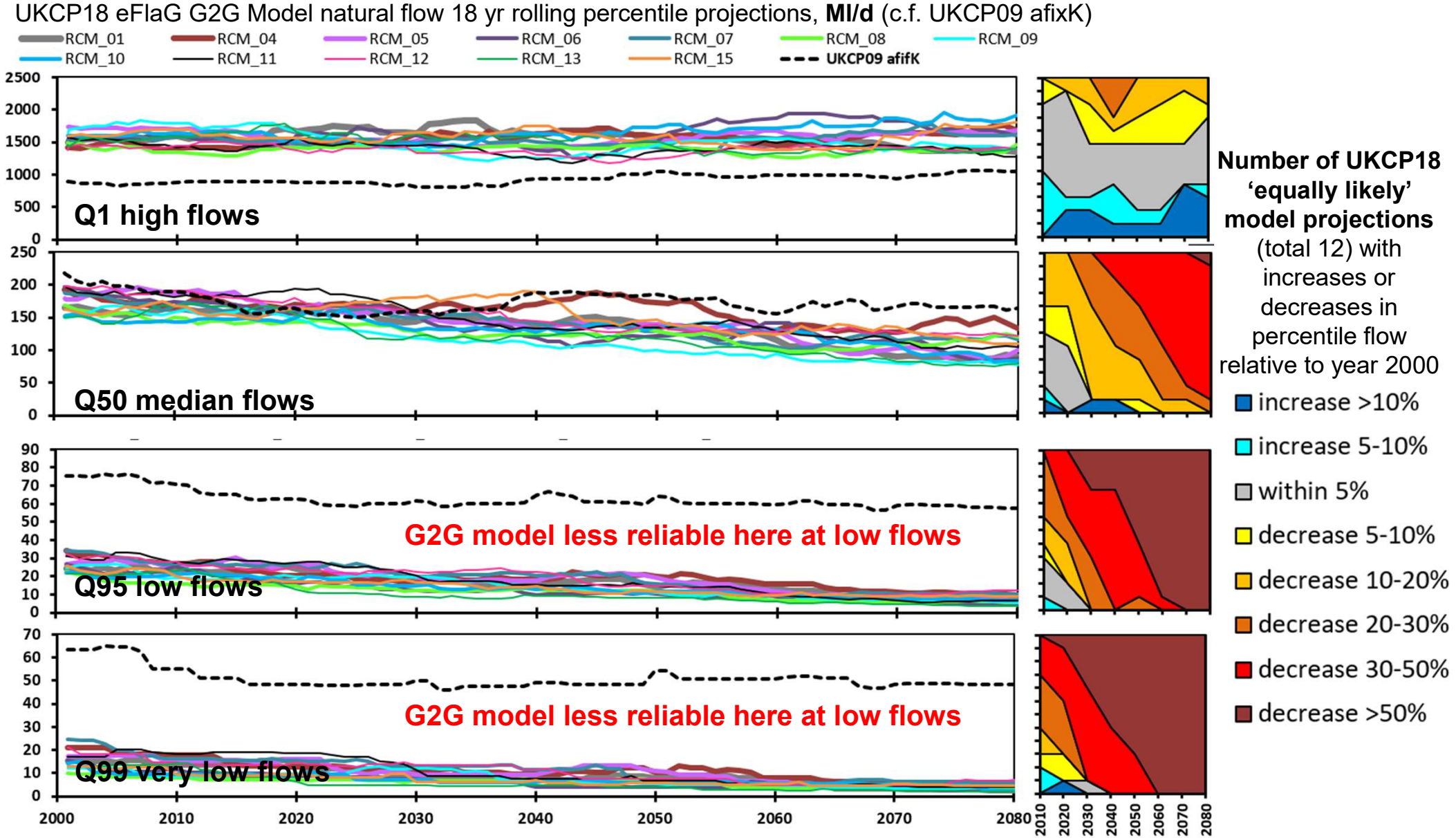

Data from EA's National Framework modelling in 2020

## Figure A3.2 Flow changes expected due to climate (Otter at Dotton): Projections from UKCP18 climate & PDM gauge-calibrated river flow models



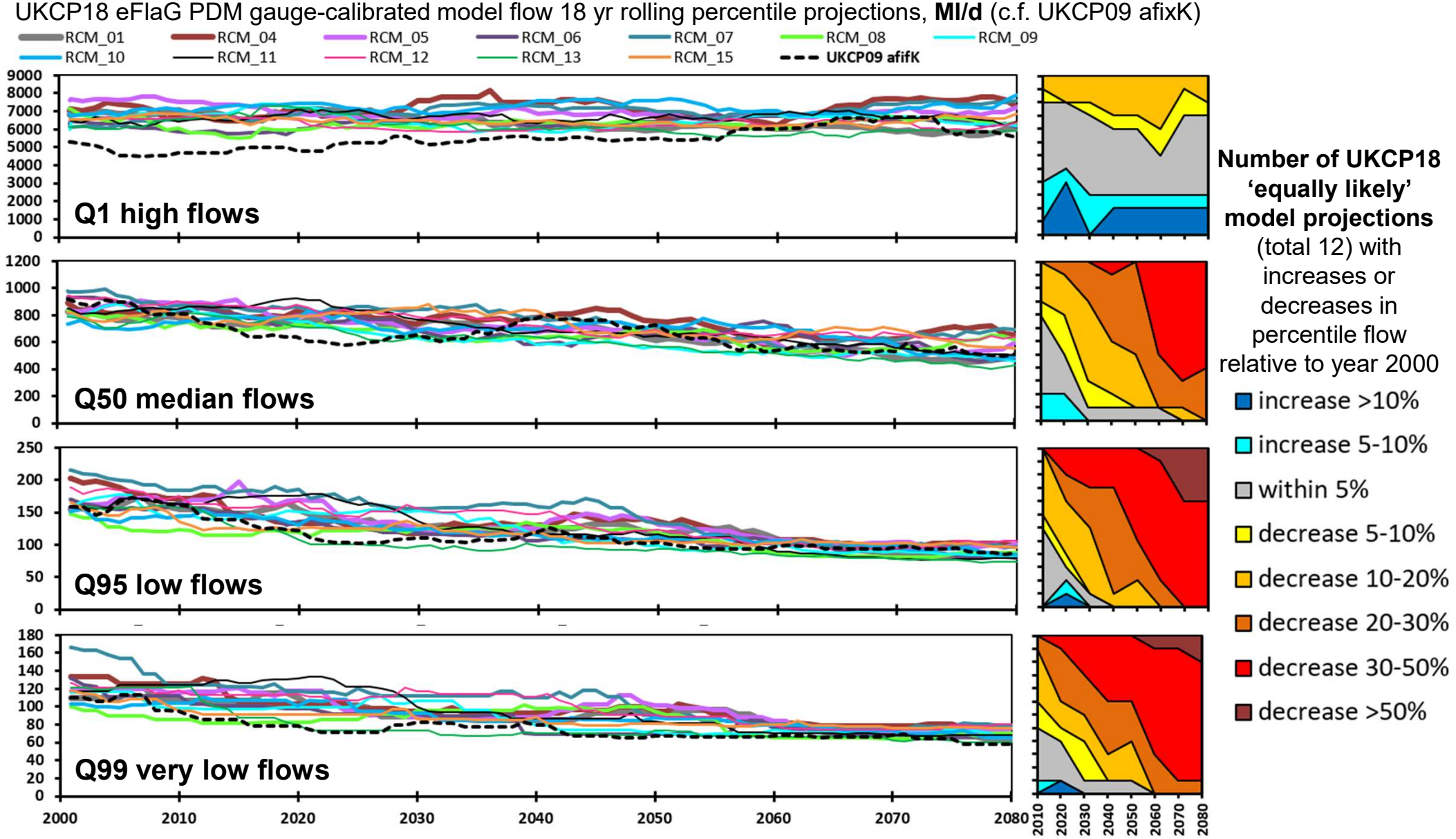

Data source: natural flows from 12 equally likely UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

## Figure A3.3 Flow changes expected due to climate (Otter at Dotton): Projections from UKCP18 climate & G2G national natural river flow models




Data source: natural flows from 12 equally likely UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

## Figure A3.4 Flow changes expected due to climate (Exe at Thorverton): Projections from UKCP18 climate & PDM gauge-calibrated river flow models




Data source: natural flows from 12 equally likely UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

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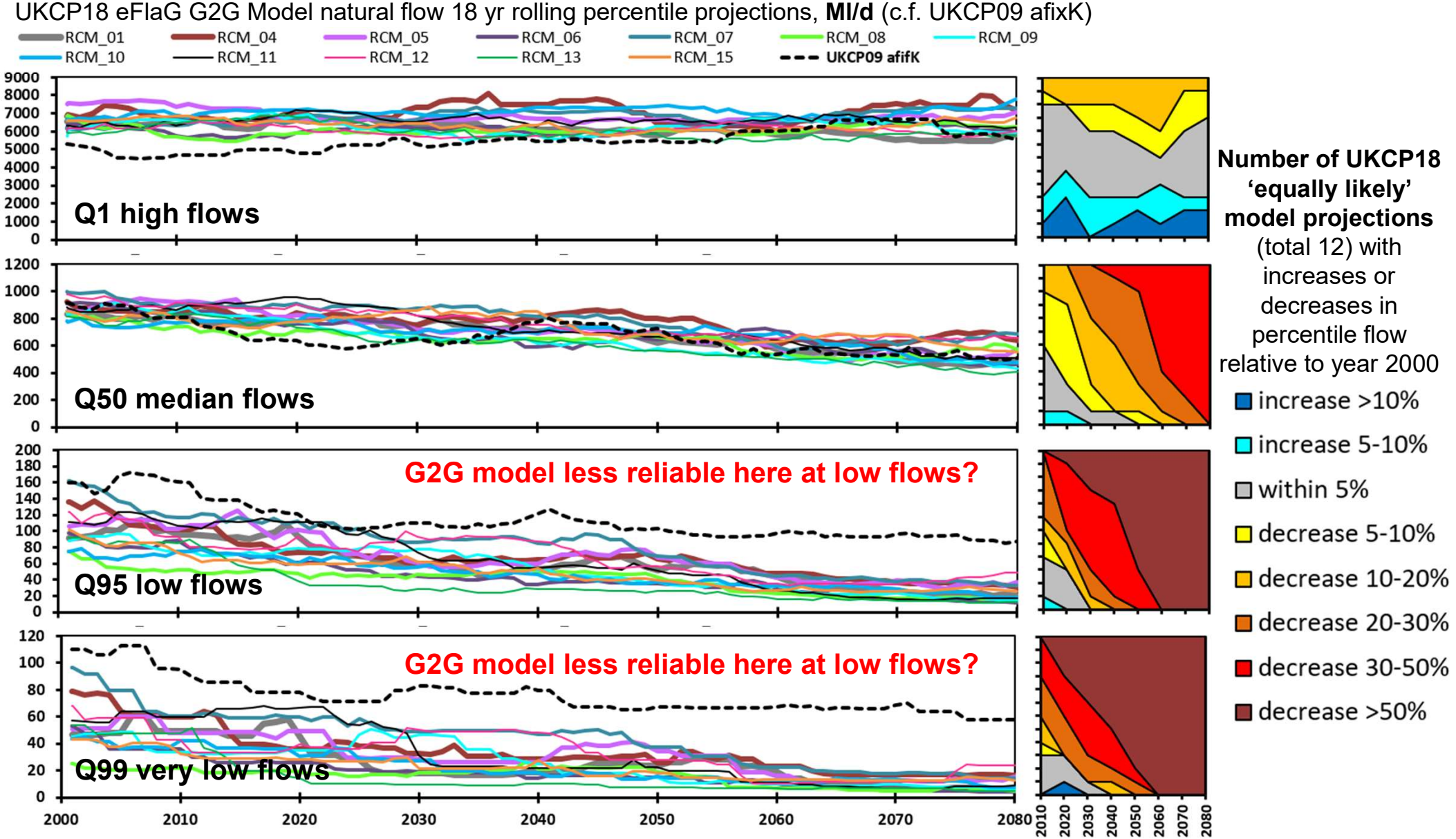
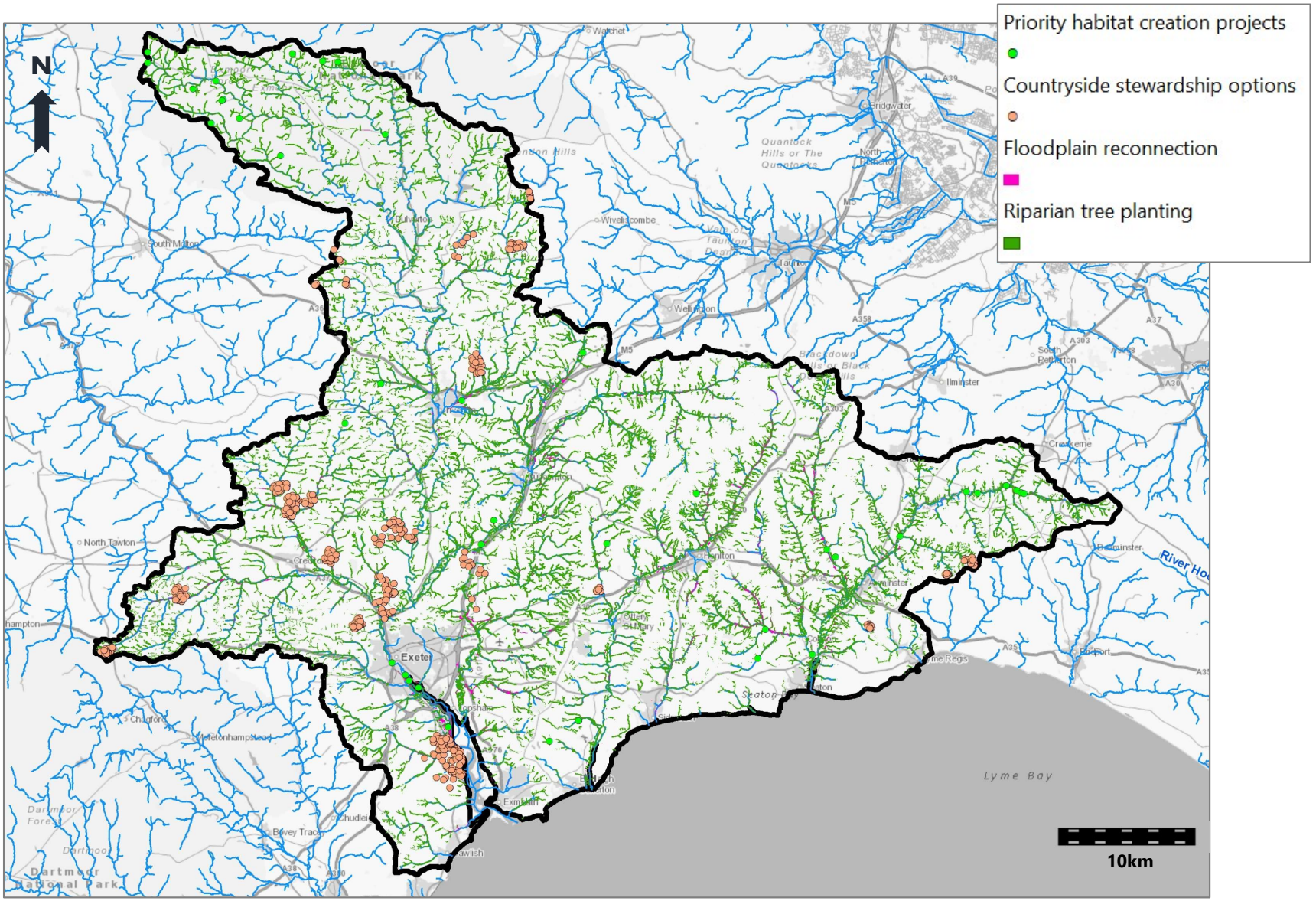


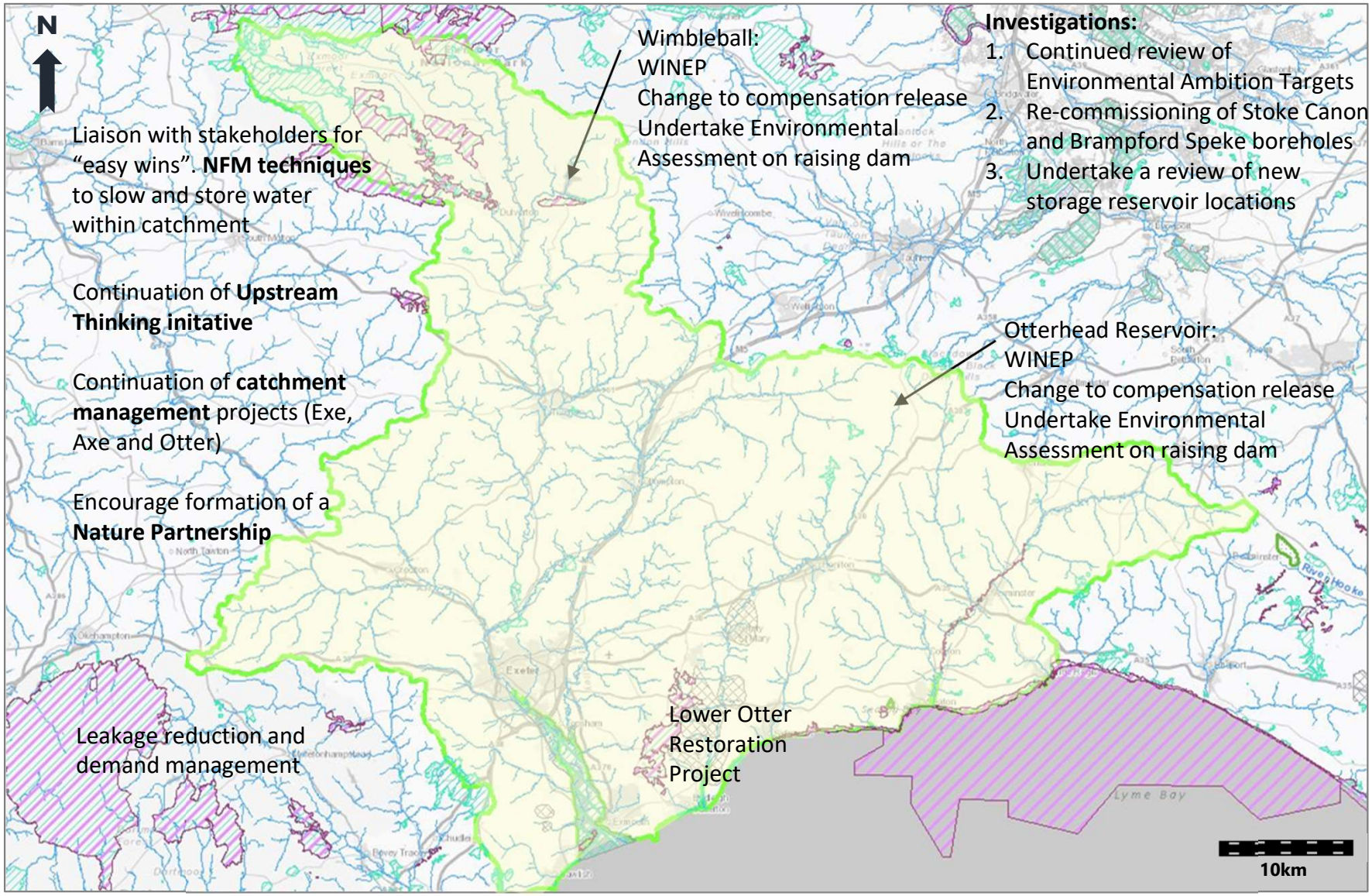

Data source: natural flows from 12 equally likely UKCP18 regional climate models (with UKCP09 afixK natural projection for comparison): https://eidc.ac.uk/

# Figure E4.1 East Devon catchments CaBA opportunity mapping

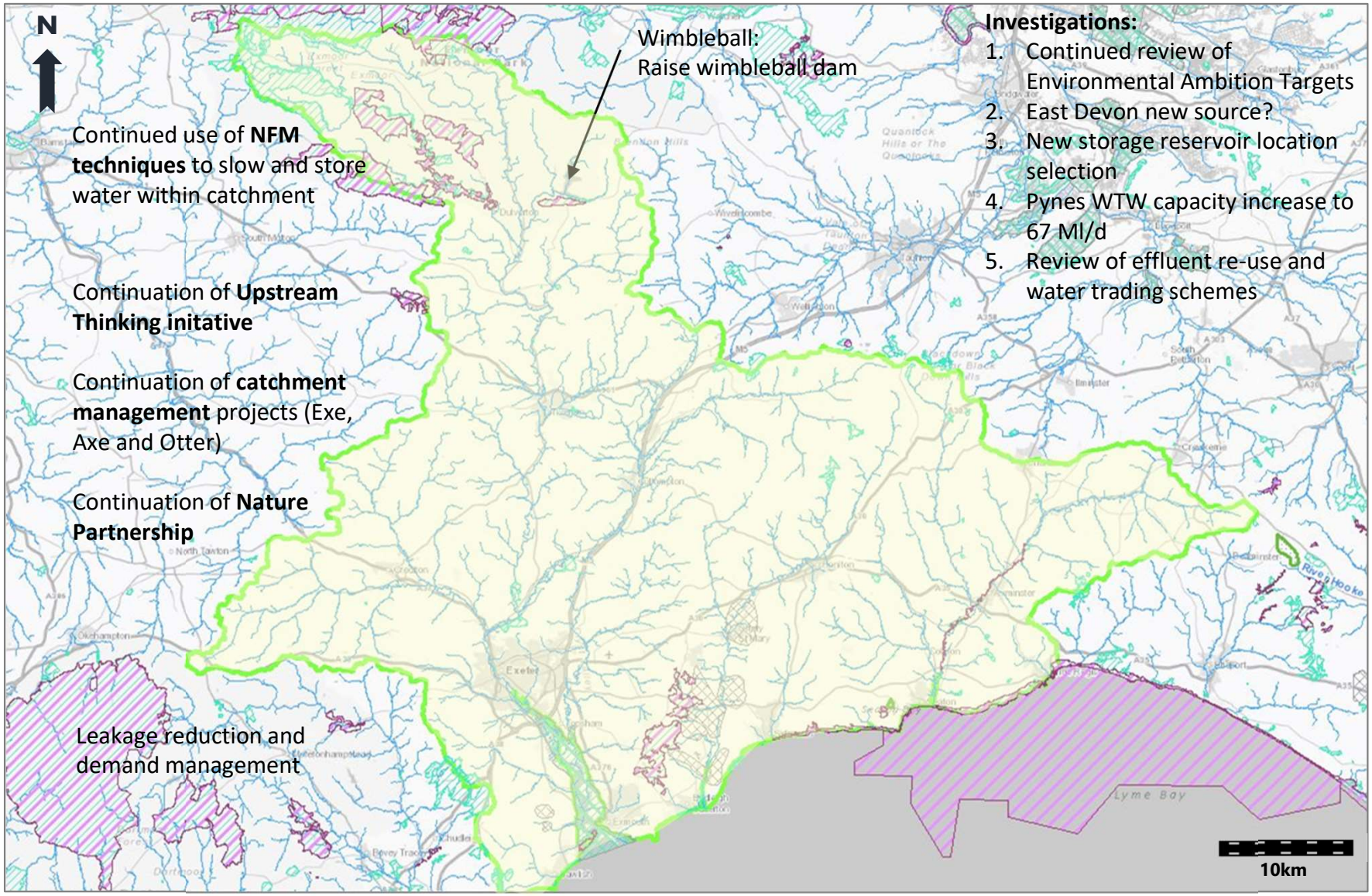



Data downloaded June 2021 from Catchment Based Approach Data Hub website

# Figure E4.2 Short term 2030 catchment measures: East Devon



# Figure E4.2 Medium term 2040 catchment measures: East Devon



# Figure E4.2 Long term 2050 catchment measures: East Devon