June 2021

Progress in adapting to climate change

2021 Report to Parliament

Climate Change Committee

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Contents

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The UK's Climate Change Act had extraordinary foresight. It laid the groundwork for the nation's escalating climate ambition. It anticipated, correctly, the need to cajole governments into climate plans that would not otherwise fit the political cycle. It has kept UK climate policies rooted in the scientific realities and the technical feasibilities.

That framework now faces its sternest test, as demand grows to see Net Zero delivered; as the urgency becomes more obvious; and as the inadequacies of our planning for the impacts of climate change become clear.

The rigour of the Climate Change Act helped bring COP26 to the UK, but it is not enough for Ministers to point to the Glasgow summit and hope that this will carry the day with the public. Leadership is required, detail on the steps the UK will take in the coming years, clarity on tax changes and public spending commitments, active engagement with people and businesses across the country. These steps are essential, so people can see opportunity in climate-positive choices. We cannot rely on good will alone.

This demands a step change in Government action, but it is hard to discern any comprehensive strategy in the climate plans we have seen in the last 12 months. There are gaps and ambiguities. Climate resilience remains a second-order issue, if it is considered at all. We continue to blunder into high-carbon choices. Our Planning system and other fundamental structures have not been recast to meet our legal and international climate commitments.

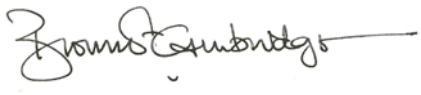
We commend Ministers for accepting our advice on the future path for UK emissions. The setting of the UK's 2030 NDC, the passing into law of the Sixth Carbon Budget, the decision to bring international aviation and shipping emissions within the UK carbon budgets; all were made on the Committee's recommendation. But the Committee's advice to step-up the ambition and resourcing of adaptation continues to go unheeded. And the willingness to set emissions targets of genuine ambition contrasts with a reluctance to implement the realistic policies necessary to achieve them.

It has therefore been a year of climate contradictions. Important statements of ambition, like the agreement to phase out the sale of petrol and diesel cars and vans, have been undermined by delays to essential legislation and much-needed plans to decarbonise buildings and improve their climate resilience. We await a Treasury Net Zero Review, once promised in autumn 2020. The transport decarbonisation plan is still slated, somewhat optimistically, for spring 2021. A pattern has emerged of Government strategies that are later than planned and, when they do emerge, short of the required policy ambition.

There is still time to address this. This Progress Report offers more than 200 policy recommendations, covering every part of Government. The opportunity to implement them is there. Before COP26, a Net Zero Strategy is promised, which will carry the greatest weight if it is accompanied by Treasury's review of funding. The Government's climate change risk assessment, due in early 2022, can change the tone on adaptation and climate risk management. But it is time for the Government to implement these changes with the urgency that the science demands.

COVID-19 casts a long shadow, but there are three broad lessons from the pandemic: first, we have seen the critical importance of effective planning for high-impact eventualities; second, we have experienced the ability of government to act with pace and scale when it is required; and third, we have learned that people are willing to support change when they have the information before them.

These lessons can shape a successful COP26 summit in November. With strong climate plans at home, the UK Presidency can have global influence. Our message to Government is simple: act quickly – be bold and decisive. Your moment has arrived.



Lord Deben
Chairman, Climate Change Committee

Baroness Brown
Chair, Adaptation Committee

Overall progress in climate policy: Net Zero and adaptation

The 2020s must be a decisive decade for climate action.

We are in the decisive decade for tackling climate change. Global emissions of greenhouse gases are as high as they have ever been. Nevertheless, green shoots of progress suggest this can change. And it must. The 2010s was the hottest decade on record globally, driving dangerous weather patterns and affecting societies and ecosystems around the world. Without a much stronger and urgent effort, we will breach 1.5°C of warming in the early 2030s and remain ill-prepared for the future.

The world needs to cut emissions and adapt to climate risks.

Global emissions must be cut rapidly to Net Zero, integrated with actions to adapt to the climate risks and impacts. Action must occur across the world, with richer countries acting earliest, while offering support for poorer countries. As host of the upcoming UN climate talks ('COP26') the UK has a particular responsibility to implement effective climate action and drive global efforts.

The UK's record to date is strong in parts, but it has fallen behind on adapting to the changing climate and has not yet provided a coherent plan to reduce emissions in the critical decade ahead:

The UK has a strong track record on climate action, but it is incomplete.

- **Statutory framework for climate.** The UK has a strong climate framework under the Climate Change Act (2008), with legally-binding emissions targets, a process to integrate climate risks into policy, and a central role for independent evidence-based advice and monitoring. This model has inspired similar climate legislation across the world.

- **Emissions targets.** The UK has adopted ambitious territorial emissions targets aligned to the Paris Agreement: the Sixth Carbon Budget requires an emissions reduction of 63% from 2019 to 2035, on the way to Net Zero by 2050. These are comprehensive targets covering all greenhouse gases and all sectors, including international aviation and shipping.

- **Emissions reduction.** The UK has a leading record in reducing its own emissions: down by 40% from 1990 to 2019, the largest reduction in the G20, while growing the economy (GDP increased by 78% from 1990 to 2019). The rate of reductions since 2012 (of around 20 $MtCO_2e$ annually) is comparable to that needed in the future.

- **Climate Risk and Adaptation.** The UK has undertaken three comprehensive assessments of the climate risks it faces, and the Government has published plans for adapting to those risks. There have been some actions in response, notably in tackling flooding and water scarcity, but overall progress in planning and delivering adaptation is not keeping up with increasing risk. The UK is less prepared for the changing climate now than it was when the previous risk assessment was published five years ago.

- **Climate finance.** The UK has been a strong contributor to international climate finance, having recently doubled its commitment to £11.6 billion in aggregate over 2021/22 to 2025/26. This spend is split between support for cutting emissions and support for adaptation, which is important given significant underfunding of adaptation globally. However, recent cuts to the UK's overseas aid are undermining these commitments.

The UK's record on climate change compares well with that of other countries. But despite the recent willingness of the Government to raise ambition to cut emissions, delays in policy and implementation continue. Much greater urgency is now required from Ministers:

Delivery must accelerate and broaden.

- **The ambition of the last year must be turned into policy and real-world delivery.** The UK has begun to reinforce its new emissions targets with clear ambition for specific sectors in line with the required path (e.g. 40 GW offshore wind by 2030, phase-out of petrol and diesel cars and vans by 2030, 30,000 hectares annual afforestation by 2025). However, some commitments fall short and key strategies have been delayed, leaving holes in ambition. Policies to deliver on the commitments are mostly still to be developed.

- **Progress must extend across the economy.** The relative success of reducing emissions in the electricity sector to date has not been matched in transport, buildings, industry, or agriculture. Only a few sectors have strong plans to adapt to the current and future climate, leaving key risks to the UK's infrastructure and natural environment. Some government departments are not sufficiently prioritising climate change, and none are yet moving at the pace required.

Adaptation policy needs a step change in ambition and action.

- **A robust plan is needed for adaptation.** The UK does not yet have a vision for successful adaptation to climate change, nor measurable targets to assess progress. Not one of the 34 priority areas assessed in this year's progress report on adaptation is yet demonstrating strong progress in adapting to climate risk. Policies are being developed without sufficient recognition of the need to adapt to the changing climate. This undermines their goals, locks in climate risks, and stores up costs for the future.

- **The climate challenge must be reflected throughout policy and planning.** Climate risks affect all aspects of society, while any new source of emissions could put the Net Zero path at risk. Climate change must therefore be integrated throughout policy and planning decisions, and must be a key consideration in the Government's proposed planning reforms.

As the UK rebuilds after the COVID-19 pandemic, there is an opportunity to make systemic changes that will fill the gaps in the UK's climate response. Now is the time to invest in the UK's future through accelerated action to cut emissions and adapt to the changing climate, while supporting the global transition.

The Net Zero Strategy, due ahead of COP26, should complete the picture on how the UK will cut its emissions.

- **Delivering Net Zero.** The Government has promised a Net Zero Strategy before COP26. It must set clear and integrated ambitions across the economy that will meet the Sixth Carbon Budget, and indicate how they will be funded fairly. Efforts must then shift quickly to focus on implementation and delivery. The pace of policy development must accelerate. Credible policies should be fully functioning and properly funded by the end of the current Parliament (i.e. by 2024) to ensure that almost all investments and purchases are low-carbon by the end of the decade or soon after.

- **Adapting to climate risks.** The Government should set out its vision for a UK that is well-prepared for climate change. It should include clear quantified targets, supported by policies and regulations. Climate adaptation must be embedded in core policies if they are to succeed. Key current and upcoming policies include: the Plan for Growth, the National Infrastructure Strategy, the Environment Bill, the Environmental Land Management

Scheme, the Tree and Peat Action Plans, the Net Zero Strategy, the Planning Bill and developments in energy, housing and health policy.*

Adaptation is vital to achieving society's goals and must be embedded throughout government policies.

- **Integrating climate policy.** Achieving Net Zero will require effective adaptation. The programmes must be properly integrated. For example, as the energy efficiency of buildings is improved, they must also be protected from overheating. The vast carbon stores of the UK's peatlands and soils must be protected. Trees planted to draw CO_2 from the atmosphere and/or to provide timber should be suited to the future climate and, where possible, provide services such as flood defences, enhancing ecosystems, urban cooling, and accessible green space.

- **Embedding climate action across society.** Reducing emissions and adapting to climate change will require a whole-of-society endeavour. Success will require the public to be engaged in the challenge, building public consent for the changes with a broader understanding of what is required and why. Workers will need help to develop the required skills and to fill the jobs created during the transition. Businesses must be encouraged, and in some cases required, to invest in solutions and make low-carbon, climate-resilient choices.

- **Reinstating overseas aid commitments.** Climate challenges are fundamentally integrated with wider challenges for ecosystems and economies. This means climate finance and climate action are not fully isolated from cuts to the UK's Official Development Assistance (ODA) in practice. The Government has said the cut to ODA is temporary; now that the UK's economic recovery is underway, the Government should provide a firm timeline for reinstating its previous commitment.

Government must lead the change. Reducing emissions and adapting to climate change must be embedded throughout policy. All parts of government have a role, requiring strong coordination and an effective devolution of powers and responsibilities to drive delivery. We set out detailed recommendations for each government department and the national Governments of Scotland, Wales and Northern Ireland in an annex of Tables at the end of this report. We will revisit progress against them at our next annual progress report in a year's time. Our next major report will be a thorough appraisal of the UK's Net Zero Strategy.

Reaching Net Zero and addressing climate risks can help to build a better UK.

The transition to Net Zero and the climate adaptation programme offer a positive vision for the UK's future and for the world. They involve an investment boost that can support the economic recovery. This investment will be rewarded with reduced running costs and reduced costs of adapting to climate change in the future. It will support good-quality new jobs across the country, and bring opportunities to enhance our natural environment, our health and our well-being.

The UK can and should be a global leader on climate change.

The challenge of responding to climate change will not end with COP26 in the autumn or with the completion of the UK Presidency a year later. Global commitments are increasingly moving into line with the Paris Agreement, but we have entered a critical decade of action to consolidate and to deliver them. UK action must continue to provide an attractive model of success to maintain our climate leadership in support of a global response that meets the global challenge.

* Some of these UK policies only cover England. Equivalent devolved policies must also reflect climate change.

The Committee

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Chair, Adaptation Committee

Baroness Brown of Cambridge DBE FREng FRS (Julia King) is an engineer, with a career spanning senior engineering and leadership roles in industry and academia. She currently serves as Chair of the CCC's Adaptation Committee; non-executive director of the Offshore Renewable Energy Catapult; and Chair of the Carbon Trust.

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Michael Davies is Professor of Building Physics and Environment at the UCL Institute for Environmental Design and Engineering (IEDE). At UCL his research interests relate to the complex relationship between the built environment and human wellbeing. He is also Director of the Complex Built Environment Systems Group at UCL and a member of the Scientific Advisory Committee of 'Healthy Polis'.

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Richard Dawson is Professor of Earth Systems Engineering and Head of Water in the School of Engineering at Newcastle University. Over the last two decades his research has focused on the analysis and management of climatic risks to civil engineering systems, including the development of systems modelling of risks to cities, catchments and infrastructure networks.

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Ece Özdemiroğlu is an environmental economist and the founding director of eftec (Economics for the Environment Consultancy). Her work uses economic value evidence for natural capital and applies this evidence in accounting and appraisal. Ece is also the convenor of the British Standards Institution's Assessing and Valuing Natural Capital Committee who wrote the BSI8632 on Natural Capital Accounting for Organizations. She is Associate Editor of the Journal for Environmental Economics and Policy and a Fellow of the RSA.

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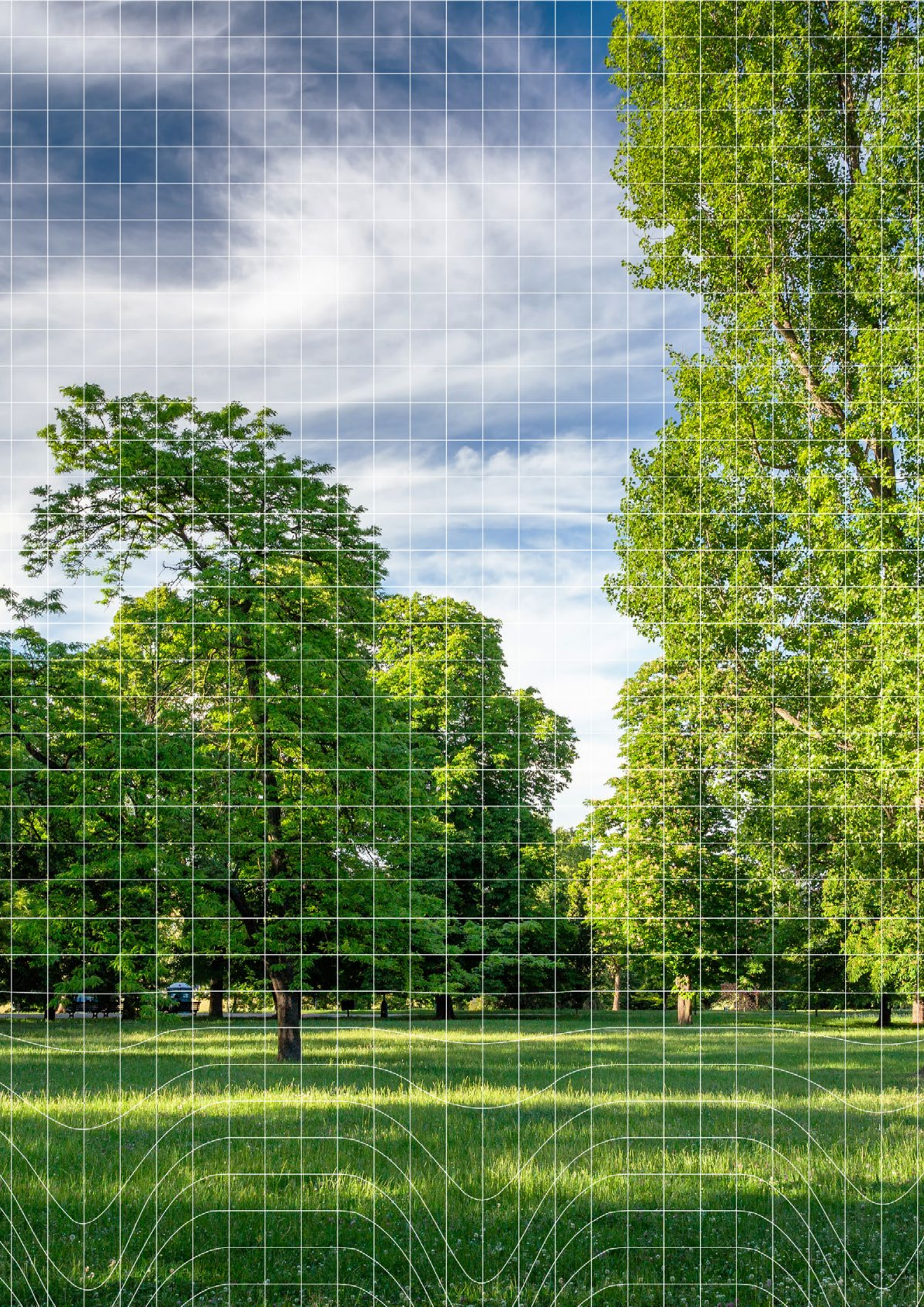
Rosalyn Schofield is a solicitor. She was Director of Company Secretariat at Associated British Foods plc, where she had global responsibility for the environmental sustainability and impact of the business. Rosalyn is also a Council Member of the University of Hull and Chair of the Audit and Risk Committee there as well as at the CCC. She has previously worked as Legal Director at JD Wetherspoon plc and was a commercial property lawyer in private practice.

Professor Kate Jones
Expert Adviser to the Adaptation Committee

Kate is Professor of Ecology and Biodiversity at University College London. Her work focuses on crossing disciplinary boundaries to address critical global challenges, especially at the interface of ecological and human health. Professor Jones has made key advances in monitoring the status and trends in biodiversity and particularly in modelling and forecasting zoonotic disease outbreaks in humans (Ebola, SARS), breaking down traditional barriers between ecology, climate change and public health to inform global policy.

Executive Summary



Climate change impacts are increasing, but the UK Government's National Adaptation Programme has not delivered the necessary improved resilience to the changing climate as was intended under the UK Climate Change Act.
As the UK enters its third statutory cycle of national risk assessment and adaptation planning, it is essential that the Government is more ambitious in the forthcoming 3rd National Adaptation Programme, with a comprehensive set of actions linked to the efforts for economic recovery from the Covid-19 pandemic and to the levelling up agenda. This is critical if country is to realise a resilient recovery from coronavirus and deliver on key policies including Net Zero.

The Government should set a clear vision for a well-prepared UK, and back that with quantifiable targets to embed adaptation in policies across the natural environment, planning, infrastructure, homes and transport as they advance in the coming 12 months and beyond.

This report follows our advice on the CCRA3 Independent Risk Assessment and focusses on adaptation implementation in England. We set out eight key messages (Box ES.1), and make 50 specific recommendations to improve progress, ten of which are joint adaptation/ mitigation recommendations that are also included in the Mitigation Progress Report.

Box ES.1
The Committee's key messages on adaptation progress

- The global and UK climate will continue to change out to mid-century at least.
- Warming at much higher levels than a 2°C increase in global temperature remain possible in the second half of the century.
- The National Adaptation Programme has not developed national preparedness for a 2°C rise in global temperature, let alone higher levels of warming.
- Our assessment shows limited changes in progress scores since 2019. Adaptation needs to be integrated into a range of key policies before the next National Adaptation Programme is published in 2023. There are signs of improvement across a number of sectors that if continued, could help to achieve this.
- The Government needs to reinstate support services and resourcing for local adaptation action.
- There are no actions in the National Adaptation Programme to respond to the risks to the UK from climate change overseas. As we stated in our last report and in our advice on the CCRA, these risks need to be included in the next Programme due in 2023.
- The next 12 months will be important for making improvements to how we measure and monitor adaptation in the UK. Global interest in monitoring and evaluation is growing in the run up to COP26 - with a focus on the UK's approach. To be world-leading, Government needs to resource new work to improve existing datasets and identify and create new ones.
- The UK is entering its third cycle of risk assessments and National Adaptation Plans. The third iteration of the National Adaptation Programme must be more ambitious; more comprehensive; and better focussed on implementation than its predecessors, in order to improve national resilience to climate change.

Below, we set out our eight key messages in more detail, drawing on the analysis in this report.

The global and UK climate will continue to change out to mid-century at least

Global temperatures are now around 1.2ºC above pre-industrial levels, with the UK showing a similar change. The world is currently warming by around 0.25ºC per decade due to human emissions of greenhouse gases. Globally, the six most recent years (2015 to 2020) have been the hottest years on record. In England, episodes of extreme heat are becoming more common, rainfall patterns are changing, and sea level is rising.

Even with ambitious global efforts to reduce greenhouse gas emissions, further climate change is inevitable. With these changes will come increasing climate impacts from a wide range of weather hazards: more and stronger heatwaves, flooding, drought, wildfire, and potential changes to storms and wind patterns. The following changes are expected by 2050 relative to a 1981-2000 baseline:

- Warmer and wetter winters. Average winter temperatures are projected to increase by around 1°C and rainfall by +5% (central estimates), with an uncertainty range of up to 2.5ºC warmer and 20% wetter. Increasing winter rainfall intensity will increase the risks of flash flooding.

- Drier and hotter summers. Average summer temperatures are projected to increase by 1.5ºC and rainfall to decrease by 10% with an uncertainty range of up to 3ºC hotter and 30% drier. Summer rainfall, when it occurs, will be more intense increasing the risk of flooding; and hotter summers will increase the risk of excess deaths and affect productivity.

- Continuing sea level rise, of around 10-30 cm with possible rises extending up to 30 – 40 cm across the UK. Depending on the location in the UK, this will increase the risks of coastal flooding under extreme high tides, and affect the functioning of coastal infrastructure.

Warming at much higher levels than a 2ºC increase in global temperature remain possible in the second half of the century

Climate commitments are strengthening but global warming of up to 4ºC above pre-industrial levels by 2100 cannot yet be ruled out. The Paris Agreement aims to keep global temperature increase to well below 2ºC above pre-industrial levels, and ideally to 1.5ºC. Recent pledges from national governments to reduce greenhouse gas emissions are closing the gap to the Paris goal but are not yet ambitious enough to meet it. Furthermore, policies are generally not yet in place to meet the pledges that have been set and are expected to only hold global emissions approximately flat over the next decade. This level of ambition, if not strengthened would imply reaching around 3ºC of global warming above pre-industrial levels by 2100, with a warming of around 4ºC above pre-industrial levels by 2100 still possible due to climate response uncertainty.

The National Adaptation Programme has not developed national preparedness for a 2ºC rise in global temperature, let alone higher levels of warming

Government action has been inadequate to drive progress in most areas. This report highlights some areas where there has been progress.

These areas tend to be where Government has intervened and taken a leading role, such as producing a National Floods Strategy, mandating reporting under the Taskforce on Climate-Related Financial Disclosure (TCFD) or setting clear planning requirements for the water sector. However, in most areas there has not been equivalent action, both from Government and other stakeholders like business and the third sector. There are various barriers preventing adaptation in these sectors such as gaps in awareness about the risks, the presence of externalities and missing markets, financial constraints and various behavioural barriers.

The gap between future levels of risk and planned adaptation has widened in the last 5 years. Neither the first nor second iteration of the National Adaptation Programme (published in 2013 and 2018 respectively) has delivered a minimum level of resilience to current and inevitable climate change. The Committee's recent advice to Government on the third UK Climate Change Risk Assessment highlights that over half (56%) of the risks have been given the highest urgency score, signalling that more action is needed than is currently planned for. In contrast, only around one third (36%) of the risks were given the highest urgency score in the 2016 assessment.

Planning for 2°C and consideration of 4°C warming is still not happening. Our detailed assessment of progress in England presented in this report shows that planning for 2°C and consideration of 4°C warming is still not happening in 27 of the 34 adaptation priorities considered; the exceptions being the infrastructure sectors with high plan scores shown in Figure ES.1 below (flood and water management, road, rail, energy and the design of new critical infrastructure).

The UK is leading in diagnosis but lagging in policy and action. The UK has world-leading climate science expertise. But this record is not matched in policy ambition and implementation. We have good evidence on future climate risks, good evidence on the importance of prudent risk planning and good evidence on the benefits of UK adaptation. In the wake of the Covid-19 pandemic, it has never been clearer that we need robust, well-resourced plans for known risks, however small or distant they seem and even if the decision is not to act at the end.

Our assessment shows limited change in progress scores since 2019

Improved assessment scores have been given to only five out of 34 adaptation priorities (Figure ES.1). The Committee has updated its assessment of the quality of adaptation plans, and actions to reduce risk, using the same framework as our 2019 report and taking into account evidence provided by government and stakeholders.

No sector achieves the highest risk management score. We have still been unable to award any sector a high score for risk management which means that vulnerability and exposure to climate change are not being managed appropriately nor in line to meet relevant government goals, such as public health protection or enhancing biodiversity. This remains unchanged from 2019.

Five areas have improved plan scores:

River and coastal flood alleviation

- The Government published a new, major flood and coastal erosion Policy Statement in 2020 which sits alongside the Environment Agency's updated Flood and Coastal Erosion Risk Management (FCERM) Strategy.

The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperature for flood and coastal erosion risk.

- Alongside the new plans, significant announcements have also been made to boost investment in flood defence schemes and supporting projects, including £5.2 billion to create around 2,000 new flood and coastal defences for 336,000 properties. There is still a gap in developing a national monitoring and evaluation strategy, but work is underway to consider which metrics should be used to measure progress.

Surface water flood alleviation

- The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptative planning. All Lead Local Flood Authorities (LLFAs) now have published surface water flood management strategies, a key recommendation from our earlier progress reports.

Extreme weather impacts on business

- There has been significant progress by government in the last two years to help businesses better prepare for the impacts of climate change. There is a new plan for mandatory disclosures for physical risk under the Taskforce on Climate-related Financial Disclosure (TCFD), which will apply to listed and UK-registered companies, banks and building societies, insurers, and some pension schemes.

- In 2022, a further refresh of the Government's Green Finance Strategy is expected, along with the next Bank of England Stress Test which is focussed on climate change risks. The Taskforce on Nature-related Financial Disclosures (TNFD) has launched since our last progress report and aims to serve the same strategic role as TCFD.

Supply chain interruptions

- The first part of the National Food Strategy has been published and Government has made further commitments to report and develop a better understanding of issues related to food supply chains, including climate change. However, despite an improvement in the plan score, the risk management score for supply chains has dropped (see below).

Commercial fisheries

- Climate change adaptation was included as one of eight priorities under the Fisheries Act (2020) and requires the Marine Management Organisation (MMO) to set out how this objective will be met. There are currently no specific plans for adapting to a minimum 2°C rise in global temperature, which if/when such plans are published by the MMO could improve the plan score further in the future.

In three cases, scores have become worse since 2019:

Supply chain interruptions

- Despite some improvements in planning, the score for managing risk has dropped due to the increased evidence since 2019 of greater vulnerability in supply chains than previously estimated. This reflects both the experience of the Covid-19 pandemic and survey evidence showing the high costs of disruptions. The level of adaptation underway has remained roughly the same. Further work on building resilience into supply chains was highlighted as one of the UK's top national priorities in our recent advice to Government on the third UK Climate Change Risk Assessment.

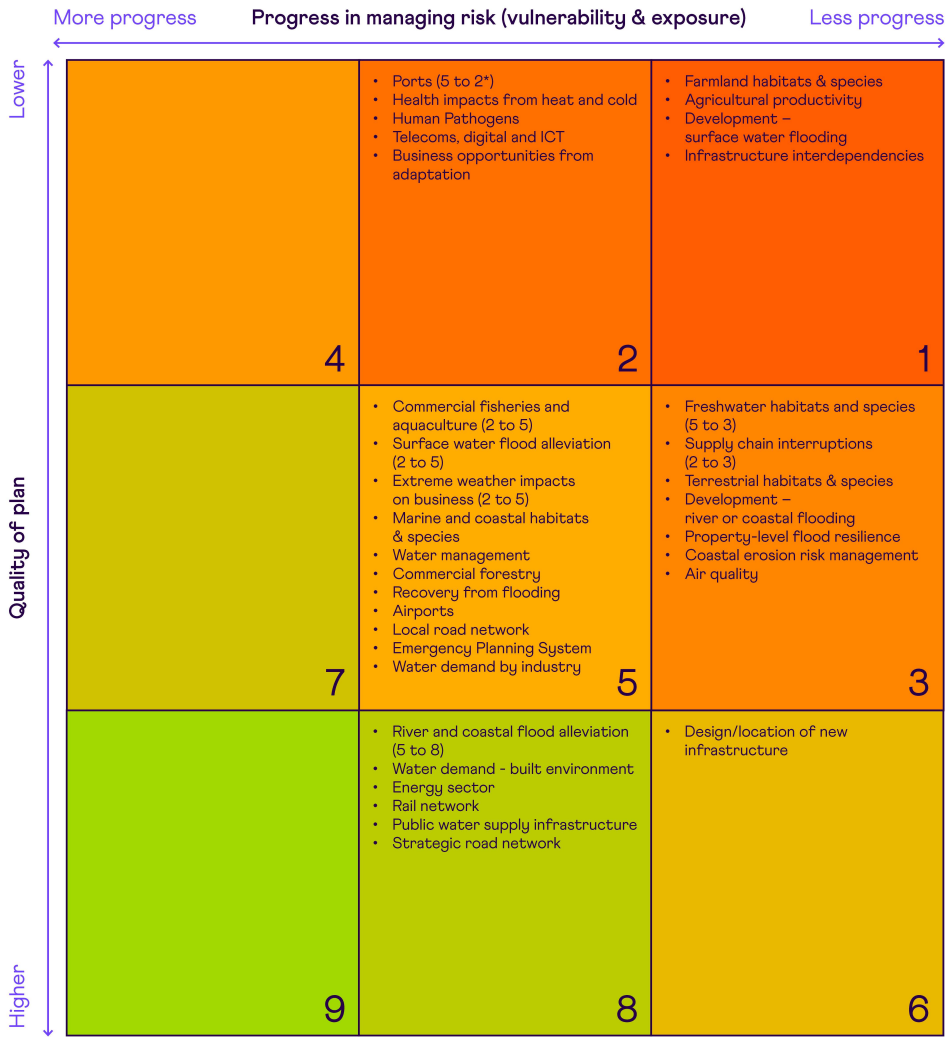
Ports

- In this assessment we have split out our assessment of airports from ports. This has resulted in a lower plan score for ports. Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts, and the resulting impacts on the movement of goods. Several ports declined to participate in the last round of the Adaptation Reporting Power and expected participation in the current round is unclear.

Freshwater habitats

- While general plans to build the resilience of freshwater habitats to climate change are in place, they have had only limited impact on managing pressures on biodiversity to date. Available species metrics indicate that populations are remaining stable, but the long-term declines in the ecological status of water bodies in England persist. Surface water temperatures across England have consistently exceeded their long-term mean in recent decades, yet details on the ongoing revisions to River Basin Management Plans suggest risks from higher water temperatures are still not given sufficient consideration.

Figure ES.1 The Adaptation Committee's scoring of adaptation priorities (2021)



Source: CCC
Notes: Definitions for each of the score boxes are given in Chapter 1. Adaptation priorities where scores have changed since 2019 are highlighted with the change in score provided in brackets.
*The score for ports has dropped from 5 to 2, but this is due to the splitting of a joint airports/ports priority in 2019 into separate priorities for this report. The level of planning has not changed for ports since 2019.

The lack of change in scores hides some signs of progress that present opportunities to drive adaptation forward, if adaptation is integrated effectively into policies.

There are key opportunities for new policies to integrate adaptation over the coming 12 months, in the run up to COP26 and the publication of the Government's next adaptation programme.

In our advice on the Third UK Climate Change Risk Assessment we set out eight risk areas where there are major upcoming policy announcements, and in this report we have highlighted specific policy opportunities for England in more detail:

Natural environment

- The current overhaul of policies and plans for protecting the natural environment has not yet adequately integrated adaptation. Without this integration, the aims of the Government's 25-Year Environment Plan are unlikely to be met because climate change will reduce habitat condition, soil and water quality and quantity, threatening further the health of ecosystems and the natural environment, which are already in serious decline.

- The Government needs to set outcome-based, long-term targets for widespread habitat restoration, with statutory interim targets to drive the early action that is needed now to improve resilience.

- Actions that reduce vulnerability and exposure to climate change across all environmental public good outcomes* should be rewarded under the forthcoming Environmental Land Management scheme (ELM). We made a series of recommendations to this effect in 2019. None have been implemented, but it is not too late to do so as policies are still under development.

Infrastructure

- The National Infrastructure Commission has identified climate change as one of three key challenges for infrastructure resilience. The 2020 National Infrastructure Strategy states that climate change should be fully considered at the design stage and cost-effective adaptation actions should be built in over the whole life cycle of the asset.

- In our advice to Government on CCRA3, we point to the vulnerability of the power system as a key priority for further action now.

- The new UK National Infrastructure Bank, launching in interim form in 2021, is a key component of the National Infrastructure Strategy and can support adaptation through stimulating investment in green infrastructure.

- The Treasury's Supplementary Green Book Guidance (*Accounting for the Effects of Climate Change*) supports analysts and policymakers to identify if and how their proposals could be affected by climate risks and how to design adaptation measures in response.

- The Infrastructure and Projects Authority is working in collaboration with the CCC to incorporate tests for climate change into assurance processes for all projects on the Government's Major Project Portfolio.

- In the water sector, the next round of water company plans will incorporate the latest UK climate projections, and set stricter targets for leakage, aiming for a 50% reduction by 2050.

- In aviation, a new 2050 strategy, consulted on in 2019 but not yet published, is expected to include actions for improving resilience.

* Environmental public good outcomes refer to the Government's objectives to protect, improve and expand the natural environment to ensure it continues to provide the market and non-market goods and services that are essential to society.

Health and the built environment

- New housing developments continue to be built without resilience to heat, or a focus on water efficiency and in some cases to flooding, especially from surface water. This is despite the Committee's consistent advice, which has highlighted fundamental gaps in policy since it began to assess these issues ten years ago.

- More information is required to understand the Government's intentions with planning reform and the forthcoming Planning Bill. Some draft proposals (such as the extension of permitted development rights, moving to a single sustainability test that may not adequately take account of climate change mitigation and adaptation, and removing the duty to cooperate) may make adaptation more difficult to achieve.

- A more forward-looking outlook on flood risk is required for new developments. There may be no material increase in present day flood risk from some limited building in the floodplain, but these developments increase exposure in the event of defence breaches and future climate and population changes. If building on the floodplain continues at the current level, the funding required to build and maintain new defences, will continue to rise.

- The planning system is not designed to incentivise 'green' Sustainable Drainage Systems, and some homes are being built in areas at risk of surface water flooding without any expert flood mitigation advice.

- Potential progress on taking steps to manage overheating risk in new residential buildings should come through MHCLG's proposed overheating standard. This proposal is strongly welcomed by the Committee, and now needs to become reality.

- There remains a substantial gap in addressing overheating in existing homes and health and care facilities. There has been better planning for 2˚C and 4˚C in schools and prisons.

- There are opportunities across multiple policies to improve urban greening including the Environment Bill, updates to National Planning Policy including implementation of biodiversity net gain (if gains are real) and the forthcoming Net Zero Strategy.

- The outcome of the 2019 consultation on measures to reduce personal water use, expected in 2021, presents a key opportunity to introduce more stretching water efficiency targets.

Business

- Consultations on pension scheme regulations, the future of audit and criteria for public procurement have set out proposals for greater consideration of climate change, which now need to be enacted.

- The new SME Climate Hub offers tools and resources to help small businesses develop their climate strategy and contribute to efforts to reduce UK emissions to Net Zero. There is an opportunity improve promotion and integration of adaptation through this or a similar initiative.

- Stronger assurance is required for the resilience of supply chains, particularly key supply chains such as for food and medical supplies, as part of the Government's new Plan for Growth.

- More should be done to explore how current uses of green finance for adaptation could be replicated or scaled up across regions in England.

- There has been progress in planning for a green recovery in response to the economic impacts from COVID-19. However, the measures announced, such as the Ten Point Plan for a Green Industrial Revolution and the Green Jobs Taskforce, focus almost exclusively on achieving Net Zero and miss out on the opportunities for climate change adaptation. There are good examples to draw on, such as exploring potential revenue streams in areas such as natural capital and resilience, new financial products such as green and sustainability bonds and regional initiatives such as the Greater Manchester IGNITION project. Again, there are still opportunities in the next 12 months to integrate adaptation more fully into these policies.

This list is not comprehensive, but it emphasises the urgency of integrating adaptation into current policy to avoid lock-in and unnecessary future expenditure.

The Government needs to reinstate support services and resourcing for local adaptation

Support services need to respond to the needs of business and promote the importance of adaptation alongside achieving Net Zero. The UK Climate Impacts Programme and subsequently Climate Ready was the lead national adaptation support service for businesses, as well as other sectors, and was responsible for developing tools and guidance before its closure in 2016. This created a gap and lack of assurance that smaller businesses and organisations in particular would be aware of and able to access resources and the latest expertise on climate risk and adaptation. As mentioned above, the new SME Climate Hub aims to provide a 'one-stop-shop' for SMEs to make a climate commitment and access 'best-in-class' tools and resources. It already offers several resources for physical risk and understanding climate impacts, though it should aim to improve integration and promotion of adaptation alongside reducing emissions to Net Zero. It will be important to monitor feedback for the SME Climate Hub and whether action from Government is required to develop resources to ensure the needs of different types of business and organisations are met.

The Government should ensure that local authorities are properly funded with resources and training available to tackle climate change. This includes ensuring that local authorities have the capacity to respond to extreme weather events such as flooding; provide clear guidance for how adaptation should be included in development plans; ensure local authorities are properly resourced and have trained personnel to enforce building regulations; and ensure long-term resource budgets are in line with capital investments in flood risk management. Local authorities should have powers to require enhanced building standards in areas where climate impacts are particularly significant – for example higher water efficiency standards in areas with growing populations which will be increasingly drought-prone.

There are no actions in the National Adaptation Programme in response to the risks to the UK from climate change overseas

As we stated in our last report and in our advice on the CCRA, the risks to the UK from climate change overseas need to be included in the next National Adaptation Programme due in 2023.

The urgency of UK action for some overseas climate risks is greater than previously assessed as there is now more evidence on the scale and number of risks as shown in the CCRA3 Technical Report. The majority of these are scored as 'more action needed', including risks to UK food availability, international supply chains, public health and systemic risks from multiple impacts that will cascade across the globe. The Covid-19 pandemic, while not a climate-driven risk, has shown how quickly systemic risks can propagate and affect all aspects of society and the economy.

The Government needs to include specific actions to manage international climate risks to the UK in the next National Adaptation Programme. These should include:

- Reviewing the environmental governance and exposure to climate risks in emerging free trade agreements.
- Addressing food access inequality and informing dietary choices, given that the UK imports over 50% of its food. This action would reduce vulnerability to the risk of decreasing nutritional quality of food produced due to climate change
- Increasing the resilience of international trade systems, reducing reliance on long, just-in-time supply chains which are susceptible to shocks
- Real-time monitoring of transmission pathways for emerging diseases, alongside increased surveillance of wildlife, people and other imports; and improvement of public and professional level information
- Planning for increasing unpredictability and the potential for sudden shifts in the climate, which are possible even at lower levels of warming.

The next 12 months will be important in improving how adaptation is measured and monitored in the UK

Global interest in monitoring and evaluation is growing in the run up to COP26 - with a focus on the UK's approach. Measuring progress is fundamental to understanding whether adaptation is working. The Committee published a set of recommended adaptation indicators in 2019 for Defra to populate, but little has happened to progress this. We have highlighted the following key issues related to metrics in this report:

- The use of habitat condition and species abundance as proxy indicators for the vulnerability of biodiversity to climate change only offers a simplistic assessment of progress. Development of more sophisticated metrics is needed to help inform how ecosystems and biodiversity are responding to climate change, and the components or functions that are most vulnerable, so that adaptation responses can be better focussed. For instance, the use of remote sensing tools will provide new data to improve our understanding of changes in water flow, fractional vegetation cover, impervious surface area mapping and drought predictions based on soil water index.
- For flooding and coastal change, the Government must deliver a well-established monitoring and evaluation framework and national set of indicators to monitor trends and policy impact effectively. Improved indicators need to include data on the uptake and type of sustainable drainage systems being installed both in new build and retrofit.

- While surveillance programmes exist in England for disease vectors such as ticks and mosquitoes, the current level of surveillance should be improved and expanded. The new Health Security Agency provides an opportunity for climate change to be considered in the context of disease spread, expand current surveillance across the UK, and provide suitable indicators to measure vector abundance.

- There is a continuing lack of data on the vulnerability of infrastructure to extreme weather and the steps being taken to manage interdependencies between sectors. When used effectively, the Adaptation Reporting Power (ARP) can present updated risks and adaptation actions, allowing an assessment of preparedness of all infrastructure sectors and their interdependencies. Very few ARP3 reports have been available for this assessment due to a misalignment of timeframes with the CCC's mandatory reporting schedule, and the voluntary nature of the ARP reporting means there is no guarantee of sector-wide coverage. These reports are intended to be a key input to the development of the NAP and the CCRA; but to date it has not been possible to use them effectively in this way.

The Government should resource new work to improve existing datasets and identify and create new ones. Improved understanding of how adaptation actions lead to better outcomes is needed, following the approach set out in the Government's Magenta Book (Guidance for Evaluation). Funding is also needed to support the sustained measurement of relevant indicators like soil health, and to consider how to bring together different organisations and groups that collect data to streamline and share data. In the coming months, prior to COP 26, the CCC would be willing to coordinate this work if requested to do so by Defra, in collaboration with other relevant organisations such as the Office for Environmental Protection.

The third iteration of the National Adaptation Programme must be more ambitious; more comprehensive; and better focussed on implementation

In this report, we have prioritised what needs to be done by Government in England – and brigaded our climate recommendations by Government Department as an aid to better policy (Table 1). We stated in 2019 that the country was at risk of becoming complacent on climate change adaptation. Since then, there have been some signs that Government is taking climate change risks more seriously. Adaptation is one of the key themes for COP26, and the Government has appointed a dedicated Adaptation Champion. Some policy milestones have been met, such as spelling out the need for adapting to 2°C and planning for 4°C in the updated Treasury Green Book guidance on appraising policies, projects and programmes; which all departments are expected to follow. But the specific actions that need to be delivered have not taken place in many sectors. Adaptation is not being sufficiently resourced, and must not continue to be the poor relation to climate change mitigation as the Government prepares for the spending review later this year.

Our recommendations for the key actions needed before the publication on the next National Adaptation Programme are shown in below by department.*

Table 1
The Adaptation Committee's Recommendations for Adaptation

No.	Department	Sector	Recommendation	Timing
1	All (Joint adaptation/mitigation recommendation)	All	Ensure all policy decisions , and procurement decisions, are consistent with the Net Zero goal and reflect the latest understanding of climate risks.	Now and ongoing
2	All (Joint adaptation/ mitigation recommendation)	All	Review guidance documents used in policy and business case development (e.g. the Green Book) and ensure these are consistent with the requirements of Net Zero and account for the impacts of climate change. Consider options for introducing a Net Zero Test to ensure that all policies and decisions are compliant with Net Zero.	2022
3	All (Joint adaptation/ mitigation recommendation)	All	Work towards securing more climate finance commitments from developed countries to get back on track for mobilising $100 billion a year in climate finance as soon as possible.	2021 (COP26)
4	COP Unit, FCDO, DIT	All	Provide a clear commitment prior to COP26 regarding the timescale by which the UK's official development assistance (ODA) contribution will return to 0.7% of GNI given the UK's commitment to align its ODA spend with Paris Agreement requirements and the need for increased finance to achieve the Paris Agreement.	2021
5	Defra	All	The next National Adaptation Programme, due in 2023, should ramp up adaptation ambition, implementation and evaluation. It should: • Set out the Government's vision for a well-adapted UK, alongside the measurable outcomes that the Government is aiming to achieve by the end of the next NAP period (2023 – 2028). • Include a detailed monitoring and evaluation framework, including which indicators will be used to monitor progress in reducing risk and showing the effectiveness of different adaptation responses for each risk in CCRA3. • Report how departments have addressed the top eight priority risks set out in the CCRA3 Advice Report for urgent action between 2021 and 2023 (see recommendations by department below). • Set out how adaptation is being integrated into policy, and the measurable actions by department for adaptation across each of the 61 risks and opportunities set out in the	2023 onwards

* Recommendations that are joint with the Mitigation Progress Report are highlighted as such.

			CCRA3 Technical for the period 2023 – 2028 (see recommendations by department below). • Ensure the adaptation actions and the programme as a whole are framed around the principles for good adaptation outlined in the CCRA3 Advice Report: – Adapt to 2°C warming, assess the risks for 4°C – Prepare for unpredictable extremes – Assess interdependencies – Understand threshold effects – Integrate adaptation into relevant policies – Ensure adaptation is sufficiently financed – Avoid lock-in – Address inequalities – Consider opportunities from climate change • Specific actions to manage international climate risks should be included, setting out the direct response to the risks identified in CCRA3.	
6	Defra	All	Ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risks for which it has lead responsibility, coordinating work with other relevant departments as necessary: • Risks to the viability and diversity of terrestrial and freshwater habitats and species from multiple hazards • Risks to soil health from increased flooding and drought • Risks to natural carbon stores and sequestration from multiple hazards • Risks to crops, livestock, and commercial trees from multiple hazards In addition, for the coming five year period 2023-2028, Defra should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).	By 2023
7	Defra	All	Implement a public engagement programme about national adaptation objectives, acceptable levels of risk, desired resilience standards, how to address inequalities, and responsibilities across society. The findings from the programme should feed into the vision and desired outcomes of the next National Adaptation Programme.	2021

8	Defra	All	Fund a programme of work to design and populate the appropriate new priority adaptation indicators for England. These should complement other environmental and social indicators collated by Government. The CCC could be tasked to coordinate this activity in partnership with other relevant organisations such as the Office for Environmental Protection and Environment Agency.	2021
9	Defra (joint adaptation/ mitigation recommendation)	Natural environment	Publish an overarching strategy that clearly outlines the relationships and interactions between the multiple action plans in development for the natural environment, including those for peat, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change goals on both Net Zero and adaptation, along with the wider environment and other goals.	2021
10	Defra	Natural environment	The commitment in the 25 Year Environment Plan to achieve 75% restoration for terrestrial and freshwater protected sites should be extended to include all priority habitat sites.	2021
11	Defra	Natural environment	Make long-term targets for biodiversity, set out under the Environment Bill, and associated timeframes outcome-based and linked directly to the goals set out in the Government's 25-YEP.	June 2022
12	Defra	Natural environment	Make interim targets for biodiversity statutory and link them clearly to the long-term targets set out in the Environment Bill.	June 2022
13	Defra (joint adaptation/ mitigation recommendation)	Natural environment	Introduce legislation to extend the ban on rotational burning of peat from certain protected upland bog sites to all peatland before the start of the burn season in 2021; end peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023; mandate water companies to restore peatland under their ownership; and ensure lowland peat soils are not left bare.	2021-2023
14	Defra (joint adaptation/mitigation recommendation)	Natural environment	Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address degraded peatland (hectares given are for the UK): • 17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045; • Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares); • Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares); • Remove all low-productive trees of less than YC8 from peatland (equivalent to 16,000 hectares by	2021-2025

			2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).	
15	Defra	Natural environment	Set out a clear mechanism to account for the consequences of higher water temperatures and low flows (including drying up) in water bodies for freshwater habitats and species, and for meeting the Water Framework Directive (WFD) targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs).	June 2022
16	Defra	Marine	Extend the statutory requirements of marine plan policies to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is a significant gap in the protections they are designed to provide.	Now
17	Defra	Infrastructure	Make changes ahead of the next round of reporting under the Adaptation Reporting Power (ARP). When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular: • The next round of reporting must be mandatory. • The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation. • The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.	2023
18	Defra	Infrastructure	Work with Port Operators and the British Ports Association to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report. Defra should work with these organisations to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector.	2023
19	Defra; BEIS; DCMS	Infrastructure	Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for electricity, digital and ICT networks. As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.	Now and ongoing

20	Defra	Flooding	Work with the Environment Agency to set out the measures being taken to improve the uptake of property-level flood resilience (PFR) following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.	2022
21	Defra	Food security	Set out measures to ensure the resilience of the food supply chain, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England.	2022
22	Defra	Water	Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for reducing water use by business. This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.	2022
23	MHCLG	All	MHCLG should ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risks for which it has lead responsibility, coordinating work with other relevant departments as necessary: • Risks to human health, wellbeing and productivity from increased exposure to heat in homes and buildings (with DHSC) In addition, for the coming five year period 2023-2028, MHCLG should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Annex).	By 2023
24	MHCLG (joint adaptation/mitigation recommendation)	Planning	Ensure that developments and infrastructure are compliant with Net Zero and appropriately resilient to climate change through proposed amendments to The Town and Country Planning Order.	2021-22
25	MHCLG	Flooding (Planning reform)	Ensure that all types of current and future flood risk are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must include as a minimum: • Evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments i.e. not increase flooding in any other areas	2022

			• An assessment of current and future flood risk under both a 2°C and 4°C global climate scenarios. • Assess and manage the risk of flooding to local infrastructure as well as housing. • A consideration of better preparedness as set out in the Government's recent FCERM Policy Statement. • Ensure there are properly funded and trained staff in local authorities.	
26	MHCLG	Flooding	To address the issue of increased risk of surface water flooding in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking account of climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits.	2022
27	MHCLG	Flooding	To help improve the information on SuDS and surface water flood risk, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences.	2021
28	MHCLG	Flooding	The consultation process for surface water flood risk must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that Local Authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice.	2022
29	MHCLG	Building safety (overheating)	Implement a strong set of standards - with robust enforcement - that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including: • Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT. • Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-domestic buildings to residential. • Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.	2021-22

			• Ensure that the remit of the new building safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards. • Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards. • Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.	
30	MHCLG	Planning reform	Introduce an urban greenspace target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year Environment Plan goals are met.	2022
31	BEIS	All	Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary: • Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT) • Risks to people and the economy from climate-related failure of the power system In addition, for the coming five-year period 2023-2028, BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).	By 2023
32	BEIS	All	BEIS should ensure that Net Zero and adaptation are considered together in the forthcoming Net Zero Strategy. There should be a focus on maximising synergies and minimising trade-offs between mitigation and adaptation actions and the risks from climate change to achieving Net Zero. Actions that have multiple benefits across climate change mitigation, adaptation, biodiversity and health should be high on the Government's agenda for action over the next five-year period.	2021
33	BEIS and MHCLG	Building safety (overheating)	Improve understanding of and support action on overheating in existing residential buildings and encourage retrofit of passive cooling measures. The	2022

			Heat and Building Strategy must consider overheating risks. The following steps are needed: • Further research to understand when overheating occurs in existing homes, including: ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and number of homes currently adapted • Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behaviour options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance. • Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes. • Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.	
34	BEIS (joint adaptation/ mitigation recommendation)	Businesses	Support businesses to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans.	2021-22
35	BEIS and HM Treasury (joint adaptation/mitigation recommendation)	Businesses	Develop further ways to embed Net Zero and climate risk in financial decisions by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used. It should also consider the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.	2021-25
36	BEIS	Research	Make monitoring and data analysis of climate risks more accessible, alongside better digitisation of past records. Further efforts should be taken to make the evidence on climate risks more usable for decision makers through co-design of research programmes with end users, where the user drives the research question from the beginning of the process. A major gap is the lack of projections of impacts in 2°C and 4°C scenarios; this needs addressing as an urgent priority ahead of CCRA4.	2022

37	Cabinet Office	All	Cabinet Office should ensure that adaptation is integrated into major upcoming policies in the next two years related to the priority CCRA3 risk for which it has lead responsibility, coordinating work with other relevant departments as necessary: • Multiple risks to the UK from climate change impacts overseas In addition, for the coming five year period 2023-2028, Cabinet Office should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA3 for which it is the lead department (see Annex).	By 2023
38	Cabinet Office	All	Cabinet Office should build a strong climate resilience capability for the UK, including making use of storyline or 'what-if' scenarios to assess risks, in addition to or instead of using 'reasonable worst-case' approaches. It should develop an early warning system for global climate shocks. It should consider how more allowance and flexibility can be built into policy making and policy implementation. This could include enhancing the ability of the Government to make fast decisions by bringing in technical advice and expertise quickly when needed, and both protecting, and enhancing, monitoring and surveillance systems to enable faster reactions as events unfold.	By 2023
39	DHSC	All	For the coming five year period 2023-2028, DHSC should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the four risks and opportunities in the CCRA for which it is the lead department (see Annex).	2023
40	DHSC	Building safety	Assess health sector vulnerability to existing and future climate risks, particularly, for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from CQC, PHE, NHS, MHCLG and local level public health bodies.	2022
41	DHSC	Public health – vector-borne diseases	Fund the strengthening and widening of vector and pathogen surveillance and early warning mechanisms, due to the increasing risk of disease spread as a result of climate change and other factors.	Now and ongoing
42	HM Treasury	All	For the coming five year period 2023-2028, HMT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA3 for which it is the lead department (see Annex).	2023
43	HM Treasury (Joint adaptation/mitigation recommendation)	All	The spending review(s) should ensure departments are fully equipped to deliver the necessary actions across climate change mitigation and adaptation, during the rest of this Parliament and beyond.	2021

44	DCMS	All	For the coming five year period 2023-2028, DCMS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA for which it is the lead department (see Annex).	2023
45	DCMS	Infrastructure	Resilience standards for the digital sector must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed. Standards for digital infrastructure operators should include requirements to: • assess climate risks under both 2°C and 4°C global climate scenarios, • consider interdependencies with other critical infrastructure, and • set out actions to reduce risk and monitor progress.	2022
46	FCDO	All	For the coming five year period 2023-2028, FCDO should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023
47	DfT	All	For the coming five year period 2023-2028, DfT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Annex).	2023
48	DIT	All	For the coming five year period 2023-2028, DIT should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks and opportunities in the CCRA3 for which it is the lead department (see Annex).	2023
49	MoJ	All	For the coming five year period 2023-2028, MoJ should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023
50	DfE	All	For the coming five year period 2023-2028, DfE should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the risks in the CCRA for which it is the lead department (see Annex).	2023

Chapter 1

Introduction

1.1 Observed and projected climate change

This section summarises observed and possible future changes in the UK's weather and climate.

This section covers the most up-to-date evidence regarding observed and projected changes in the UK's weather and climate. It highlights that several recent trends in UK's weather and climate can be linked to human-induced climate change – with further changes expected over coming decades.

Global climate change

Global temperatures continue to rise rapidly – with human influence the driver.

Global temperature observations over recent years are fully consistent with those expected from continuing long-term global warming resulting from human activity:

- Annual global mean surface temperature in 2020 was the joint warmest or second warmest on record across all prominent global temperature datasets (Figure 1.1). 2020 global temperature was similar to that in 2016, in which global temperature was boosted by a very strong El Niño. The six most recent years were the six warmest years globally in the observational record.

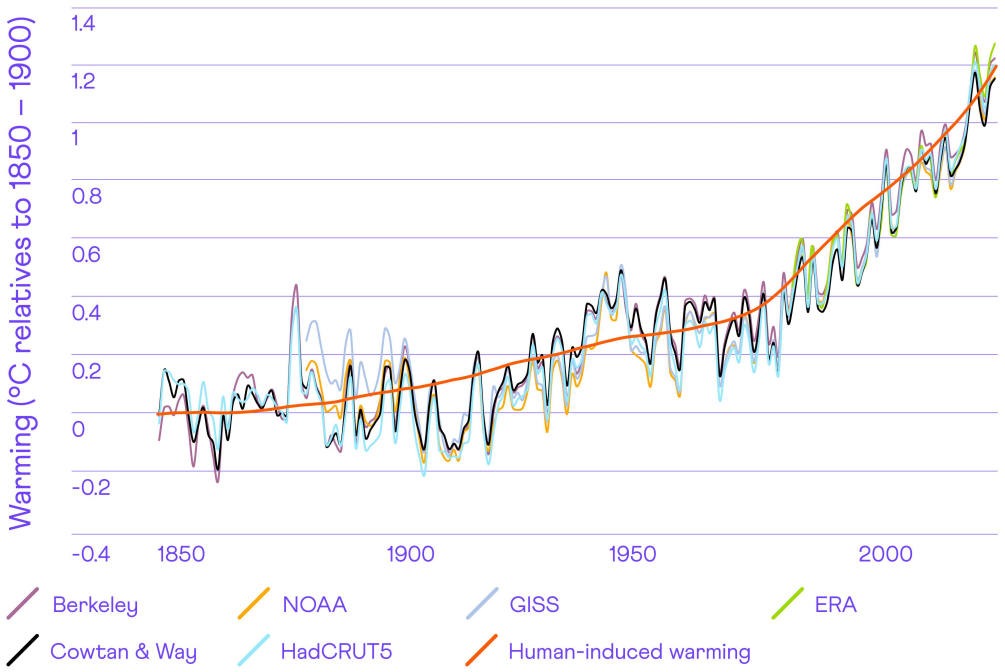
- Estimated human-induced warming has now reached around 1.2ºC above 1850-1900 (an approximation for preindustrial levels). Human-induced warming is estimated to explain 100% (± 20% uncertainty) of the observed warming since 1850 – 1900.

- Human-induced warming is increasing at around 0.25ºC per decade leading to further increases in global and UK climate hazards in the future. At this present rate of increase, human-induced warming would exceed 1.5ºC above preindustrial levels (the lowest level referred to in the Paris Agreement long-term temperature goal) by the early 2030s.

COVID-19 related impacts on emissions will not have a long-term effect on climate risks.

In 2020 the impact of measures to address the COVID-19 pandemic on global energy demand caused global annual energy-related CO_2 emissions to fall by around 6% relative to 2019 levels.[1] Global emissions rates have since recovered to be closer to 2019 levels. This temporary fall in global CO_2 emissions did not significantly affect atmospheric CO_2 concentrations, global temperature or climate impacts, as these are primarily determined by cumulative global CO_2 emissions over time. Changes in the global climate, and climate hazards, will continue until global emissions fall to close to zero.

Figure 1.1 Global average surface air temperature change



Source: CCC analysis
Notes: Each thin line represents a different global temperature dataset. The NOAA, GISS and ERA datasets are expressed relative to 1850 - 1900 using the offset over the 1981-2000 period from the HadCRUT5 dataset. Human-induced warming is taken from globalwarmingindex.org.

Observed climate change in the UK

Changes in aspects of the UK's weather and climate are already being seen.

The latest observations of UK weather and climate continue to document several clear recent trends[2] in aspects of UK climate (Figure 1.2):

- **Warmer average temperature.** The UK's annual average temperature has risen by around 0.6ºC above the average of the 1981 - 2000 period, consistent with a trend of nearly 0.3ºC per decade since the 1980s. Human-induced climate change in the UK is estimated to have raised UK average temperature above preindustrial levels by a similar amount to the global average.

- **Higher average sea levels.** The level of the seas around the UK has risen by around 6.5 cm since 1981 - 2000. They are currently estimated to be rising at around 2.5 cm per decade.*

- **Changed temperature extremes.** The shifting UK climate is having a clear effect on observed temperature extremes.[3]

* Based on a linear trend over the past 20 years.

  - The warmest temperature recorded each year has increased over time. Averaged across the UK, the warmest temperature of the year has increased to around 27ºC today from around 25ºC in the 1960s, with much more rapid rates of increase in the South East of England. The average duration of heatwaves (periods in which there are more than three days in excess of 25ºC) has increased over time. For the UK as a whole, summers as hot as in 2018 (the joint warmest summer on record) are expected to occur in up to 25% of years, compared to less than 10% of years a few decades ago.

  - The coldest temperature of the year has also increased over time. Averaged across the UK, the coldest temperature of the year is now around -7.5ºC today. In the 1960s it was around -9ºC.

  - The number of icing days (days in which the maximum temperature remains below 0ºC) across the UK was around six per year in the 1960s but has fallen to around three per year today. Individual years with a significantly greater number of icing days remains possible, such as in 2010.

- **Sunshine.** The most recent decade has been the sunniest on record in the UK (around 5% sunnier than over 1981 - 2000, with increases largely confined to winter and spring), however the causal link between this trend and human-induced climate change currently remains under investigation, with possible links to changes in aerosol emissions.[4]

In some aspects of the UK's weather and climate clear signals of global climate change have yet to emerge.

Signals of climate change may be emerging in other climate variables, but the strong annual and decadal variability in the UK's weather and climate still prevents their clear detection despite this being possible in other regions of the world:

- **Annual and seasonal precipitation.** Since the 1980s there has been an overall increase in the annual average amount of UK rainfall. The most recent decade was around 3% wetter than over 1981 - 2000, but interannual variability remains strong with both significantly wetter and drier years being observed. Western Scotland is the part of the UK with the most statistically significant trends to wetter years.[5] For the UK, winter and spring shows trends to being wetter and drier respectively, consistent with expected long-term trends due to climate change, but the statistical significance of these trends remains limited. The recent run of wet summers means that summers over the last decade have been around 20% wetter than over 1981 - 2000, despite projections for drier summers on average in the future. This highlights the continued impacts that annual and decadal variability have on near-term changes in some aspects of the UK's weather and climate.

- **Precipitation extremes.** Heavy rainfall metrics generally show an increase in very wet days across the UK, but the expected signal from climate change remains hard to distinguish from the large interannual variability in the observational record. Extreme event attribution studies have found robust signals that human-induced climate change has increased the likelihood of some observed UK precipitation extremes.[6]

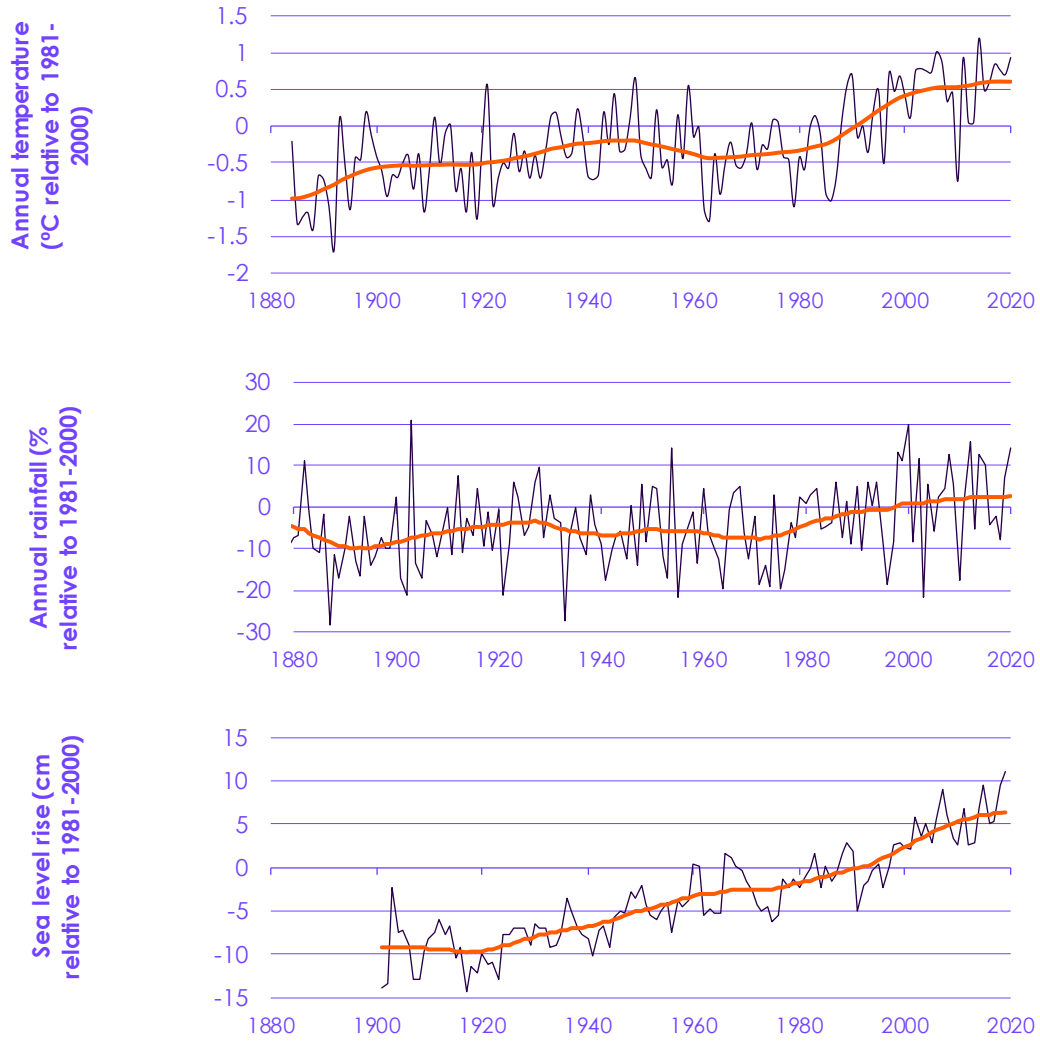
- **Storminess.** Storms can bring heavy rainfall and strong winds to the UK (particularly in winter), with risks of flooding and wind damage.

There are no clear trends in UK storminess over the observed record.* As UK storminess is strongly linked to the Jetstream improving understanding of how Jetstream variability may change in the future is an important area of research to better understand future UK climate hazards.†

Further changes in aspects of the UK's climate are expected.

The absence of clearly distinguishable observed trends in these aspects of UK weather and climate does not mean that there is no effect of climate change. For many variables (e.g. rainfall) there are good physical reasons to expect human-induced global warming to drive changes. Detectable changes in other aspects of UK climate are expected to emerge from natural climate variability as human-induced global warming continues to increase.

Figure 1.2 Observed changes in aspects of UK climate



Source: CCC analysis; HadUK-Grid dataset, Kendon, M. et al. (2020) State of UK Climate 2019. *International Journal of Climatology*, 40 (S1), 1-69.
Notes: Annual data is shown in all panels. The orange line is a moving 29-year triangular averaging window (reflecting at ends of timeseries) in all panels.

* Storminess is here defined in terms of maximum wind gust speed.

† Evidence from the latest generation of climate models produced by the UK Met Office, which have improved representation of Jetstream variability, suggests a possible shift to more stormy winters on average in the future.

In the UK the year 2020 was the third warmest year on record and the fifth wettest. There were several notable extreme weather events in the UK over 2020, some of which have been demonstrated to have been made more likely by human-induced climate change (Box 1.1).

Box 1.1
Extreme weather and climate events in the UK during 2020

Extreme weather and climate events occurred throughout 2020, across a range of different climate variables. Research over the last year has helped to provide insights into the relative role of human-induced climate change and natural climate variability as drivers:

- **Rainfall and storms in February.** A series of storms crossing the UK made February more than twice as wet as would be expected on average. This was the wettest February on record and the fifth wettest month ever recorded. This contributed to extensive flooding, particularly across Northern England and Wales, with peak flow rates recorded on many rivers.
- **Record sunshine in spring.** Following the wet end to the winter, the spring was exceptionally dry and sunny. Overall, the spring was the UK's sunniest spring on record (sunnier than most UK summers) and May was the driest May on record for England. This was largely driven by stable conditions in the North Atlantic Jetstream that brought repeated periods of high pressure over the UK. The spring sunshine in 2020 would still be a very sunny spring by the end of the century under all plausible future scenarios for global greenhouse gas emissions.
- **Heatwaves in August.** August saw a long-lasting heatwave affecting (primarily) southern England. Night-time temperatures were particularly affected with temperatures remaining above 20ºC at some location in the UK for five nights. This heatwave was linked to a rise in the death rate above the average rate for the time of year. Summer heatwaves are becoming more common and hotter in the UK.
- **Record daily rainfall in October.** October saw the UK's wettest day on record. Robust trends in the UK's wettest day of the year have not yet emerged in the observational record, but a trend towards more intense rainfall extremes is expected as the atmosphere holds more water when it is warmer.

These events highlight that the combination of rare instances of natural climate variability and the background of continued human-induced climate change can combine to create highly unprecedented weather and climate events in today's climate. This emphasises the value of preparing for unprecedented climate impacts today, not just in the future, and that climate variability will remain a key driver of UK climate impacts in the future under all future climate scenarios.

Source: Parry, S. et al. (2020) *Briefing Note: Severity of the February 2020 floods - preliminary analysis*; Kendon, M. & McCarthy, M. (2021) *The United Kingdom's wettest day on record – so far – 3 October 2020. Weather.*

Projected changes in UK climate and weather

The Committee recently published its advice on the Third UK Climate Change Risk Assessment (CCRA3). This advice, supported by an extensive Technical Report, provides a detailed assessment of the changes in UK weather and climate that might be expected in the future.

Further changes are expected in UK weather and climate over the next few decades.

The changes in UK weather and climate expected out to 2050 are:

- **Warmer and wetter winters.** By 2050 the UK's average winter could be around 1ºC warmer (0.5ºC cooler – 2.5ºC warmer uncertainty range) than it was on average over 1981-2000 and around 5% wetter (10% drier – 20%

wetter uncertainty range). An increase in both the intensity of winter rainfall and the number of wet days is expected.

- **Drier and hotter summers.** By 2050 the UK's average summer could be around 1.5ºC warmer (0ºC – 3ºC uncertainty range) than it was on average over 1981-2000 and around 10% drier (30% drier – 5% wetter uncertainty range). A summer as hot as in 2018 (the joint hottest summer on record) for the UK as whole could be normal summer conditions by 2050. The temperature of the hottest days each year are expected to increase more than the average summer temperature increase. The intensity of summer rainfall (when it occurs) is expected to increase.

- **Continued sea-level rises.** The seas around the UK will continue to rise over the three decades to 2050. By 2050 sea levels could be around 10 – 30 cm higher than over 1981-2000, depending on the specific location in the UK.*

These additional changes in the UK's climate to 2050 are largely insensitive to the pathway of global greenhouse gas (GHG) emissions over coming decades.

In the long-term, UK climate changes depend strongly on efforts to reduce global greenhouse gas emissions.

Beyond mid-century, the different possible future trajectories in global GHG emissions become the main source of uncertainty in global and UK climate changes. If global emissions continue at a high level through to mid-century and beyond, global temperature will continue to rise beyond 2050 and associated climate changes in the UK and elsewhere will continue in the second half of the century. If, however, global emissions have been significantly reduced by mid-century and are brought to Net Zero soon after, then many aspects of global and UK climate in the second half of the century can be kept close to that experienced at mid-century.†

Long-term UK climate risks therefore depend on both the ambition and implementation of global emissions reductions:

- Recent trends in costs of key technologies (e.g. renewable electricity) are helping the world move away from the futures with ever increasing global emissions. This means that exceeding 4ºC of warming above preindustrial levels by 2100 is no longer the most likely estimate of current climate trajectory outcomes.

- Current ambition for global emissions reduction is expected to be consistent with a central estimate of around 3ºC of warming above preindustrial levels by 2100.[7] Climate response uncertainty means that exceeding 4ºC by 2100 (or keeping warming below 2ºC) remains within the envelope of possibilities and cannot yet be ruled out as a possible outcome.

- Recent commitments to achieve Net Zero emissions by large emitters (including China and the USA) by around mid-century would, if delivered, move the central estimate for 2100 warming close to keeping below 2ºC above preindustrial levels. There would remain a non-negligible chance of warming exceeding 2ºC even if this scenario for global emissions were delivered.

* Range (in 50th percentile) outcomes across UK capital cities is given here. Climate uncertainties means that changes could range from 30 – 40 cm above 1981 – 2000 levels across capital cities under a high climate response (95th percentile).

† Some aspects of the climate (e.g. sea level) will continue to change in the second half of the century regardless of global emissions trajectories continuing to increase hazards such as coastal flooding.

Keeping central estimates of warming 'well-below' 2ºC, the Paris Agreement long-term temperature goal, would require significant strengthening of near-term commitments to emissions reductions by 2030 in addition to reaching Net Zero around mid-century.

It remains prudent to plan for a range of possible longer-term climate outcomes given the uncertainty in both the climate response and future trajectories of global GHG emissions when considering UK climate risks in the second half of the century.

Purpose of this report

This is the Adaptation Committee's second assessment of progress in delivering the current National Adaptation Programme, required under the UK Climate Change Act (2008).
The UK Climate Act requires the CCC's Adaptation Committee to report on progress in adapting to climate change through the National Adaptation Programme, covering England and reserved matters, every two years. The Committee's first assessment in 2019 of the latest National Adaptation Programme (NAP2, published in 2018), considered how the National Adaptation Programme and other actions were changing vulnerability and exposure to climate risks in England.[8] That report concluded that:

- On the basis of the evidence available, England is not prepared for even a best-case scenario of a 1.5 - 2°C rise in global temperature (see above), let alone more extreme levels of warming that remain likely on the basis of current pledges to reduce greenhouse gas emissions.

- The National Adaptation Programme does not address all the risks and opportunities set out in the second UK Climate Change Risk Assessment (CCRA) in 2017, despite this being a requirement of the UK Climate Change Act.

- The institutional and support framework for adaptation in England has been eroded over the past ten years.

- Vulnerability and exposure to climate change continue to increase across a range of sectors that are classed in the CCRA as needing urgent action.

- There are pockets of excellence in adaptation planning and action across England, that need to be supported and scaled up over the next ten years.

The 2019 report concluded that the Government must raise the profile and strengthen governance for adaptation over the coming decade to prepare for the impacts of climate change. The Committee offered 12 recommendations, which the Government responded to in autumn 2019.[9] A further set of recommendations on adaptation was also included in the CCC's subsequent Mitigation Progress Report in 2020, to which the Government also responded.[10,11]

This report re-assesses progress for the same set of 'adaptation priorities' or sectors that were covered in 2019. Each chapter considers changes in relevant policy, and shows updated indicators of vulnerability, exposure, adaptation action and impact. We have provided an updated set of conclusions in the Executive Summary.

The 2019 Progress Report assessed plans to adapt to climate change based both on the quality of the plan and whether adaptation is reducing risk.

The CCC's assessment framework and structure of this report

The Adaptation Committee revised its assessment framework for its 2019 Progress Report, and we use the same framework here.
The 2019 report explains in detail the rationale and context for the assessment framework used by the Committee for adaptation. It is based on two questions:

- **Is there a good quality plan?** The Committee has reviewed whether plans are in place that include adaptation actions to prepare for inevitable change (approximately a 2°C rise in global temperature above pre-industrial levels), and a consideration the risks for that sector in a 4°C scenario. We also assess whether plans are SMART – specific, measurable, attainable, relevant and time-bound. A good plan will have clearly stated outcomes that are appropriate in the context of climate change, have considered the short-term and long-term effects of climate change, have an effective monitoring and evaluation framework and demonstrate clear links between the outcomes and corresponding actions. A weaker plan might have vague or unclear outcomes, make weaker links to the current and future effects of climate change, and may only include guidance but not require specific action.
- **Is progress being made in managing risk?** The Committee assesses indicators of vulnerability, exposure, adaptation action, and climate change impacts to assess how risk is changing, and whether goals remain on track to be met where this is relevant. For this step, we also consider how the actions set out in the National Adaptation Programme, and other relevant actions, are addressing risk. In this context, the Committee has considered to what extent the actions taking place relate to the risks identified in the Climate Change Risk Assessment and whether they are being implemented in accordance with NAP2. The assessment seeks evidence of what impact the actions are having on risk, wherever possible.

For each adaptation priority, an assessment score of high, medium or low is given for plans and managing risk using a set of defined criteria (Table 1.2). Those scores then place each adaptation priority on a 9-box grid.

Across the chapters, each section includes a progress summary table explaining the differences in plan and risk scores between 2019 and now.
These are included as signposts for the reader. The analysis is then expanded below with a narrative on changes in the plan score, changes in the risk score, and an overall conclusion. The Committee's full set of indicators is provided in an annex to this report, but some of the key indicators that support the scores are highlighted in the chapters.

We provide specific recommendations for Government departments.

Recommendations related to each adaptation priority are provided in the relevant places in the text in this report. The complete set of adaptation recommendations is provided, by department, in the Executive Summary.

Table 1.2
Adaptation Committee Assessment Criteria

Score	High	Medium	Low
Plan Score	**Good quality plan:** **Considers climate change, including a range of scenarios (adaptation planning for inevitable change i.e. a 2°C scenario, consideration of risks for a 4°C scenario)** **Sets out specific action – not just guidance** SMART – specific, measurable goals with timescales Has effective monitoring and evaluation built in Can see links from the plan down to the actions Plans up to date	**Medium quality plan:** **Considers climate change, though possibly vague on what scenarios are included** **Requires general action – not just guidance** Some aspects of being SMART Some monitoring and evaluation Some links to action	**Low quality plan:** **Minimal or no consideration of climate change** **No firm actions, not SMART** No monitoring and evaluation No firm link through to actions Plans not up to date
Risk Management Score	**Evidence that risk (vulnerability and exposure) is reducing at an appropriate rate, and/or is in line to meet goals** **Good evidence of impact of actions on risks**	**Mixed picture – some evidence of risk being managed, but other areas where progress is lacking** **Some evidence of impact of actions on risks**	**Evidence that risk is not reducing or is increasing, or lack of evidence to judge what is happening to risk** **No evidence that actions are having an impact on risk**

Source: Bold criteria are considered as key to that score; other criteria are also assessed but are of lesser importance.

International climate risks are important for a full understand of the possible impacts of climate change in the UK and actions to avoid them.

The National Adaptation Programme does not include any actions on addressing the risks to the UK from climate change overseas. We include a joint section on international dimensions of risk in our accompanying mitigation Progress Report. Both the CCRA2 Evidence Report and the recently published CCRA3 Evidence Report consider how international climate risks would directly and indirectly impact the UK. The elements of international risks that are especially relevant to the UK, identified by CCRA2 (and so relevant for NAP2), fall into the following categories: (1) global trade and supply chains, especially for food; (2) migration and displacement; and (3) broader geopolitical and macroeconomic issues. There are also risks specific to particular Government departments, such as risks to overseas military operations.

In particular, the CCRA2 Evidence Report assessed that extreme weather events have the potential to affect global food production, trade and supply chains, making prices more volatile and/or altering productivity in the long-term. Furthermore, weather-related events were identified as potential drivers of increased international human displacement with subsequent impacts on overseas development efforts. These risks were assigned to the 'more action needed' category.

However, the formal NAP2 actions do not cover any of the international risks from CCRA2. We have not, therefore, included an International Dimensions chapter in this Progress Report as there are no NAP actions against which to assess progress. A summary of our latest assessment of the importance of international dimensions of risk is provided in a joint section considering mitigation and adaptation in the accompanying report to this one on reducing UK emissions.

Adaptation indicators

Better indicators and data are needed to understand more clearly the effectiveness of adaptation actions.

Measurement is fundamental to understanding if adaptation is working. Relevant measurement indicators are needed which effectively monitor progress in reducing climate change risk and show the effectiveness of different adaptation responses.

Current indicators for measuring progress and the effectiveness of adaptation actions are inadequate.
Most currently available indicators measure progress towards policy targets or legal requirements. They are not necessarily aligned with the measurements needed to identify tangible reductions in climate risk or improvement of resilience. For example, for the natural environment sector, peatland condition and species abundance indicators can be used as proxy indicators for the vulnerability of the habitat to climate change; better condition and higher abundance can be interpreted as higher resilience. However, they do not confidently link how restoration activities can improve resilience of peatland and its services to reduce specific climate impacts. In addition, such indicators are only available for protected sites, not all peatlands.

By improving the ability to monitor the impact of adaptation interventions, the Government can plan more effective and cost-efficient adaptation actions. However, without appropriate indicators it is not possible to accurately determine whether sufficient funding is allocated towards the right actions in the right places. This is vital if the Government is to achieve its long-term policy aims, including delivering Defra's Environmental Land Management scheme outcomes, the 25-year Environment Plan (25 YEP) goals, and the objectives outlined in the Flood and Coastal Erosion Risk Management (FCERM) strategy.

As more countries are expected to come forward with National Adaptation Plans or Adaptation Communications in advance of COP26, attention will turn to measuring progress against these commitments. There is a window of opportunity for the Government to drive improvements in measuring progress on adaptation.

The Committee has reviewed its previous indicator framework following the 2019 Progress Report and identified key gaps.
As part of its biennial review of progress in adapting to climate change in England, the Committee collects indicators to assess trends in risk factors: hazard, vulnerability and exposure. We also collect indicators to assess trends in adaptation actions, and climate impacts.

In order to assess the suitability of existing adaptation indicators with the increasing challenge of measuring adaptation progress, the Committee has conducted work to align its existing adaptation indicator framework with a theory of change (ToC) approach. A ToC is a methodology that helps establish links between inputs, outputs, outcomes and impacts. These can be defined as: inputs - specific actions implemented to bring about outputs or outcomes (e.g. funding levels, capacity building activities); outputs – products or events produced that result from the

completion of adaptation actions (e.g. area of peatland restored, energy efficient boilers installed in homes); outcomes – an intermediate prerequisite for meeting the Government's overarching policy goals (e.g. meeting good ecological status benchmarks for water bodies); impacts – the contribution of outcomes to the achievement of goals that can be attributed to a particular intervention. (e.g. change in the number of properties flooded each year resulting from increased expenditure on flood risk management).

A review of the Committee's current set of adaptation indicators has identified significant gaps.
The Committee's work has included a rapid review of existing indicators against this ToC framework and producing an indicator wish-list for all sectors (see accompanying standalone annex to this report for more details). The results from the review show a high proportion of indicators within the Committee's adaptation indicator framework measure the level of inputs to and outputs from given adaptation activities, however, there is a gap in metrics to measure progress towards outcomes (i.e. the effectiveness of adaptation actions). Furthermore, many indicators within the current set were originally designed for other purposes, and not to measure changes in risk vulnerability, so they can therefore be used only as proxy indicators at best.

The exercise has enabled the Committee to identify areas where the assessment process would benefit from future work to design and populate additional adaptation indicators. These include:

- **Natural environment** – a shortage of impact indicators that enable the assessment of: a) the effectiveness of adaptation actions in reducing climate risk; and b) changes in the natural environment that can be directly attributable to climate change.

- **People and the built environment** – a significant lack of data on sewer capacity and sustainable urban drainage (SuDS) uptake which makes it difficult to assess progress in surface water flood alleviation; and lack of monitoring of internal temperatures in homes and other buildings.

- **Infrastructure** – indicators that enable the assessment of impacts from disruption due to severe weather events on key infrastructure; indicators on the condition of slopes and embankments supporting the strategic and local road network; data on interdependent risks and resilience actions by infrastructure providers; data on the extent to which climate risk is being considered in the design and location of new infrastructure.

- **Business** – many of the current set of indicators are based on self-reported or survey evidence which may not be representative for businesses of different sizes or sectors; a shortage of impact indicators that enable a consistent assessment of the effectiveness of adaptation interventions over time.

Defra should bring together relevant stakeholders to share data and knowledge.
There are many UK organisations who recognise the challenges of measuring adaptation progress and are in the process of developing indicators. For example, within government, Defra is developing a range of adaptation metrics within its 25-YEP indicators framework, while the Environment Agency is exploring the design and use of indicators to measure progress towards the adaptation objectives set out in its FCERM strategy.

The CCC has been approached by the Interim Environmental Governance Secretariat to provide guidance around the adaptation indicators required for the proposed Office for Environmental Projection (OEP) to conduct its independent scrutiny of the Government's progress towards meeting the 25-YEP goals. Following a special interest group workshop, the British Ecological Society (BES) is also coordinating the production of a peer-reviewed manuscript investigating how a suite of indicators may be developed to track the effectiveness of adaptations actions in the natural environment, within a monitoring and evaluation framework.

Defra should consider how it can help to streamline these various processes and requirements, and bring together the different expertise available on developing and populating indicators.

There is an urgent need for Government to fund work to develop new indicators to support the comprehensive assessment of adaptation progress.
The next six months, in the run up to COP 26, would be a key time for the CCC to lead this work if requested by Government. In addition to a comprehensive framework for adaptation indicators, alignment of indicators across organisations and sectors will require coordination. The Committee is well placed to play a key role in harmonising indicators currently in development, drawing on expertise from different sectors and ensuring a consistent approach across organisations.

The CCC would work together with Defra, the Office for Environmental Protection, the Environment Agency, MHCLG, the British Ecological Society and others to identify, develop and source data for new indicators, create a framework for using them and coordinate ongoing work to ensure indicators remain appropriate and relevant. There is also a role for the Chief Scientific Advisers to coordinate action across all Government departments and to consider how to better resource monitoring and evaluation.

Endnotes

[1] International Energy Agency (2021) *Global Energy Review: CO_2 Emissions in 2020*.

[2] Kendon, M. et al. (2020) *State of the UK Climate 2019*. 40, S1, 1-69.

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[5] Hawkins, E. et al. (2020) Observed Emergence of the Climate Change Signal: From the Familiar to the Unknown. *Geophysical Research Letters*, 47, 6.

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[7] Climate Action Tracker Initiative.

[8] CCC (2019) Progress in preparing for climate change: 2019 report to Parliament

[9] HM Government (2019) Government response to the Committee on Climate Change: 2019 report to Parliament, Progress in preparing for climate change

[10] CCC (2020) Reducing UK emissions: Progress Report to Parliament

[11] HM Government (2020) Government Response to the Committee on Climate Change's 2020 Progress Report to Parliament: Reducing UK emissions

Chapter 2

Natural Environment

2.1 Introduction

This chapter considers progress in adapting the natural environment to climate change including both natural capital assets, and the ecosystem services they provide.

The structure of this chapter follows the Natural environment and natural assets chapter in the Evidence Report for the 2021 UK Climate Change Risk Assessment. Its focus is the protection of the natural environment and goods and services that are provided directly from land, water and sea. Some of these services are covered in other chapters. For example, the business chapter covers a range of other provisioning services (minerals, energy); flood regulatory services are also covered in the infrastructure chapter; while water appears in several chapters across the report. Supporting services such as biodiversity and soil quality cut across all priorities so are not separately identified. Cultural services are not included in this discussion. The natural environment priorities covered in this chapter and their place in a natural capital framework are set out in Table 2.1.

Table 2.1
Natural environment chapter priorities

Natural capital assets including biodiversity	Regulating services	Provisioning services
Terrestrial habitats and species Farmland habitats and species Freshwater habitats and species Marine and coastal habitats and species	Water management	Agricultural productivity Commercial forestry Commercial fisheries and aquaculture

Source: CCRA3 Technical Report

Many of the services that the natural environment provides not only underpin human well-being and economic activity, but are also key to societal resilience to climate change.

The natural environment is critical for adaptation because all other sectors ultimately depend upon it.

Many of the services that the natural environment provides not only underpin human well-being and economic activity, but are also key to societal resilience to climate change. They support livelihoods and economies, help to moderate the climate itself, and offer protection from climate-related impacts such as storms, landslides and flooding. This was recognised in the UK National Ecosystem Assessment[1], which noted that appreciation of the full value of ecosystem services requires recognition of values that are shared.[2] For instance, the annual non-market benefits (e.g. recreation, carbon sequestration, pollution removal, urban cooling) of UK woodland were found to exceed the market benefits of timber by approximately 12 times.*[3]

The type and scale of ecosystem services vary across contexts and scales. Provisioning services deliver resources (e.g. food, fibre) for economic activities such as agricultural production, fishing, timber and water supply.

* Estimate should be interpreted as the minimum value of the habitat, as a number of 'non-market' ecosystem services that support the valuation are not currently measured.

At local to catchment scales, ecosystems contribute to regulating water flow and flooding, water quality, soil quality and retention, the spread of pests and diseases, and help to moderate direct climate-related impacts. At the regional to global landscape scales, ecosystems provide climate regulation through carbon sequestration.

Supporting services, such as biodiversity and nutrient cycling, contribute to well-being and resilience by underpinning ecosystem function. Cultural services such as recreation are central to health and human well-being and contribute to economic activities like tourism. The Covid-19 pandemic has increased awareness of the value of cultural services, such as access to the natural environment and the benefits it provides for mental and physical well-being.

There remains only limited evidence of natural capital being considered in Government policy design, incentives for better environmental management and appraisal.

There are a growing number of practical tools that support this approach. For example, the Enabling a Natural Capital Approach (ENCA) online tool[4] provides practical advice, and easy access to data and references to better understand natural capital and how to take it into account. Accounting for natural capital has also influenced the long term thinking behind the 25 Year Environment Plan for England, and other advice from the Natural Capital Committee. However, there remains only limited evidence of natural capital being considered in Government policy design, incentives for better environmental management and appraisal.

Integrated, ecosystem-based approaches or nature-based solutions can contribute to adaptation for the natural environment and other sectors.
Nature-based solutions (NbS) can help build the resilience of the natural environment to climate change impacts through delivering actions to protect, sustainably manage and restore natural or modified ecosystems in both urban and rural areas. For example, green and blue infrastructure are an increasingly important adaptation measure and generate a range of benefits both for wildlife (e.g., through habitat creation) and human health (e.g., reducing the Urban Heat Island effect, providing shading and surface water flood resilience; providing recreational opportunities; as well as potentially improving air quality).

Effective planning for Net Zero can also deliver climate change adaptation and wider environmental goals.

It is vital that the impacts of climate change risks on the natural environment and its ability to contribute to mitigation are incorporated in the delivery of mitigation measures.

There are both risks and opportunities from the effects of a changing climate for the natural environment and its contribution to Net Zero. It is vital that the impacts of climate change risks on the natural environment and its ability to contribute to mitigation are incorporated in the delivery of mitigation measures. For instance, peatlands are critical for carbon storage and water regulation. If peatlands are not in good condition, they are at much higher risk of degradation and carbon loss as the climate changes, as well as not delivering its other benefits.

In addition, mitigation measures such as new tree and hedgerow planting, catchment-sensitive farming and peatland restoration have important benefits for building climate resilience. However, careful planning about species mix, location and management actions is necessary for such measures to deliver planned greenhouse gas removals as the climate changes. The Government must therefore ensure the future local climatic and ecological context is considered when implementing the measures. The changes that are needed will vary across the country because climate change impacts will vary spatially, as well as the quantity and condition of natural capital assets, local needs and demands.

The Government should leverage private sector financing to support climate adaptation and resilience activities.
Government alone will not be able to finance the costs of addressing the adverse impacts of climate change, as well as fund the innovations needed to capitalise on any potential opportunities.

Environmental restoration and management to build climate resilience at the landscape level will result in private benefits as well as public goods. For many of these, specifically in the areas of flood risk management, carbon sequestration and water quality improvements, it is critical to encourage private investment alongside Government funding (e.g. such as through the Environmental Land Management schemes), in order to deliver the scale of transformation in land use and management that is required. Combining public sector funds with private sector capital (blended finance) could offer the potential to scale up the deployment of projects that deliver multiple environmental benefits, including climate change adaptation. The Government's Green Finance Strategy also looks to address this through aligning private sector financial flows with clean, sustainable and resilient economic growth.

However, further work in this area is needed if the scale of the challenges from climate change in England are to be met. The Government should encourage private sector participation in climate change adaptation activities through expanding its portfolio of blended, innovative funds and facilitating risk-sharing.

Monitoring the effectiveness of actions in the face of changing climate risks will be vital to assess how the extent and condition of the natural environment and the services it provides change over time.

Research into developing more sophisticated metrics for the natural environment is urgently needed to help inform on how ecosystems and biodiversity are changing due to climate change, and the components or functions that are most vulnerable to climate change, so that adaptation responses can be better focussed.

Some of the indicators used in this chapter to assess changes in risk and effectiveness of adaptation plans are based around the Lawton principles, established in 2010, for improving the resilience of the natural environment by making habitats 'bigger, better, more numerous and more joined up'. Habitat condition and species abundance (whether impacted by climate change or not) are used as proxy indicators for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are. However, this enables only a simplistic assessment of progress. As noted in chapter 1, research into developing more sophisticated metrics for the natural environment is urgently needed to help inform on how ecosystems and biodiversity are changing due to climate change, and the components or functions that are most vulnerable to climate change, so that adaptation responses can be better focussed.

There must be no regression in existing environmental protections.

Any changes to existing environmental regulations must only proceed after consultation with experts such as Natural England and the new Office for Environmental Protection.

Our 2019 report identified a range of legislation designed to help protect the natural environment in England, several of which contain key mechanisms for reducing climate risks. The current lack of a non-regression commitment within the Environment Bill increases the danger of backsliding on environmental standards. The Government has tabled amendments to the Environment Bill to re-focus the habitats regulations to domestic priorities, including new secretary of state powers to amend the existing EU regulations. Ensuring the condition of all conservation areas, the wider countryside and urban environment are maintained is an important adaptation goal as set out in the Lawton Review noted above. Any changes to existing regulations must only proceed after consultation with experts such as Natural England and the new Office for Environmental Protection. Furthermore, to ensure that environmental protections are maintained in the future, the government should reaffirm in law its commitment to international nature conventions.

2.2 Terrestrial habitats and species

Progress summary – Terrestrial habitats and species		
2019 score:	**What has changed since 2019:**	**2021 score:**
3	**Plan score: medium** • The Government has published England action plans for peat and trees, while a range of other plans are in development (nature, soil heath, plant health biosecurity). These should both individually and collectively help improve resilience of terrestrial habitats, but each must include careful consideration of future climate change. • The Government has increased spending in biodiversity and climate change, however, it is unclear if funding levels will be sufficient to meet all commitments. Environment Improvements plans (EIPs) mandated under the Environment Bill still need to clearly outline measures to ensure plans meet the 25-year Environment Plan goals. EIPs must integrate climate risks into the delivery of all plan outcomes, and include actions that reduce vulnerability and exposure to climate change. • Without statutory interim targets, linked to long-term targets, future EIPs risk becoming aspirational. **Risk management score – low** • Metrics to monitor the vulnerability of terrestrial habitats and species continue to show slow progress or a decline. The majority of targets set out in the Government's Biodiversity 2020 strategy have not been met, with many falling well short.	3
Notes: See annex for full datasets Key Indicators: Terrestrial SSSIs in England, by condition, Peatland SSSIs in England, by condition, Measure of woodland resilience to climate change, Woodland species indices: breeding birds in woodland in England, Number of Wildfire incidents		

This adaptation priority covers semi-natural habitats classed by Natural England as terrestrial - woodlands, grasslands, heath, montane habitats and bogs, which together represent just over a quarter of total land cover in England.* It excludes enclosed farmland and extensive grassland used for farming, which is covered in section 2.3. We consider trees in terms of woodland habitats here, but their provisioning services in section 2.6.

As with our previous progress reports, we have measured the vulnerability of biodiversity to climate change based on the principles set out in the Lawton Review (2010).† The high-level findings of the review suggested that habitats need to be in good condition, bigger, better and more joined up in order to have a greater chance of allowing the species they support to adapt naturally as the climate changes.

* Based on ONS UK Natural Capital Land Cover in the UK, 2015. Total semi-natural terrestrial habitats comprise semi-natural grassland; broadleaf and conifer woodland; shrubland, bushland, heathland, barren; and sparsely vegetated areas.

† See a fuller description of the Lawton principles in CCC (2013) *Managing the land in a changing climate.*

We assess progress in adaptation as related to the changing condition and size of the habitats, but condition data is only available for Sites of Special Scientific Interest (SSSIs), which are a small percentage (ca.20%*) of the overall area of terrestrial habitats covered in this chapter.

Summary of 2019 report score

Terrestrial habitats and species scored a 3 rating in our 2019 report (medium plan score, low risk management score).
Our 2019 report noted that whilst plans are in place, the measures outlined in them were not specific, with the effectiveness of many actions difficult to assess, especially for climate change adaptation. Furthermore, targets contained in the plans were narrow in scope and did not include all priority terrestrial habitats. There was evidence of actions being taken to restore species, habitats and ecosystems, but most were in the early stages of development.

Has the plan score changed?

No. The plan score remains medium.

It is as yet unclear how risks from climate change and actions to address them will be incorporated into plans for improving the condition of terrestrial habitats and species.

A new range of separate action plans including those for peat and trees were recently published, or are being developed by Government, which should help build the resilience of terrestrial habitats. However, more detail is needed on how the different strategies will combine to support the Government's climate change adaptation goals.

There are several plans for the natural environment that should individually and collectively help to improve the resilience of terrestrial habitats and species.
Restoration of peatlands, alongside woodland planting, was identified as a priority climate action measure in the CCC's Sixth Carbon Budget report.[5] The Government has now published separate actions plans for peat and trees in England.

England Peat action plan
Unless addressed in advance, some of the downside risks of climate change could result in irreversible loss of upland peat areas in England.[6]

The England Peat Action Plan reiterates the 25-Year Environment Plan (25-YEP) commitment for all of England's soils to be managed sustainably by 2030. Under the plan, a new Nature for Climate Peatland Grant Scheme (part of a broader £640m Nature for Climate Fund) will support the restoration of 35,000 hectares of degraded peatland in England, backed by over £50 million in funding between 2021 and 2025. While this is a step in the right direction, the scale of restoration targeted relates to only around 5% of total peatland area in England. Of this, 15% of the area restored by 2025 will involve the restoration of lowland agricultural land to peat habitat. It is not clear what the target will be beyond 2025.

* 20% England figure calculated as semi-natural terrestrial SSSIs published by Natural England (https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx) as a proportion of the total area of semi-natural habitats published in ONS UK Natural Capital Land Cover in the UK, 2015.

As outlined in the Plan, the sale of peat in compost for the amateur horticultural market will be banned in England by 2024, subject to a consultation later in 2021 on a range of legislative measures to achieve this. The consultation will also consider the ban on peat for the professional market. There are no new actions in relation to ending peat extraction in England. The Plan also does not contain any new actions to prevent the rotational burning of upland peat areas, in addition to the partial ban legislated with effect in 1st May 2021, which relates only to certain protected blanket bog sites. However, the government will keep under review the environmental and economic case for extending the approach to additional areas of blanket bog after assessing how the new regime works in practice (see below).

Recommendation (see CCC 2021 Joint Progress Report)

Extend current ambition set out by the UK government and the devolved administrations to implement a comprehensive delivery mechanism to address degraded peatland (hectares given are for the UK):

- 17% of upland peat is restored, equivalent to 200,000 hectares (and where this is not possible, stabilise the peat) by 2025; 58% by 2035 (700,000 hectares) and the remaining area by 2045;
- Rewet and sustainably manage 12% of lowland peat used for crops by 2025 (24,000 hectares), rising to 38% by 2035 (72,000 hectares);
- Rewet 8% of lowland grassland area by 2025 (18,000 hectares), rising to 25% by 2035 (54,000 hectares);
- Remove all low-productive trees of less than YC8 off peatland (equivalent to 16,000 hectares by 2025), and restore all peat extraction sites by 2035 (equivalent to 50,000 hectares by 2025).

Department: Defra, Timing: 2021-2025

Soil Health action plan

To help achieve the Government's commitment for all of England's soils to be managed sustainably by 2030, Defra are considering the potential scope for a soil health action plan as an appropriate means of supporting land managers and farmers. While broader in scope, since it will cover all soils in England, the draft Plan would be complementary to the England Peat Action Plan.

The draft plan will include developing and implementing a number of actions that support sustainable soil management and implementing new measuring and monitoring schemes for soil health. For example, the Sustainable Farming Incentive (SFI) will support sustainable approaches to farm husbandry to deliver for the environment. Plans also include developing a new Soil Health Monitoring Scheme (SHMS) for England to produce a new robust data baseline. A healthy soils indicator will be developed to feed into the SHMS and will inform a future target for soil health under the Environment Bill. Separately, a new Soil Structure Measuring and Monitoring Scheme is being developed to enable visual assessments to be carried out by farmers and land managers across all land use/soil types.

England Tree action plan

The CCC's land use report (2018) showed that woodland planting is a key measure for improving climate resilience; though much depends on ensuring that the right species are planted in the right location to ensure the delivery of multiple ecosystem services, in addition to carbon sequestration and storage.

Under the England Tree Action Plan, the Government will spend over £500 million of the £640 million Nature for Climate Fund on trees and woodlands between 2020 and 2025. The funding will support a trebling of current woodland creation rates, equating to ca.7,000 ha per annum out to 2025. According to the Forestry Commission, this is broadly consistent with the Government's aspiration to increase woodland cover in England from 10% presently to 12% of total land area by 2060, but the expansion rate would need to be maintained to mid-century. Woodland expansion will include conventional planting in urban and rural areas (including trees on farms), as well as natural colonisation. To incentivise more biodiverse woodlands, higher payment rates will be offered to landowners creating predominantly native broadleaf woodland. Under the Woodland Creation Offer grant, a range of ecosystem services provided by woodlands will be recognised, and extra funding will be provided for planting that can deliver wider benefits such as riparian shading, biodiversity, water filtration and flood risk alleviation (see section 2.6).

The Government's new Environmental Land Management schemes will provide the main mechanism for publicly funded woodland creation after 2024. Work is being undertaken by Defra to determine the specific actions the ELM schemes will pay for, and quantify their contribution to climate adaptation. It is understood this work is being informed by detailed modelling, which will also test the resilience of these actions to climate uncertainty (see section 2.3).

Plant Biosecurity Strategy

The 25-YEP includes a commitment to revise the 2014 Plant Health Biosecurity Strategy, which will set out the strategic framework to protect plant health in order to protect natural capital in England from invasive non-native species. The strategy was delayed due to the national election in 2019 and Covid-19 pressures, with plans now for it to be published in Autumn 2021.[7]

An overarching 'wrapper strategy' would be useful to clearly outline the relationships and interactions between the Government's various new action plans for the natural environment.

Nature Strategy

The Government committed to a strategy for nature in England to implement commitments under the Convention on Biological Diversity (CBD). Government has already announced key elements of its strategy (e.g. on targets, legislative reform and new funding for nature based solutions) and will continue to develop its approach, including developing legally the binding biodiversity targets (see below) and updating its plans and strategies in response to the 15th Conference of the Parties to the CBD in October of this year.

An overarching 'wrapper strategy' would be useful to clearly outline the relationships and interactions between the multiple action plans both published and in development for the natural environment.

This wrapper strategy should set out how the different strategies listed above will interact and combine to support meeting the Government's climate change adaptation goals, alongside broader objectives for the natural environment.

Recommendation
Publish an overarching strategy that clearly outlines the relationships and interactions between the multiple action plans either published or in development for the natural environment, including those for peat, soil health, trees, nature and plant biosecurity. This must clearly outline how the different strategies will combine to support the Government's climate change adaptation goals. Department: Defra, Timing: 2021.

The Nature Recovery Network (NRN) is a key Government policy that will underpin the Nature strategy.
As outlined in the 25-YEP, the NRN will aim to deliver on the recommendations of the Lawton Report that recovering biodiversity will require habitats in better condition; in bigger patches and that are more closely connected. Goals for the NRN set out in the 25-YEP include restoring 75% of terrestrial (and freshwater) protected sites to favourable condition, and creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats. However, as noted in our 2019 progress report, in its current form, the 75% restoration target falls well short of the recognition in the Government's response to the CCC's 2017 report* that much wider action is needed, in that it only applies to terrestrial protected sites. As noted above, protected sites cover only around one-fifth of the total area of semi-natural terrestrial habitats - the target should be extended to include all priority terrestrial sites.

Natural England is leading work to explore how climate change considerations can be incorporated into the NRN's design, both spatially and as a core principle. A NAP ecosystems and biodiversity group has been established to support this, which includes major landowners such as CLA, RSPB and National Trust. The group is used as a platform to discuss with a wider group of partners, issues including potential impacts under 2°C and 4°C degree global temperature scenarios.

Recommendation
Defra must extend its commitments outlined in the 25-Year Environment Plan. The commitment to achieve 75% restoration for terrestrial and freshwater protected sites should be extended to include all priority habitat sites. Department: Defra, Timing: 2021.

Legislation has been introduced to prevent the rotational burning of certain blanket bog sites in England with immediate effect.
The partial ban applies only to protected sites† that are also a Special Area of Conservation or a Special Protection Area covering a total area of around 142,000 hectares, representing around 40% of all blanket bog in England. The England Peat Action Plan notes that the Government will continue to review the environmental and economic case for extending the approach to additional areas of blanket bog after assessing how the new regime works in practice. However, this ban is less ambitious than the recommendation set out in the CCC's Sixth Carbon Budget Advice[8] that all rotational burning in England should cease immediately.

Recommendation (see CCC 2021 Joint Progress Report)
Introduce legislation to extend the ban on rotational burning of peat from certain protected upland bog sites to all peatland before the start of the burn season in 2021; end peat extraction, and ban its sale for all horticultural uses including in the professional sectors and apply this to imports by 2023; mandate water companies to restore peatland under their ownership; and ensure lowland peat soils are not left bare. Department: Defra, Timing: 2021-2023

* In its response to recommendation 6 of the CCC's 2017 report to parliament, the Government recognised the need for action to be 'taken to enhance the condition of priority habitats and the abundance and range of priority species, both on protected sites and in the wider countryside'.

† Also referred to as Sites of Specific Scientific Interest (SSSIs)

Natural England and the RSPB have updated their joint Climate Change Adaptation Manual.
The manual is a resource to support practical and pragmatic decision-making, by bringing together recent science, experience and case studies, and is intended to be an accessible entry point to a range of available resources and tools. Climate impacts and associated adaptation actions are presented by habitat. The guidance emphasises the importance of considering 2°C and 4°C warming scenarios.

Environment Improvements Plans (EIPs) mandated under the Environment Bill will need to clearly outline measures to ensure they meet Defra's 25-year environment plan goals.
Delivering significant improvements across the whole of the natural environment is vital to building the ecosystem resilience required to adapt to climate change. The Environment Bill creates a new statutory cycle of monitoring, planning and reporting progress, including a duty on the Government to prepare rolling Environmental Improvement Plans (EIPs)* and set requirements for what the plans must contain. The EIPs are necessary to provide the comprehensive and long-term vision that will guide legislation and policy to deliver better protection and enhancement of the natural environment.

However, the EIPs need to be strengthened to ensure that they include time bound, specific measures, which are more explicitly linked to the delivery of the environmental outcomes outlined in the 25-YEP. Furthermore, adaptation is a necessary pre-requisite to meeting the 25-YEP goals, because climate change will prevent the goals from being met without additional adaptation.[9] It is vital that climate change risks are considered in the delivery of all outcomes, and actions that reduce vulnerability and exposure to climate change must also be clearly identified and incorporated into the EIPs.

The government has committed to increase the amount of protected land in the UK to 30% by 2030.
The Government has suggested that 26% of land in England is already protected for nature. However, the majority of this area is not specifically designated for nature's protection. Even where there are environmental designations in place, many are poorly-managed sites that are not in a good condition for nature and have not been regularly monitored.[10] This suggests significantly more resources will be required than that currently estimated by Government if the target is to be delivered effectively. To help achieve the 30% commitment, all sites contributing to the target must be monitored and in favourable condition or showing demonstrable signs of ecological recovery.

Action-based long-term targets will not be sufficient to ensure the Government's goals for biodiversity are met.
The Environment Bill will mandate the government to set at least one long-term target in four priority areas (air quality, resource efficiency and waste reduction, water, and biodiversity) with each required to have a minimum duration of 15-years. The ability to set more than one long-term target within a given priority area will be particularly beneficial for biodiversity where a single measure will not be sufficient; different ecosystems, habitats and species are changing in different ways.

* The 25-year Environment Plan is the Government's current Environmental Improvement Plan

In addition to the long-term targets, Defra confirmed in May 2021 it will also introduce a separate 2030 target for species abundance. The details will be set in secondary legislation following consultation and further evidence gathering.

It is vital that a range of outcome-based long-term targets, determined through an independent, evidence-led process of expert advice, stakeholder engagement, and public consultation, are set for biodiversity.

Proposals outlined in Defra's environmental targets policy paper suggest that for biodiversity, its long-term "outcome" targets may be limited to goals concerning the restoration of protected sites, whilst relying on "actions" targets for other important habitats. As noted above, protected sites represent around ca. 20% of the area of semi-natural terrestrial habitats in England. It is vital that a range of outcome-based long-term targets, determined through an independent, evidence-led process of expert advice, stakeholder engagement, and public consultation, are set for biodiversity. Furthermore, meaningful biodiversity measures to assess progress in meeting the targets need to be agreed with standardised methods. Failure to do so risks setting arbitrary targets, which meet legal requirements but do not lead to progress towards the 25-YEP outcomes.

The Government will be required to periodically review its long-term targets, by carrying out a Significant Improvement Test at least every five years.
This means that the Government must consider whether meeting its long-term targets, alongside any other relevant statutory environmental targets, would significantly improve the natural environment in England. The first test will be conducted by January 2023, three months after the October 2022 deadline for the long-term priority targets to be laid before parliament.

Recommendation
Long-term targets for biodiversity, set out under the Environment Bill, and associated timeframes must be outcome-based and linked directly to the goals set out in the Government's 25-YEP. Department: Defra, Timing: June 2022.

Without legally binding interim targets which are linked to clear legally binding long-term targets, it is likely that the ten 25 YEP goals and future EIPs will become aspirational.

Interim targets should be placed on a statutory footing to compel action now.
Interim targets will also be included in the EIPs, which will set out government's five-year trajectory, progress of which will be updated annually. However, the interim milestones are non-mandatory meaning there is nothing to compel the Government to act now to meet targets, or to take future remedial action where targets are missed. Without legally binding interim targets which are linked to clear legally binding long-term targets, it is likely that the ten 25 YEP goals and future EIPs will become aspirational.

Recommendation
Interim targets for biodiversity must be made statutory and linked clearly to the long-term targets set out in the Environment Bill. Department: Defra, Timing: June 2022.

Has the risk management score changed?

No, the score remains low.

Indicators available to monitor the vulnerability of priority terrestrial habitats and species show no progress, or a decline. The majority of targets set out in the Government's Biodiversity 2020 strategy have not been met, with many falling well short.

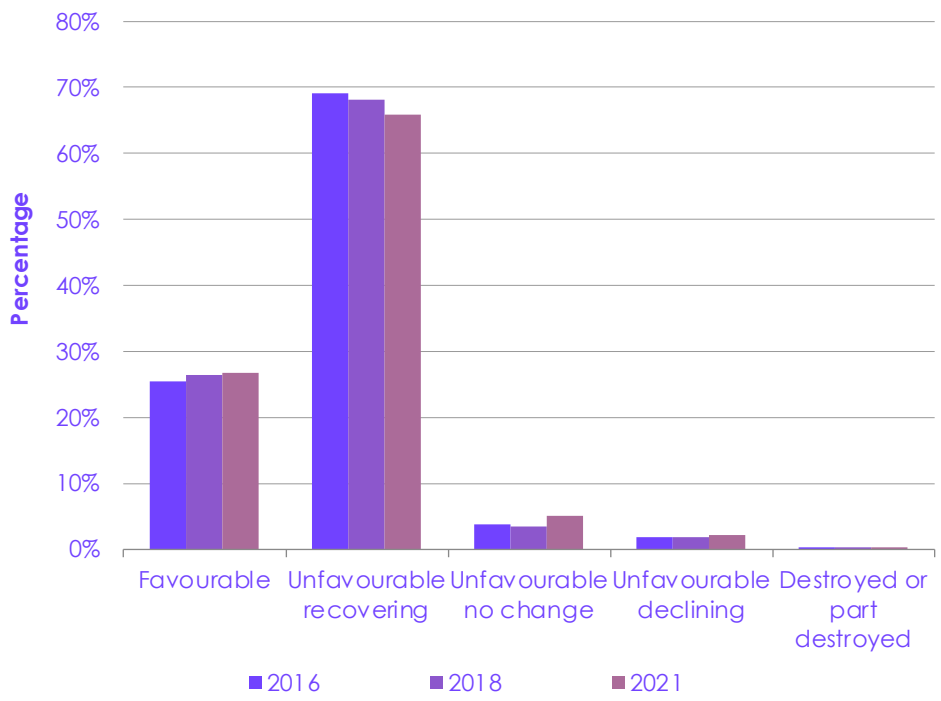
Indicators available to monitor the vulnerability of priority terrestrial habitats and species show no progress, or a decline.

Changes in habitat condition and species abundance (whether impacted by climate change or not) act as proxy indicators for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are This aligns to the idea in the Lawton Review that ecosystems will withstand the risks from climate change more effectively if other pressures on them are reduced.

The Biodiversity 2020 strategy[11] contained a goal to achieve at least 50% of sites of special scientific importance (SSSIs) in favourable condition, while maintaining at least 95% in favourable or recovering condition.

There has been little change in the condition of terrestrial SSSIs.
The proportion of terrestrial SSSIs* in England classed as in either 'favourable' or 'unfavourable recovering' condition declined from around 94% in 2016 to around 93% in 2021 (see figure 2.1). Within that, protected sites classed as in 'favourable' condition increased by 2% over the same period, although these represent only 27% of total terrestrial sites.

Figure 2.1 Terrestrial SSSIs in England, by condition

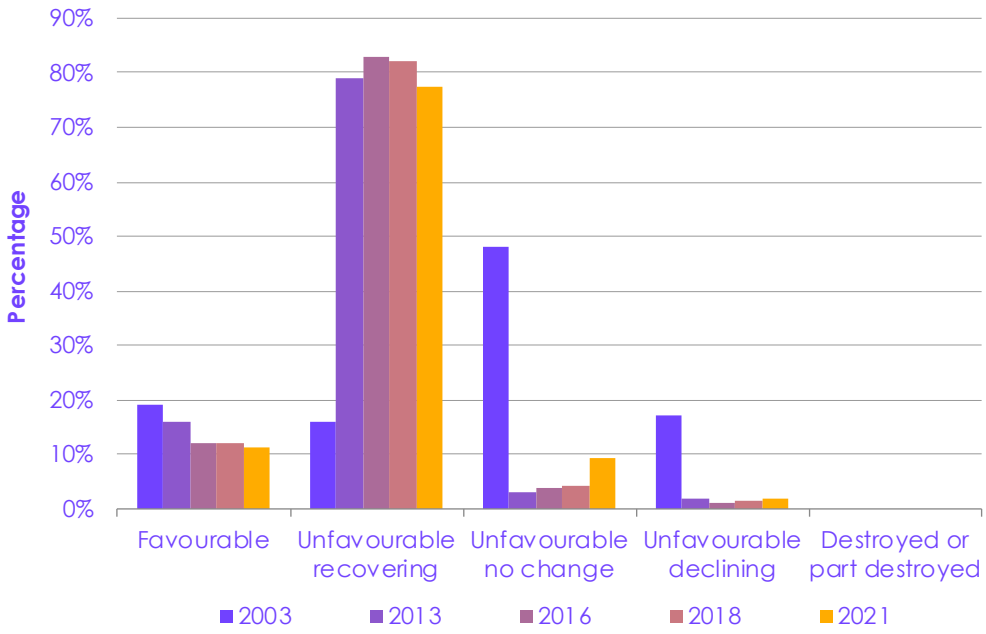


Source: Natural England, https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx

The percentage of upland peat SSSIs in favourable or unfavourable recovering condition has dropped since 2016.
Approximately half of upland peatland in England are designated as SSSIs (51% as at 2018).[12] Since 2016, there has been a decrease in the area of upland peat blanket bog SSSI sites classed as in 'unfavourable recovering', down from 83% to 78% in 2021 (figure 2.2). This has coincided with an increase in sites classed as 'unfavourable no change', up from 4% in 2016 to 9% in 2021.

* Also referred to as protected sites.

Figure 2.2 Upland blanket bog SSSIs in England, by condition



Source: For 2016 to 2021 data see Natural England: https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx
For 2003 and 2013 data, see ECI (2013) for the CCC, Assessing preparedness of England's natural resources for a changing climate

Without routine national monitoring of soil condition in England, it is difficult robustly assess the progress being made in managing vulnerability to climate change. The last national assessment of soil condition in England was published as part of the 2007 Countryside Survey, while the National Soil Inventory, which also covers soil condition, was last conducted 2003. As noted above, draft proposals for the soil health action plan indicate it will include a number of actions that support sustainable soil management and implementing new measuring and monitoring schemes for soil health

Without routine national monitoring of soil condition in England, it is difficult robustly assess the progress being made in managing vulnerability to climate change.

As part of the Nature for Climate Fund (see above) initiative Defra has commissioned a project to deliver an updated peatland map. The project's aim is to map England's peatlands by determining peat location, depth, condition and extent to improve spatial prioritisation of restoration work and more accurately estimate greenhouse gas emissions. The peatland map is scheduled to be delivered by 2024 and will form a part of the England Peat Action Plan.

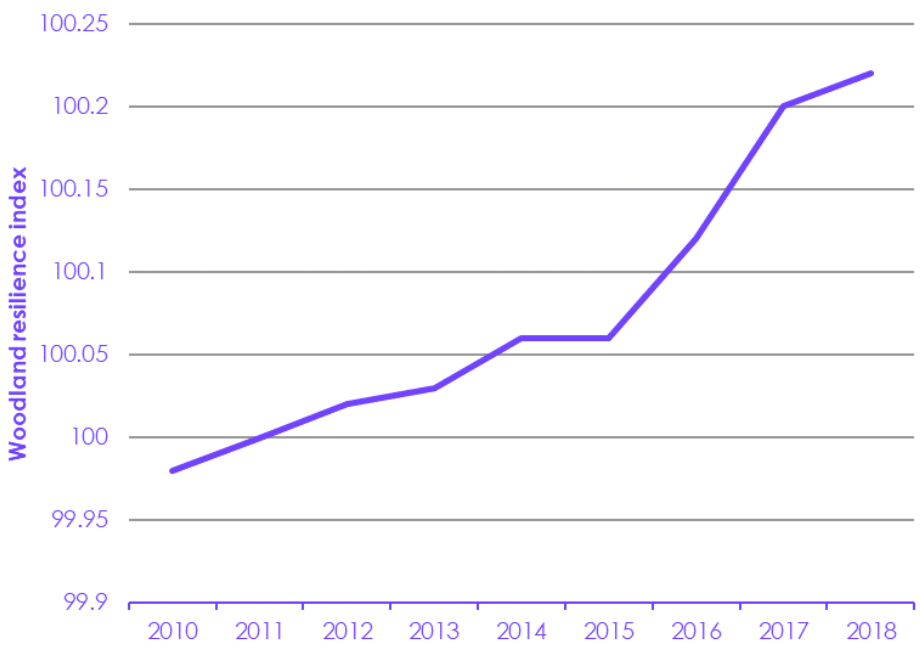
UK CEH also started a scaled down version of the Countryside Survey in 2019, using a UKRI-NERC- funded research platform with an annual rolling program to measure soils and vegetation repeated every five years.

The aim is to revisit all the grid squares surveyed in 2007 survey, but with a reduced set of measurements, focusing on plant monitoring and soil sampling for basic soil chemistry. The impact of Covid-19 has caused delays to the survey since 2020, although it is understood it has recommenced.

Some progress appears to have been made in improving woodland connectivity. Maintaining and improving connectivity is important in promoting biodiversity in a fragmented landscape, especially under a changing climate. However, it is very challenging to measure at the national scale.

The Forestry Commission has made some progress in this area, through its woodland resilience indicator, measured as the size and spatial configuration (i.e. connectivity) of patches of forests and woodlands, relative to 2011 values (assigned as 100). This indicator shows a consistent year-to-year increase in connectivity for forests and woodlands in England between 2011 and 2018 (figure 2.3).

Figure 2.3 Measure of woodland resilience to climate change



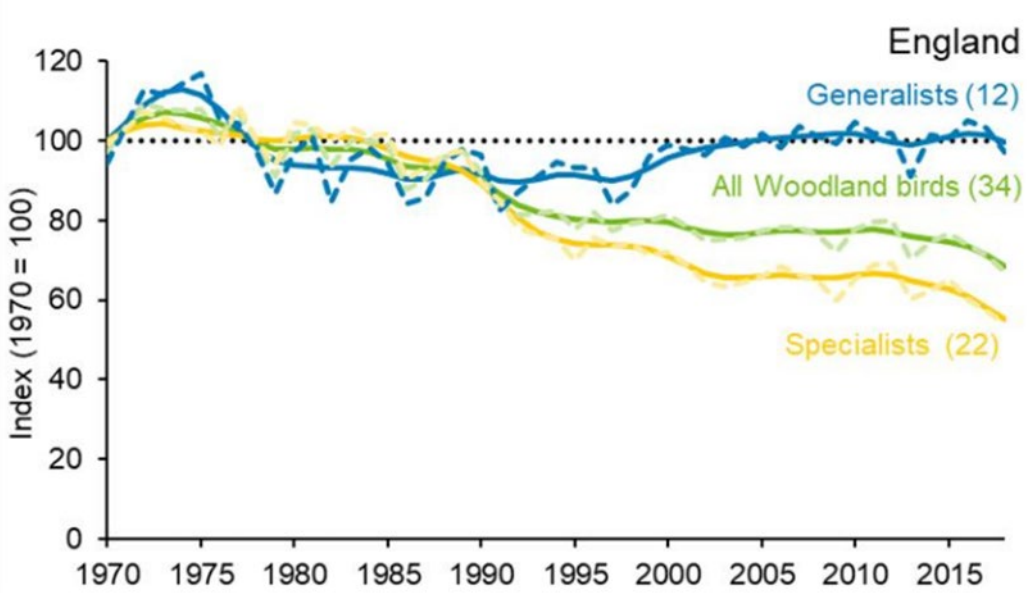
Source: Forestry Commission
Notes: Area of woodland created with support from the Rural Development Programme for England: both the English Woodland Grant Scheme (EWGS) and the Countryside Stewardship incentives. Areas of private-sector funded planting or planting supported by other Government funding streams are relatively small and not included.

Woodland bird species diversity is still declining.
Woodland ecosystems that are less diverse are less resilient to changes in climate, and indeed, other pressures. Species groups such as birds and butterflies provide a good indication of the broad state of the natural environment

Woodland species indicators suggest declining trends for both the long-and short-term.

Woodland species indicators suggest declining trends for both the long-and short-term. Between 1970 and 2018, the index for woodland bird specialists declined by 45% while the index for woodland bird generalist species increased by 3% (see figure 2.4). The long-term decline of the woodland bird indicator in England has been mostly driven by the decline of specialist woodland birds such as willow tit, spotted flycatcher and lesser redpoll (species restricted to or highly dependent on particular woodland habitats). A recent report by the Woodland Trust[13] also found just 7% of Britain's native woodlands are currently in good ecological condition.

Figure 2.4 Specialist and generalist woodland birds in England



Source: Defra biodiversity indicators 2020 update.
Notes: 1. The line graph shows the unsmoothed trends (dashed lines) and smoothed trends (solid lines). 2. The figures in brackets show the number of species in each index.

There has been an increase in the number of wildfires and area burnt between 2015 and 2019.

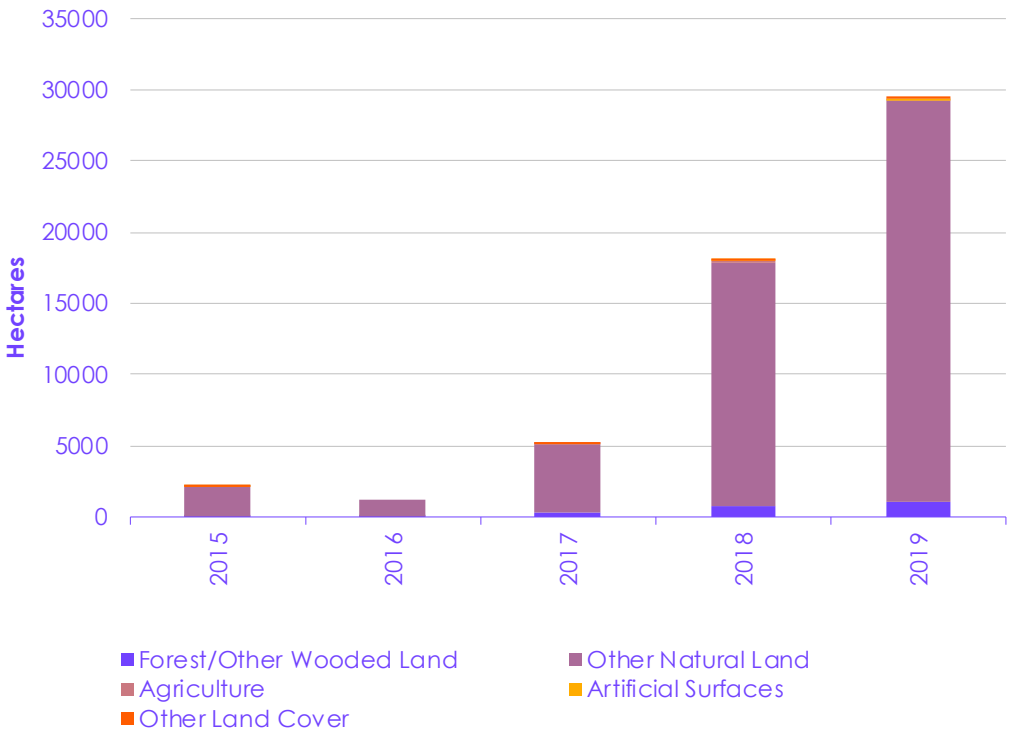
Wildfire is an emerging risk that requires more attention in adaptation planning, so we include it as an impact indicator here.[14]

The number of recorded wildfires in the natural environment have increased significantly since 2015.

Delays due to COVID-19 mean Forestry Commission has not been able to produce an update on wildfire statistics since the 2016-17 reference period. However, UK-wide data from the European Forest Fire Information System (EFFIS) suggest that the number of recorded wildfires have increased over the last few years, from less than 20 during 2015 to 2017, increasing to 79 in 2018 and 137 in 2019.[15] These data concur with analyses of Forestry Commission wildfire statistics data for England published in our 2019 progress report. In terms of the UK area burnt by wildfires, this has increased significantly in the last few years, from around 2,000 hectares in 2015 to 18,000 hectares in 2018 and 29,000 hectares in 2019 (figure 2.5).

The majority of the area burnt each year was classified as 'other natural land' and accounted for around 95% across each of the five years (2015-2019). This suggests that the majority of large wildfires over 30 hectares in size occur in natural habitats, rather than e.g. agricultural land.

Figure 2.5 Total UK wildfire area burnt, per annum, split by land cover class.



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England.*
Notes: Area burnt (hectares) by wildfires larger than 30 hectares in size.

2.3 Farmland habitats and species

Progress summary – Farmland habitats and species		
2019 score:	**What has changed since 2019:**	**2021 score:**
1	**Plan score - low** • The forthcoming Environmental Land Management scheme has the potential to form a comprehensive plan to improve the resilience of the farmed countryside to climate change. The scheme's three-level design and the focus on 'payments by results' should support this. However, plans to date indicate adaptation is still not given sufficient consideration: it is not clear how climate risks will be incorporated in the delivery of private and public good outcomes, while explicit payments for actions that reduce vulnerability to climate change are still limited to flood risk. **Risk management score – low** • Long-term downward trends in abundance indicators for key farmland species suggest agri-environment schemes have had only limited impact on managing pressures on biodiversity to date. Habitat condition indicators show the proportion of protected farmland habitats in favourable/ improving condition remains relatively high, but they only represent ca.1% of total farmland areas.	1
Notes: See annex for full datasets Key Indicators: SSSIs in the farmed countryside, by condition, Changes in abundance of species (birds, butterflies) in the farmed landscapes (England), Changes in abundance of plant species in arable farmland habitat types (UK) –Experimental		

The farmed countryside is the largest land use class across the UK, occupying around 70% of land area.[16] It is exposed similarly to the current and future pressures from climate change as those facing the terrestrial habitats and species priority. However, farmland areas are also exposed to significant other pressures from agricultural practices meaning they are likely to be highly vulnerable to climate change, hence we assess them separately.

Summary of 2019 report score

In our last report, Farmland habitats and species scored a 1 (low plan score, low risk management score).
Our 2019 progress report highlighted that the adaptation plans in place for the farmed countryside would not be sufficient to address the risks identified in the Second UK Climate Change Risk Assessment. On progress in managing risk, we highlighted that the decline in abundance for key species in the farmed countryside suggest Agri-Environment schemes had had limited impact on managing pressures on biodiversity.

Has the plan score changed?

No, the plan score remains low.

While the Environmental Land Management scheme (ELM) has the potential to foster a sustained improvement in the condition of farmland habitats and species, plans to date indicate climate change adaptation is still not given sufficient consideration.

Plans to date for the Government's proposed Environmental Land Management scheme indicate climate change adaptation is still not given sufficient consideration.

As outlined in the Government's second national adaptation programme (NAP2), the Government is currently working to develop a new long-term land management payments strategy to replace the former Common Agricultural Policy (CAP). The Environmental Land Management (ELM) scheme set out in the Agriculture Act 2020 will be a key mechanism in supporting the Government to improve the condition of the farmed countryside. Under current plans, the ELM scheme aims to deliver outcomes under six categories of public goods as identified in the 25-YEP: clean air, clean and plentiful water, thriving plants and wildlife, reducing risk from environmental hazards, mitigating and adapting to climate change, and enhanced beauty, heritage and engagement with the natural environment. Activities to improve and protect soil health will be central to delivering on these goals, although current plans do not include it as an outcome in itself. Existing plans for the scheme propose a three-scheme payment structure, with each one targeting a different geographic scale: These comprise:

- Sustainable Farming Incentive Scheme; pays farmers and land managers for actions taken (beyond regulatory requirements) to manage land in an environmentally sustainable way.

- Local Nature Recovery Scheme; pays for actions that support local nature recovery and deliver local environmental priorities. The focus is ensuring the right things are delivered in the right places.

- Landscape Recovery Scheme; supports the delivery of landscape and ecosystem recovery through long-term, land use change projects. This includes projects to restore wilder landscapes in places where that is appropriate, large-scale tree planting, peatland and salt marsh restoration projects.

The piloting and implementation of the three future schemes will be funded by gradual reductions in current Basic Payment Scheme* payments between 2021 to 2027.

ELM has the potential to form a comprehensive plan to improve the resilience of biodiversity in the farmed countryside to climate change.

The three-level scheme design and the focus on 'payments for outcomes' (e.g. clean water) should support this. In particular, the Local Nature Recovery and Landscape Recovery schemes have the potential to drive systemic change, while the broader landscape focus of the latter could help deliver mitigation and adaptation co-benefits.

The Government must build adaptive capacity through ensuring the local context is considered in ELM.

The Government must build adaptive capacity through ensuring the local context is considered in its Environmental Land Management Scheme.

The best use of land to support the delivery of public goods will vary depending on the local ecological and geographical context. The changes that are needed will differ across the UK because the effects from climate change will vary spatially, as well as the quantity and condition of natural capital assets, local needs and demands. For instance, as noted in section 2.1, carefully considered tree planting that ensures the right trees are planted in the right places can help deliver the Government's objectives for adaptation and mitigation. However, it is not yet clear how this spatial element of ELM will work.

* The Basic Payment Scheme (BPS) is the European Union's rural grants and payments to help the farming industry under the Common Agricultural Policy (CAP)

It is vital that ELM design recognises adaptation as a necessary pre-requisite to meeting the scheme's other public good outcomes, and this is reflected in actions the schemes will pay for.
Mitigating and adapting to climate change Is one of the six environmental public goods that will be rewarded under the ELM schemes to contribute to delivering the 25-Year Environment Plan (25-YEP). Work is being undertaken to determine the specific actions the schemes will pay for, and quantify their contribution to mitigating and adapting to climate change alongside other policy levers. Defra has confirmed that this is being informed by detailed modelling, which will also test the resilience of these actions to climate uncertainty. Previous analysis by the CCC [17] has shown how difficult this is to do at a national level and that providing the right tools for local decision making may be a better approach from an adaptation perspective. Further details on the schemes will be published later in 2021.

An integrated response to climate change, agriculture and the environment is needed.
ELM must sit within a wider suite of climate and environmental policies. Defra has yet to set out how ELM, the Environment Bill, the 25-YEP and various policies planned for trees, peatlands and biodiversity will fit together. As noted in section 2.2, it is unclear how the different strategies together will support the Government's climate change adaptation goals.

It is vital that ELM design recognises adaptation as a necessary pre-requisite to meeting the scheme's other public good outcomes, and this is reflected in actions the schemes will pay for.

Defra has reported ongoing targeting of Agri-Environment Schemes (AES), such as Countryside Stewardship, on the maintenance and restoration of special sites of scientific interest (SSSIs) to deliver favourable condition of farmed habitats.
Several research projects have been completed to evaluate and clarify the extent to which different factors may be inhibiting or masking the progress towards shifting SSSIs in AES to favourable condition, with a view to improving the implementation of current schemes and informing the development of future AES.[18] NAP2 also includes an action to conduct research on the resilience of AES to climate change, which has been completed. While there is evidence to suggest the range of activities incentivised through AES are making some contribution to improving the resilience of the farmed countryside,[19] biodiversity indicators for Farmland species show continuing declines in populations (see below). With the farmed countryside representing over two-thirds of land cover in England, analysis of progress is hindered by the same issues around monitoring as terrestrial habitats and species (section 2.2).

The England Peat Action Plan includes activities to restore over 5,000 hectares of lowland agricultural land.
Under the Plan, the Government has committed to restoring 35,000 hectares of degraded peatland in England by 2025. Of this, the Government's aim is for 15% of the area restored by 2025 to involve the restoration of lowland agricultural land to peat habitat. This compares to the CCC's recommendation in its Sixth Carbon Budget report for the restoration of 8,000 hectares of lowland peat by 2025.

Has the risk management score changed?

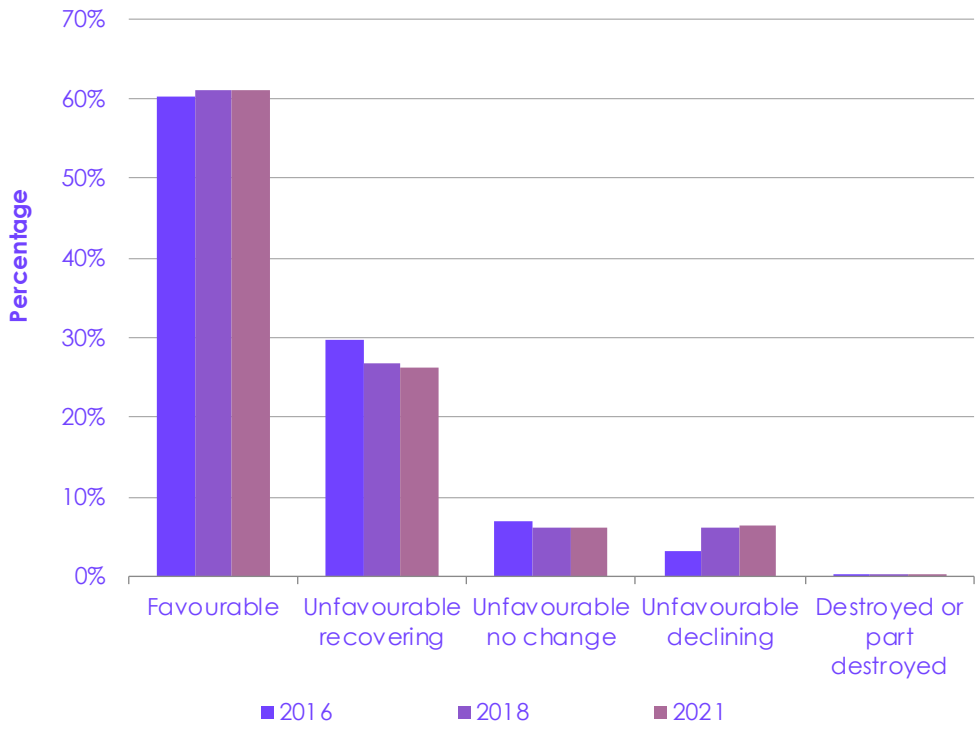
No, the risk management score remains low.

Indicators show there has been no reversal in the long-term downward trend in abundance indicators for key farmland species, suggesting AESs have had only limited impact on managing pressures on biodiversity to date.
As noted above, the vast majority of land in England is farmed in some way[20] – so how this land is managed has a big impact on its condition and resilience to climate change.

Data available on the percentage of SSSIs in the farmed countryside that are in favourable or unfavourable recovering condition remains relatively high (87%). However, designated sites such as these represent a very small proportion (less than 1%)[21] of the total area of farmed habitats (figure 2.6).

Indicators show there has been no reversal in the long-term downward trend in abundance indicators for key farmland species.

Figure 2.6 Farmland SSSIs in England, by condition

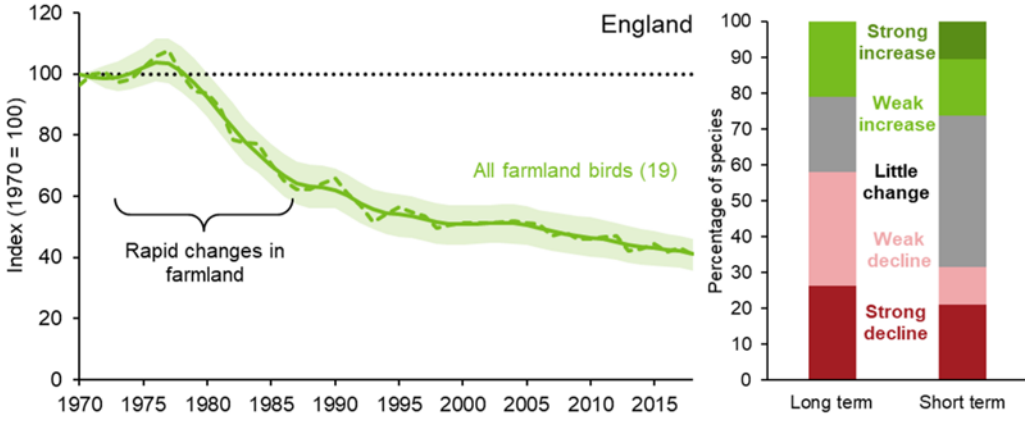


Source: Natural England, https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx

Breeding bird numbers on farmland in England are less than half the levels recorded in 1970.

According to the Lawton principles, habitats need to be in good condition, bigger, and more joined up in order to have a greater chance of allowing the species they support to adapt naturally as the climate changes. Species groups such as birds and butterflies provide a good indication of the broad state of the farmed environment. In 2018, the England farmland bird index was less than half (43%) of its 1970 value (see figure 2.7). The majority of the decline occurred between the late 1970s and early 1980s at a time of rapid changes in many farmland management practices. Declines have continued in recent years, albeit at a slower rate.

Figure 2.7 Breeding birds on farmland in England



Source: Defra biodiversity indicators 2020 update.
Notes. 1. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded). 2. The figure in brackets shows the number of species in the index. 3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change.

Hedgerow habitats support resilience of the farmed countryside to climate change, but the absence of current data mean it is not possible to assess recent trends in their condition.

Hedgerows are an important feature of agricultural landscapes. They deliver a range of biodiversity benefits by providing food and shelter for a range of birds, insects and mammals. They also facilitate movement through the landscape by providing respite for organisms such as flying insects.[22] Hedgerows also provide wider environmental benefits and regulatory services such as increasing water quality and regulation, increasing air quality, reducing flood risk, reducing soil erosion, maintaining climate regulation through carbon sequestration, and promoting pollination and pest control by providing habitat for pollinators and predators of crop pests. By acting as a physical barrier at a field edge, hedgerows are able to reduce the amount of fertiliser, pesticides and sediment, which may be included in surface water run-off, from reaching watercourses. They can also contribute to managing the flow of water run-off, which can support in reducing peak flows and the risk of flooding across the catchment.

Managed hedgerows provide significant value, both to farmers and wildlife, however, if these are neglected the value can greatly reduce or become negligible.[23] Similarly, where hedgerows are lost, the benefits associated with the hedgerows are lost alongside this, which can have negative impacts for biodiversity and regulatory services, and also result in an increase in carbon emissions.

In 2006, it was estimated that only 22% of the UK's hedgerows were in a favourable state.[24] Furthermore, between 1984 and 2007, there was a 24% decrease in the length of 'managed' hedgerows in Great Britain. However, the absence of recent data on the condition and extent of hedgerows in England means that it is currently difficult to determine whether progress is being made in managing the vulnerability to climate change of this vital farmland habitat.

2.4 Freshwater habitats and species

Progress summary – Freshwater habitats and species		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • The score has remained at medium. The Environment Agency has incorporated findings from national level risk assessments that consider climate impacts under 2°C & 4°C scenarios into the River Basin Management Plan revisions process. However, current plans still do not give adequate consideration of risks to freshwater habitats from higher water temperatures and there is still no clear mechanism that accounts for the consequences of reductions in quality or flows due to climate change in meeting Government targets. **Risk management score – low** • The score has changed to low from medium. Available freshwater species metrics indicate populations remain stable. However, there has been a recent decrease in the proportion of protected freshwater sites in 'favourable' or 'unfavourable recovering' condition, while broader measures of the health of all surface water bodies indicate persistent long-term declines in ecological status. New evidence shows water temperatures in freshwater environments have consistently exceeded their long-term mean in recent decades.	3
Notes: See annex for full datasets Key Indicators: Protected freshwater sites in England, by condition, Proportion of water bodies in England meeting good status, Breeding wetland birds in England, England water temperature index - Annual variance from long-term mean		

This adaptation priority covers all semi-natural freshwater habitats and the species they contain as classified by Natural England; rivers, streams, standing open water and canals. At a UK level, freshwater habitats cover around 12% of land.[25]

Freshwater habitats provide a wide array of important ecosystem services, including water supply (see section 2.8) pollution removal, and recreation (e.g. fishing and tourism). The annual value of these services, to the UK, has been estimated at approximately £1.3 billion per annum.[26] Though this estimate does not include all relevant ecosystem services, it will likely represent an undervaluation.

Summary of 2019 report score

In our last report, freshwater habitats and species scored a 5 (medium plan score, medium risk score).
Our 2019 assessment found that while plans were in place to incorporate evidence on climate impacts under a range of future warming scenarios into the third cycle of the River Basin Management Plan, the revisions lacked adequate consideration of risks to the freshwater environment from higher water temperatures. On progress in managing risk, we highlighted that while the percentage of designated freshwater sites in favourable condition was improving, broader measures of the ecological condition of all surface water bodies assessed as part of the Water Framework Directive (WFD) indicated a worsening trend.

Has the plan score changed?

No. The score remains the medium.

EU protections for the water environment in England have been fully transposed into UK law and thus have remained in place following EU exit.
Historically, the European Union Water Framework Directive (EU WFD) has provided the framework for the management of freshwater resources in England. The EU legislation, and accompanying environmental standards and targets, were translated into UK law prior to the UK leaving the EU. They will continue to operate under the policy of "roll-over". The UK Government's Environment Bill also includes provision for water resources management now that the UK has left the EU.

Plans are in place that consider the impact of reduced water availability as a result of climate change, contain clear outcomes and align to the goals for freshwater habitats outlined in the 25-Year Environment Plan (25-YEP).

River Basin Management Plans (RBMPs) are a requirement of the UK Water Framework Directive (WFD) regulations and alongside national and river basin district activity, adopt a catchment-based approach, setting out how organisations, stakeholders and communities will collaborate to improve the environmental quality of fresh and saline water bodies. The RBMPs set out the actions that will be taken in England to improve the water environment (quality, quantity and habitat) and achieve statutory water body objectives by specified timescales. The Environment Agency are continuing the statutory process of reviewing and updating the third cycle of the RBMPs originally scheduled for publication in 2021, although it is understood the timetable may be revised in light of challenges due to the Covid-19 pandemic (e.g. obtaining stakeholder participation in the process).

The need to adapt to changing climatic conditions has been identified as integral to the RBMPs, which represent one of the Government's key mechanisms to achieving its goals for water habitats set out in the 25-YEP. To support this, the Environment Agency has completed a programme of work to ensure that climate change projections of temperature, precipitation and sea level rise are in the RBMP revisions process. An early stage of the RBMP review process is to undertake a public consultation on significant water management issues (the challenges and choices consultation). As part of this stakeholders were encouraged to consider the impact of a changing climate on water, including considering environmental impacts from 2°c and 4°c warming scenarios through tools such as the Environment Agency's climate change impact tool. Within the RBMPs, catchment partnerships have also been given the opportunity to outline the priorities for their catchments. To help them do this they have been given high level risk assessments to help consider challenges such as climate change. The ambition is next to develop the assessments at a more local level so as to build a better understanding of local impacts from climate change.

There is currently no clear mechanism in place that accounts for the consequences of changes in water temperature for meeting the WFD targets.

More detail is needed on how freshwater habitats will support the Government's strategy to build resilience to flood risk in England.
The Environment Agency's 2020 Flood and Coastal Erosion Risk Management (FCERM) strategy, outlines plans to make greater use of nature-based solutions (NbS) that take a catchment led approach to managing the flow of water to improve resilience to floods. Natural flood risk management (NFM) measures, such as restoring rivers and improving soil structure will build climate resilience through enhancing freshwater habitats' ability to slow the flow of or store flood waters.

However, it is not clear currently clear which NFM measures are being considered to support the strategy.

Guidance to inform land managers and advisors on actions to mitigate risks from higher water temperatures do not make sufficient consideration of impacts under different warming scenarios.
In order to address the risks to freshwater species from higher water temperatures, more research is needed to refine further the strategic approach to riparian tree planting to provide cooling for species that are sensitive to higher temperatures.[27]

At present, however, there is no clear mechanism in place that accounts for the consequences of changes in water temperature for meeting the WFD targets. Risks from increasing water temperatures, combined with changes to flow, will make meeting and maintaining the WFD targets even more challenging.

NAP2 includes an action to develop guidance and tools to help practitioners address risks to freshwater habitats and species from high water temperatures. The rivers and streams section of the 2020 update to the Natural England and RSPB Adaptation Manual (see also section 2.2) highlights risks posed by warming temperatures to freshwater species; the role of riparian trees in addressing them; and the wider role of the restoration of natural function and processes in providing resilience. The guidance emphasises the importance of considering 2°C and 4°C warming, but does not outline how to assess actions under different warming scenarios.

The document also signposts the Woodland Trust's 'Keeping Rivers Cool: A Guidance Manual' for more detailed information. Tree planting is supported by Countryside Stewardship, targeting of which is informed by spatial data layers, including the Keeping Rivers Cool layer that Natural England and Forestry Commission advisors can access internally, and applicants can access via the Forestry Commission's web-browser. Forest Research will also publish a Riparian Woodland Practice Guide (see section 2.6) over the coming months to support implementation of the UK Forestry Standard.

Recommendation
Set out a clear mechanism to account for the consequences of higher water temperatures and low flows (including drying up) in water bodies for freshwater habitats and species, and for meeting the WFD targets. This is lacking in current plans to revise the River Basin Management Plans (RBMPs). Department: Environment Agency, Timing: June 2022.

Has the risk management score changed?

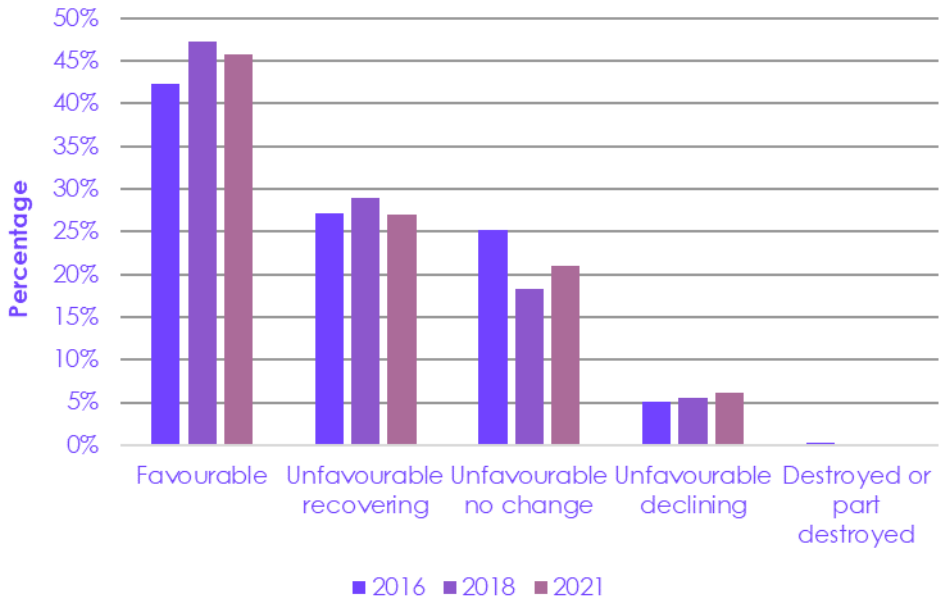
Yes, the risk management score has decreased from medium to low.

Data on the percentage of protected freshwater sites in 'favourable' or unfavourable recovering' condition suggest a recent decline, while the ecological condition of all surface water bodies assessed as part of the WFD continues to worsen.
Protected freshwater sites of special scientific interest (SSSIs) represent only around 8% of the total area of freshwater habitats in England, but are the only habitats for

which condition data is available.* The latest data from Natural England on the condition of freshwater SSSIs show a slight decrease in proportion of sites in 'favourable' condition from 47% in 2018 to 46% in 2021, although they remain higher than 2016 (42%) (see figure 2.8). There has also been a decline in freshwater habitats classed as 'unfavourable recovering', down to 27% in 2021 from 29% in 2018.

There has been a recent decrease in the proportion of protected freshwater sites in 'favourable' or 'unfavourable recovering' condition, while broader measures of the health of all surface water bodies indicate persistent long-term declines in ecological status.

Figure 2.8 Freshwater SSSIs in England, by condition



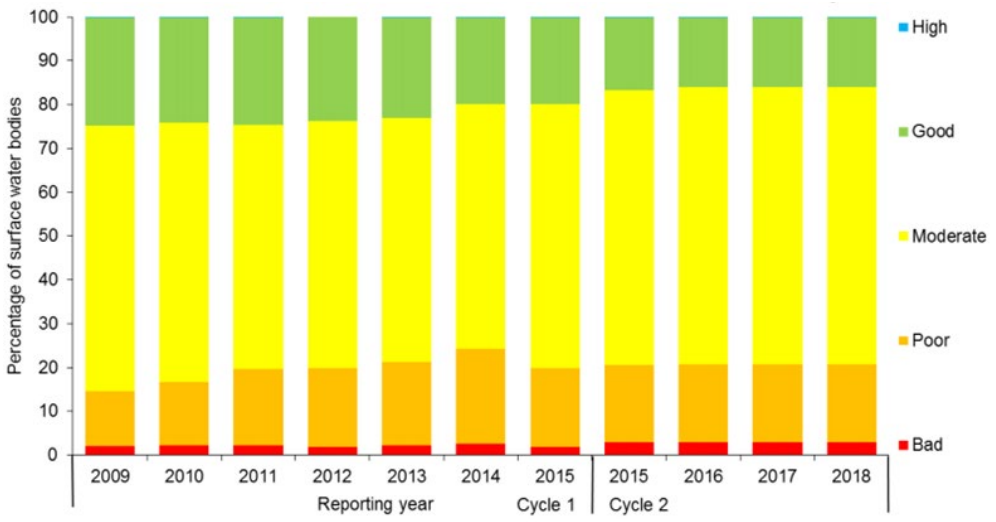
Source: Natural England, https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx

In England, the Environment Agency has responsibility for monitoring and reporting on the status of surface water bodies and the reasons why good ecological status has not been achieved. There has been a decrease in the proportion of surface water bodies in England awarded high or good ecological status classification under the WFD since the indicator was first prepared in 2009 (figure 2.9). In 2018, only 16% of surface water bodies assessed under the WFD were in high or good status compared with 25% in 2009 and 23% in 2013. Declines have continued in recent years, albeit at a slower rate.

* 8% calculated by comparing area of designated rivers and streams, and standing open waters and canals according to Natural England designated sites data, with data on total area of freshwater habitats published in the ONS Land Cover Account as at 2007

In 2018, only 16% of surface water bodies assessed under the WFD were in high or good status compared with 25% in 2009.

Figure 2.9 Status classifications of surface water bodies in England under the Water Framework Directive

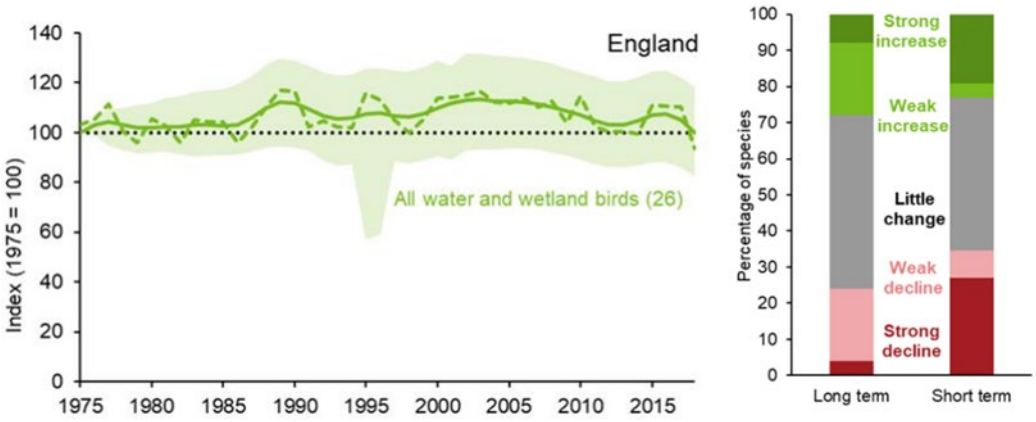


Source: Source: Defra biodiversity indicators 2020 update.
Notes. 1. Based on the numbers of surface water bodies classified under the Water Framework Directive (WFD) in England. 2. Surface water status is a composite measure that looks at both the chemical status and the ecological (including biological and habitat condition) status of a water body. The classification scheme for surface water ecological status includes five categories: high, good, moderate, poor and bad. 'High status' means no or very low human pressure. 'Good status' means a 'slight' deviation from this condition, 'moderate status' means 'moderate' deviation, and so on. Around 5,000 water bodies are assessed each year, including rivers, canals, lakes, estuaries and coastal waters.

Species abundance (whether impacted by climate change or not) is used as a proxy indicator for the vulnerability of biodiversity as a whole, as they give a sense of how 'under pressure' different systems already are.* Wetlands, including rivers, lakes, ponds, reedbeds, grazing marshes and lowland raised bogs provide important habitats for breeding wetland birds. The water and wetland bird index has remained relatively stable for most of the period since data collection started in 1975. In 2018 the index was 9% lower than in 1975 (Figure 2.10). Numbers rose slightly in the early 2000s with the smoothed index showing a non-significant 2% increase between 2012 and 2017.

* This is based on the idea in the review that ecosystems will withstand the risks from climate change more effectively if other pressures on them are reduced.

Figure 2.10 Breeding wetland birds in England



Source: Defra biodiversity indicators 2020 update.
Notes: 1. The line graph shows the unsmoothed trend (dashed line) and the smoothed trend (solid line) together with its 95% confidence interval (shaded). 2. The figure in brackets shows the number of species in the index. 3. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change, based on set thresholds of annual change.

Higher water temperatures will increase the degradation of freshwater habitats, and compromise the viability of some freshwater species.[28] A recent assessment of climate-driven thresholds in UK freshwater habitats[29] looked at potential risks from temperature driven incidents of harmful algal blooms (HAB) in lakes. Such blooms can have wide ranging economic impacts, including on property values, water treatment costs, tourism and fisheries revenue. The study found present impact costs per annum from HAB in England under a 4°C warming scenario were predicted to increase by around 70% by the 2050s and almost triple by the 2080s.

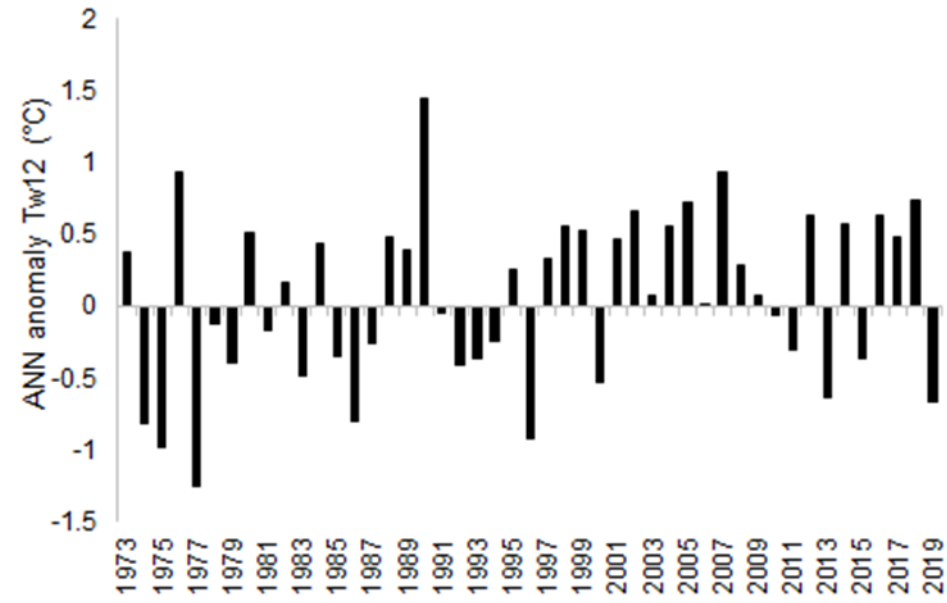
Water temperatures across England have been consistently above their long-term average in recent decades.
Average annual water temperatures across England have been consistently above their long-term mean over the 2000-2019 period; 16 out of last 20 years for southern England, and 13 out of last 20 years for northern England (figure 2.11a and figure 2.11b).

Figure 2.11a Southern England water temperature index - annual variance from long-term mean

Source: Wilby, R.L. and Johnson, M.F. (2021). National water temperature indicators for England. In preparation.

Water temperatures across England have been consistently above their long-term average in recent decades.

Figure 2.11b Northern England water temperature index - annual variance from long-term mean



Source: Wilby, R.L. and Johnson, M.F. (2021). National water temperature indicators for England. In preparation.

2.5 Coastal and marine habitats and species

Progress summary – Coastal and marine habitats and species		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • The adoption of a further seven regional marine plans by summer 2021, taking the total to 11, will cover the whole of the marine environment in England. This meets the Government's 25-YEP commitment to complete the full series of England Marine Plans by 2021. • The plans use UKCP18 projections to evaluate the potential longer-term risks and opportunities from climate change. However, only public authorities are duty bound under law to apply the plan policies to their decisions, meaning there is significant gap in the protections they are designed to provide to marine habitats. • The English component of the UK's contribution to a network of protected areas in the north east Atlantic is now complete, following the addition of 41 marine conservation zones in the third phase of designations, and taking the total to 91. • The non-statutory status of Shoreline Management Plans limits their effectiveness as a long-term strategy. **Risk management score – medium** • Condition indicators for protected marine and coastal habitat areas in England suggest a stable to improving situation, however, for the former these cover only around 40% of the total marine area. New research suggests climate change is already affecting UK coasts and seas.	5
Notes: See annex for full datasets Key Indicators: MCCIP report cards, Coastal SSSIs in England, by condition - Extent of marine protected areas, Breeding seabirds in England, Combined input of hazardous substances to the UK marine environment.		

This adaptation priority covers all coastal and marine habitats and the species they contain around England.

The analysis of changes in risk vulnerability focuses on coastal and marine sites identified as being of nature conservation importance, as these are areas for which data is most available. For coastal habitats, this comprises sites which are designated under the Wildlife & Countryside Act 1981 as supporting habitats and/or species of national importance.* A relatively high proportion of coastal priority habitats in England (between ca. 80% to 95% dependent on habitat type) fall within protected areas.[30]

For marine habitats, we assess sites classified as being Marine Protected Areas (MPAs), which cover around 40% (92,633 km^2) of English inshore and offshore waters combined.† The total extent of MPAs is the combined area of: Nationally designated sites; National Nature Reserves (NNR), and Marine Conservation Zones (MCZ)); Internationally designated sites (Special Protection Areas (SPA) and Special Areas of Conservation (SAC)) under the European Union's Birds and Habitats

* Also referred to as Sites of Specific Scientific Importance (SSSIs)

† English inshore waters contain 157 MPAs covering 51% of this region (26,126 km2). English offshore waters contain 40 MPAs covering 37% of this region (66,507 km2): https://jncc.gov.uk/our-work/uk-marine-protected-area-network-statistics/

Directives respectively; and Ramsar sites under the Convention on Wetlands of International Importance.

Summary of 2019 report score

In our 2019 report, Coastal and marine habitats and species scored a 5 (medium plan score, medium risk score).
The assessment highlighted that plans are in place to conserve and improve marine and coastal habitats, which include requirements to consider how marine planning can take climate change into account. However, none included specific proposals to adapt to the key climate risks facing the marine environment. On progress in managing risk, available indicators suggested some improvement, although it was noted that more research was needed to assess the extent to which adaptive actions could increase the resilience of marine habitats and species to impacts from changes in acidity, dissolved oxygen content, temperature and ocean stratification.

Has the plan score changed?

No – score remains the same.

Marine Plans for the whole of the English area use UKCP18 projections to evaluate the longer-term risks and opportunities from climate change to marine habitats and species. Marine Protected Areas (MPAs) including Marine Conservation Zones (MCZs) are one of many factors considered within marine plans.
The UK Marine Strategy (UKMS) provides a three-part regulatory framework for delivering marine policy at the UK level and sets out how the Government will achieve the vision of clean, healthy, safe, productive and biodiverse seas. The strategy includes overall ambitions for the marine environment, the targets to be achieved and the method to achieve those targets. Defra is currently investigating the possibility of incorporating climate considerations in UKMS assessments going forward.[31]

The imminent adoption of an additional seven marine plans will meet the Government's 25-Year Environment Plan (25-YEP) commitment to complete the full series of England Marine Plans by 2021.

The adoption of a further seven regional marine plans by summer 2021, taking the total to 11, meets the Government's 25 Year Environment Plan commitment to complete the full series of England Marine Plans by 2021.

Marine plans are developed by the Marine Management Organisation (MMO) and are agreed and adopted by Government under requirements laid out in the Marine and Coastal Act 2009. The plans set out statutory government policy to inform decision-making in the marine area. The environmental objectives and specific policies within the marine plans are informed by the high-level objectives, targets and indicators within the Marine Strategy. There are 11 Marine plans for the whole of the English marine environment in different stages of development.

Four Marine Plans have been officially adopted in England (see Table 2.2). Draft proposals for the remaining seven contain a number of policies to build the resilience of marine habitats to climate change. These include requiring plans to: demonstrate resilience to the impacts of climate change; ensure resilience to the impacts of climate change on the marine protected area network; protect adaptation measures already in place; protect habitats that provide carbon sequestration ecosystem services; not have significant adverse impacts on coastal change.

Table 2.2
Status of English Marine Plans in England

Plan	Status	Review
Marine Plan for East inshore and East offshore areas inshore and East offshore areas	Adopted 2014	Decision taken by government in 2020 to update. Update scoping begins in 2021.
Marine Plan for South inshore and South offshore areas	Adopted 2018	First 3-year review to be completed in 2021, includes a recommendation to government on whether to amend or replace.
Draft Marine Plan for the North East inshore and North East offshore areas Draft Marine Plan for the North West inshore and North West offshore areas Draft Marine Plan for the South West inshore and South West offshore areas	Published for consultation 2020 – plans are a material consideration in decision making at this stage. Final adoption expected Spring 2021 - this will complete the first round of marine plans for all English seas.	1st review will be complete 3 years after adoption, including a recommendation on whether to amend or replace.

Source: MMO

The Marine and Coastal Access Act (2009) sets out requirements for Marine Plans to take into account risks from climate change.
While marine plans do not outline actions, and are not therefore SMART (see Chapter 1), the policies they contain are targeted as they relate to specific environmental concerns, and set out clear policy outcomes. The MMO considers a range of climate change scenarios, including UKCP18, when developing options to address the issues identified as relevant for marine planning. Under provisions set out in the Marine and Coastal Access (MCA) Act 2009, there is a statutory three-yearly review and reporting cycle, while the twenty-year lifetime of each plan makes them timebound.

The statutory requirements of marine plan policies apply to decisions taken by public authorities only, meaning plans have a limited reach for managing activities of private organisations or other sea users that are not subject to public authority regulation.
Section 58(1) of the MCA Act states that public authorities must take authorisation or enforcement decisions in accordance with the relevant marine plan policies. Furthermore, public authorities must have regard to relevant marine plan policies when exercising functions capable of affecting the marine area (Section 58(3)). However, only public authorities are duty bound under law to apply the policies. The plans only influence private organisations and other sea users if their activities require a public authority consent or authorisation, or if their activity is regulated and managed through other public authority functions, for example byelaw making powers, at which time marine plan policies will be taken into account by the relevant public authority. Furthermore, even at current levels, there is not enough evidence that sufficient financial and other resources are allocated for enforcement.

Recommendation
The statutory requirements of marine plan policies must be extended to the decisions of public and private organisations. At present only public authorities are duty bound under law to apply the plan policies to their decisions meaning there is significant gap in the protections they are designed to provide. Department: Environment Agency, Timing: June 2022.

The Fisheries Act 2020 and forthcoming Environment Bill should both create added protections for coastal and marine habitats and species.
The Fisheries Act extends the powers of national authorities with regard to marine conservation in the UK. Under the Act, the Government will implement an ecosystem-based approach to fisheries management to make sure that negative impacts of fishing activities on the marine ecosystem are minimised, and to avoid degradation of the marine environment. Climate change is one of the eight objectives under the Act (see section 2.8 for further details).

Through the Environment Bill, the Government is setting the ambitious target of having all Marine Protected Areas (MPAs) in England in favourable condition by 2043. A legally binding target for MPAs will complement and bolster on-going work and existing legal obligation under the MCA Act and Conservation of Habitats and Species Regulations 2017 to meet established conservation objectives, by providing focus for the ambitions with clear aims and deadlines.[32]

The English component of the UK's contribution to a network of marine protected areas (MPAs) in the north east Atlantic is now complete.
MPAs are designated by government under the Marine and Coastal Access Act 2009 to conserve the diversity of nationally rare, threatened and representative habitats and species. The second national Adaptation Programme (NAP2) includes an action to 'establish MCZs to contribute to an ecologically coherent network of Marine Protected Areas around England'. A third tranche of 41 sites was designated in May 2019 taking the total to 91.

Marine plan authorities are required to take account of the regime for MPAs and comply with obligations imposed in respect of them. This includes the obligation to ensure that the exercise of certain functions contribute to, or at least do not hinder, the achievement of the objectives of MCZs.

Government has completed analysis on controlling invasive non-native species (INNS) in the marine environment.
In May 2019, the Government published a pathway analysis (as required then by EU Regulations) which identified three priority pathways for controlling INNS in the marine environment: (i) hull fouling, (ii) ballast water and (iii) contaminants of aquaculture animals. Further measures to provide increased prevention have been identified including: (i) ensuring vessels arriving or leaving UK waters have stringent hull cleaning and (ii) all ships to have a ballast water management plan.

The non-statutory status of Shoreline Management Plans limits their effectiveness as a long-term strategy.

The Committee's view is that the policy decisions within Shoreline Management Plans must be made statutory to ensure they are implemented.
Shoreline Management Plans (SMPs) provide a framework to plan for coastal adaptation, investment and spatial planning over a 100-year time horizon (see also section 3.3). The Flood and Coastal Erosion Risk Management (FCERM) strategy notes the Environment Agency is working with coastal groups to refresh the SMPs in England to ensure they consider a range of future climate scenarios and are informed by the best available evidence, including the latest climate change projections. At present, it is not clear how this will be factored into revised plan

outcomes (including for both climate change responses and protecting habitats and species). The non-statutory status of SMPs severely undermines their effectiveness as the main vehicle that coastal authorities have to outline and implement their long-term strategy to prepare for the impact of climate change on coastal habitats and species.

Has the risk management score changed?

No. The 'medium' score remains unchanged from 2019.

The proportion of protected coastal habitats in 'favourable' or 'unfavourable recovering' condition remains relatively high, while the extent of marine protected sites continues to increase.

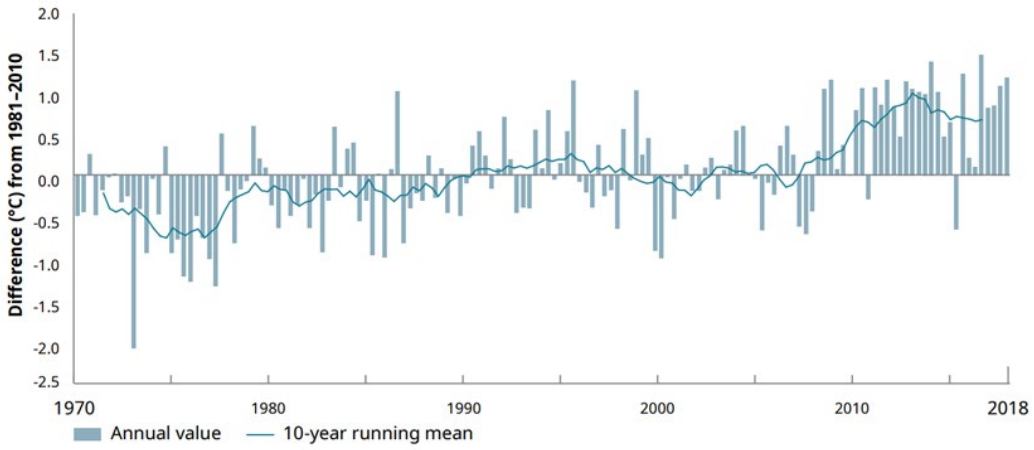
The indicators we have available to measure progress in adaptation of the coastal and marine environment include the condition of coastal sites of special scientific interest (SSSIs), and the area (but not condition) of marine protected sites. Indicators showing inputs of hazardous materials into the marine environment are also used as a proxy indicator of wider pressures that would reduce resilience to climate change overall. Unlike for terrestrial and freshwater habitats, the underlying hazard metrics that will affect marine biodiversity are also more straightforward to identify and so we include changes in these; sea surface temperature, and pH levels.

Coastal sea surface temperatures have consistently been above their long-term average in recent decades.

Changes in temperature of the seas around England can significantly influence the functioning of marine ecosystems. Long-term records show a warming trend in UK waters, despite short-term natural variability. On average, coastal sea surface temperatures have been 0.6°C warmer in the most recent decade compared to the 1961–1990 average (figure 2.12). Furthermore, eight of the 10 warmest years for UK sea surface temperature have occurred since 2002.

On average, coastal sea surface temperatures have been 0.6°C warmer in the most recent decade compared to the 1961–1990 average.

Figure 2.12 Average annual sea surface temperatures for UK coastal waters, expressed as anomalies relative to the 1981 to 2010 average



Source: State of nature report, 2019
Notes: The blue bars show the annual anomalies relative to the 1981–2010 average, shown as the grey horizontal line, and the blue line shows the 10-year running mean.

Adaptation plans outlined in NAP2 include the publication of climate impact evidence report cards by the Marine Climate Change Impacts Partnership.
The UK Marine Climate Change Impacts Partnership (MCCIP) is a partnership between scientists, government, governmental agencies, non-governmental organisations (NGOs) and industry. Its 2020 report card covered 26 marine and coastal topics, supported by detailed peer reviewed topic reports which showed that:

- There is clear evidence that warming seas, reduced oxygen, ocean acidification and sea-level rise are already affecting UK coasts and seas. Increasingly, these changes are having an impact on food webs, with effects seen in seabed-dwelling species, as well as plankton, fish, birds and mammals.

- The upper range for the latest UK sea-level rise projections is higher than previous estimates, implying increased coastal-flood risk. The likelihood of compound effects from tidal flooding and extreme rainfall is increasing, which can greatly exacerbate flood impacts.

- Oxygen concentrations in UK seas are projected to decline more than the global average, especially in the North Sea.

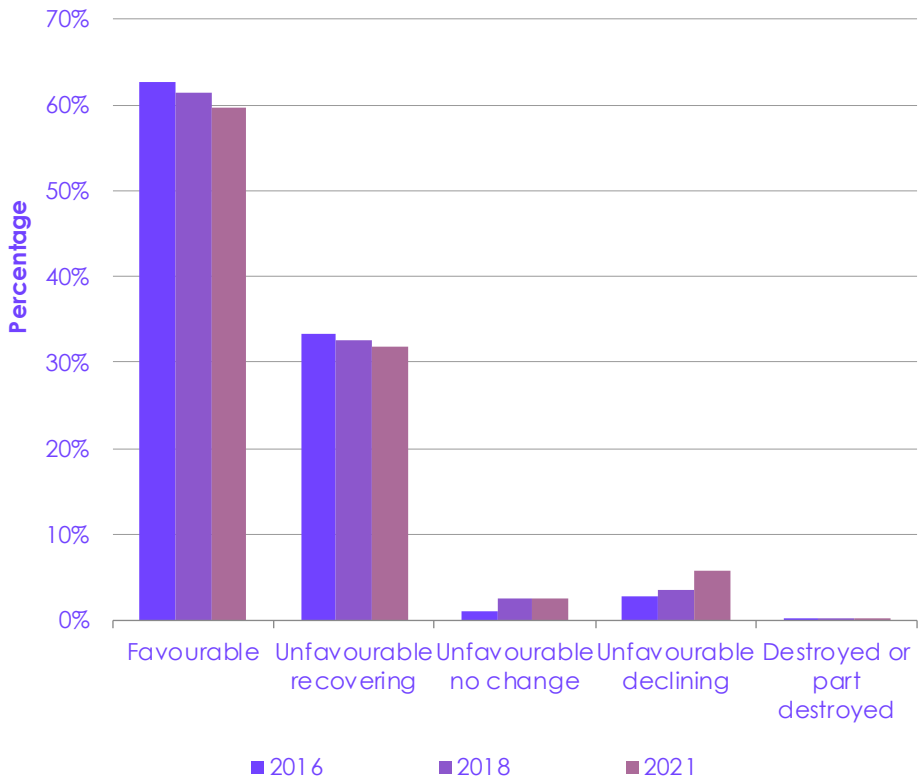
- Impacts of climate change have already been observed at a range of heritage sites. Coastal assets will be subjected to enhanced rates of erosion, inundation and weathering or decay.

New research suggests climate change is already affecting UK coasts and seas.

The MCCIP have a new 5-year programme (2020-2025) currently underway. From 2021 onwards, the report cards will be replaced by rolling updates of marine climate evidence.

There has been a decline in the overall condition of protected coastal sites.
The proportion of coastal sites of special scientific interest (SSSIs) classed as in 'favourable' or 'unfavourable recovering' condition, declined from 96% in 2016 to 92% 2021 (see figure 2.13), but remains relatively high compared to terrestrial and freshwater habitats (see section 2.2 and section 2.4).

Figure 2.13 Coastal SSSIs in England, by condition



Source: Natural England, https://designatedsites.naturalengland.org.uk/NEInterimReports/ConditionByHabitat.aspx

The area of marine protected sites around England have more than doubled since 2015.

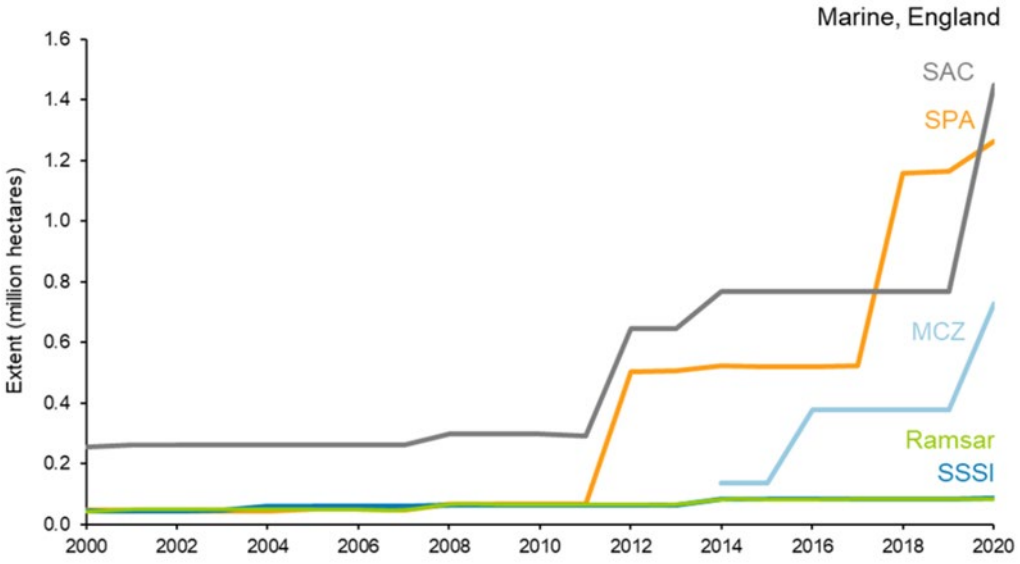
A well-designed and effectively managed network of marine protected areas (MPAs) is not just important for wildlife: it supports key sectors like tourism and recreation, safeguards habitats that store carbon, and enables fish stocks to replenish.[33] Increasing the area of MPAs is deemed to enhance the ability of marine habitats to manage vulnerability by reducing pressures through improving its condition. However, as noted above, without comprehensive powers to legally enforce marine plan policies, there is significant gap in the protections MPAs are designed to provide.

In the five years to 2020, the area of marine protected sites around the coast in England has more than doubled to 2.4 million hectares.

In the five years to 2020, the area of marine protected sites around the coast in England has more than doubled to 2.4 million hectares (Figure 2.14). A large contributor to this has been the designation of inshore marine sites under the European Birds and Habitats Directives.

As noted above, MCZ have also contributed substantially to the increase in the area of inshore marine sites around England, with the third phase of designations in May 2019 resulting in an increase of over 726,000 hectares.

Figure 2.14 Extent of national and European protected sites at sea in England, by designation



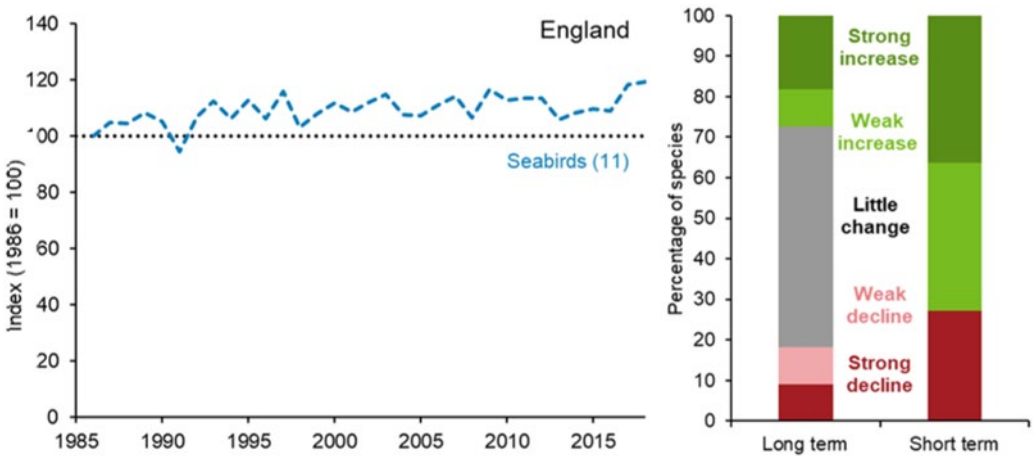
Source: England biodiversity indicators 2020
Notes: 1. The extent of protected sites is the cumulative area assessed in March of each year shown. 2. Marine sites between mean low water and the 12 nautical mile limit are included; sites beyond 12 nautical miles, in UK waters, are excluded. These are included in the UK indicator on protected sites.

It should be noted that no data is currently available on the condition of non-protected sites.

There have been some improvements in the abundance of breeding seabirds in England (although this trend is not seen when looking UK-wide).
As top predators, seabirds are key indicators as to the magnitude of climate-induced changes in the marine realm; specialist seabirds in particular are known to also be very vulnerable to its impacts.[34] Generally, seabirds have highly specialised diets, being reliant on just a few prey species, the abundance and distribution of which can alter dramatically in response to abrupt environmental changes.

England's coastline and offshore islands provide nesting sites for around seven million seabirds. Although fluctuating, the relative abundance of a suite of breeding seabird species has increased steadily since the late 1990s (Figure 2.15), recorded at the highest level in 2018, 19% higher than in 1986. Also, since 1986, a greater percentage of species show short term rather than the longer-term increase in abundance. However, this pattern is not reflective of the broader trend for breeding seabirds at the UK level, which has shown a 22% decline over the 1986 to 2015 period.[35] The difference could be due to the higher proportion of breeding seabirds being located outside of English marine waters.

Figure 2.15 Abundance of breeding seabirds in England



Source: Defra biodiversity indicators 2020 update.

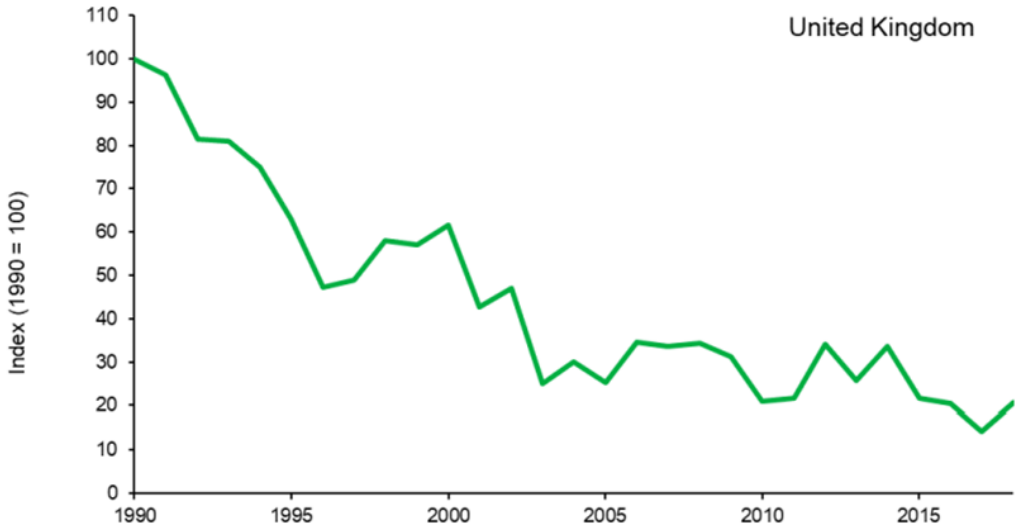
It is essential that regulatory protections around the emission of hazardous substances into marine environment be maintained and strengthened.

Regulations on the emission of hazardous substances into the marine environment must not be relaxed if recent gains are to be retained.

Reducing human stressors, such as pollution, on the marine environment helps strengthen its resilience to other pressures, including climate change and supports continued provision of ecosystem services. Trend data from the combined input of six of the most hazardous substances to the UK marine environment indicate a long-term decrease (-79% since 1990) (Figure 2.16). The introduction in 2018 of a new set of rules (as outlined in NAP2) for farmers and land managers to prevent pollutant emissions, protect water quality and improve soil health,[36] should continue to support the downward trend in emissions to the marine environment*. However, it is essential that such regulatory protections around the emission of hazardous substances into marine (and broader) environment be maintained and strengthened if the gains achieved over recent decades are to be retained.

* The rules set out what farmers must do or, consider to, manage risks posed by manures, manufactured fertilisers and soils through runoff, erosion and leaching.

Figure 2.16 Input of hazardous substances to the marine environment



Source: Defra biodiversity indicators 2020 update.
Notes: This indicator provides the combined input of six of the most hazardous substances to the UK marine environment: five heavy metals (cadmium, mercury, copper, lead and zinc) and one organic compound (lindane).

2.6 Commercial forestry

Progress summary – Commercial forestry		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • Several medium quality adaptation plans are in place, although none directly consider climate impacts under different warming scenarios, supported by a set of actions. A guide to help forest managers and owners meet the adaptation requirements of the UK Forestry Standard will be published later in 2021. • The Forest Industry still lacks a measurable goal for managing and reducing the impact of pest and diseases on trees in England. **Risk management score – medium** • There is mixed progress with the percentage of woodland under active forest management still below the target, while the number of high priority forest pests in UK Plant Health Risk Register is up 72% since 2015. However, the diversity of trees planted across the forests in England continues to increase.	5
Notes: See annex for full datasets Key Indicators: Percentage of woodland in England under active management, Percentage of conifer and broadleaf species planted on the Nation's Forests, Total number of wildfire incidents in woodlands in England, Number of high priority forest pests in the UK Plant Health Risk Register.		

Summary of 2019 report score

In our 2019 report, Commercial forestry scored a 5 (medium plan score, medium risk score).
Our 2019 report found that climate change adaptation plans, which contain clear actions and outcomes, exist for the forestry sector, however, these lack clear targets and are near-term in risk outlook. Progress towards managing risk was mixed, with the Forestry Commission's target for increasing the area of forest under active management missed, although the diversity of tree planting continued to increase.

Has the plan score changed?

No. The score is unchanged from 2019.

Adaptation plans are in place but these do not directly consider climate impacts under different warming scenarios, supported by a set of actions.
The Forestry Commission has produced adaptation guidance for woodland management ('Managing England's woodlands in a Climate Emergency'), providing practical advice to landowners to manage climate change impacts on woodland. This document presents a summary of key climate change impacts covering different combinations of climatic drivers, and possible adaptation strategies for England's woodlands and forests including diversification of species, genetics, and stand structure.

While some consideration is given to possible impacts under future climate change in the guidance, these are more generic and not directly based on a range of warming scenarios.

A UK Forestry Standard (UKFS) Practice Guide on adaptation is expected to be published during 2021.
The guide aims to help forest managers and owners meet the adaptation requirements of the UKFS. The guide has been drafted and is undergoing Government review at time of writing. However, there is still limited information on how much of this adaptation guidance is actually being implemented, especially in the private forestry sector.

There are online tools available to support practitioners select suitable tree species under climate change.
The Climate Matching Tool provided by Forest Research shows regions in Europe with a similar current climate to the climate projection for any UK location. It is designed to help practitioners to consider the selection of better suited tree species from environments that England may experience in the future. Underpinning the tool is UKCP18 climate data at 12km resolution using the RCP8.5 pathway in future projections. The climate matching tool should be seen as complementary to the Forest Commission's Ecological Site Classification tree selection tool, which shows how trees will perform in a future climate but does not take into account adaptation.

The Forestry sector has developed a set of outcome-based actions, linked to specific climate threats, however, current plans lack timebound targets and do not take sufficient consideration of future climate impacts under different warming scenarios.

At present there is no measurable goal for managing and reducing the impact of pest and diseases for forestry, and a clear deadline for achieving them.

The Government's Tree Health Resilience (THR) Strategy aims to improve the capacity of woodlands to adapt under climate change through minimising the impact of pests and diseases, as well as building resilience through selection of species and provenance. However, at present the 25-YEP and NAP2 do not include a measurable goal for managing and reducing the impact of existing plant and animal diseases including for forestry, and a clear deadline for achieving them.

The Forestry Climate Change Working Group (FCCWG), a cross-sector initiative, has developed a well-planned set of outcome-based actions to enhance the protection against pests and diseases over the next 5 years (published in 2018 as the Action Plan for Climate Change Adaptation of forests, woods and trees in England). The plan is integrated into the activities associated with the THR strategy. While the Plan contains a range of outcomes (24 in total) aligned, in varying degrees, to each of the priority actions, the outcomes do not include specific targets and timeframes over which to meet them. The FCCWG published its progress report in late 2019, which highlighted that despite progress in research and ongoing policy discussions, insufficient progress has been made in implementing adaptive actions.[37]

Defra has published an England Tree Action Plan.

The England Tree Action Plan indicates the Government will develop a Woodland Resilience Implementation Plan to improve the ecological condition of woodlands in England.

Under the Plan, the Government has committed to supporting the FCCWG in implementing its adaptation plan. It will also launch a climate change competition to highlight best forestry practice, and the need to adapt new and existing woodlands to the effects of climate change (see also section 2.2). The Plan indicates the Government will develop a Woodland Resilience Implementation Plan to improve the ecological condition of woodlands in England and increase their resilience to climate change, including pests and diseases. It is understood there will also be requirements associated with choosing resilient species under the English Woodland Creation Grant.

Has the risk management score changed?

No. The risk management score remains medium.

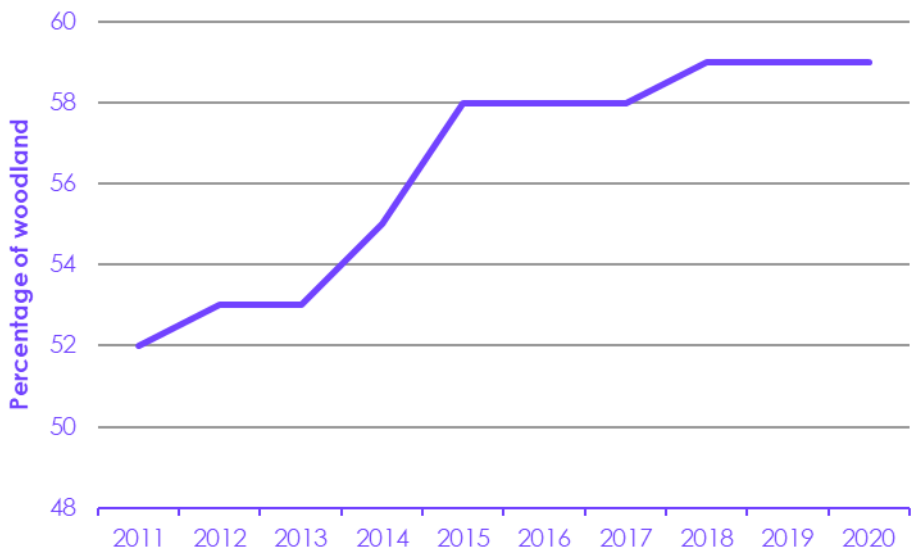
The percentage of woodland under active management has increase from 52% in 2011 to 59% in 2020, although it has remained largely unchanged since 2015.

The proportion of woodland under active management has remained largely unchanged since 2015.

Active woodland management for climate change adaptation involves anticipating future changes in temperature, rainfall, wildfire, and other extreme events to reduce risk exposure to both forestry and other ecosystem services and to thereby increase forest resilience. Immediate adaption of forests and woodland to the changing climate is critical if society is to continue to benefit from the range of services they provide to wildlife, people and continue to produce timber for future generations. Active management, therefore, is an essential pre-requisite to proactively adapting commercial and other forests to climate change.

The percentage of woodland under active management has increase from 52% in 2011 to 59% in 2020, although there has only been a 1% increase since 2015 (Figure 2.17). The Government announced new funding to bring woodlands into management and increase sector capacity in the March 2020 budget as part of the Nature for Climate Fund (see Section 2.2).

Figure 2.17 Percentage of woodland in England under active management, by area size (hectares)



Source: Forestry England.
Notes: As of 2020, 59 out of every 100 hectares of English woodland are actively managed, totalling 764,000 hectares of woodland in management.

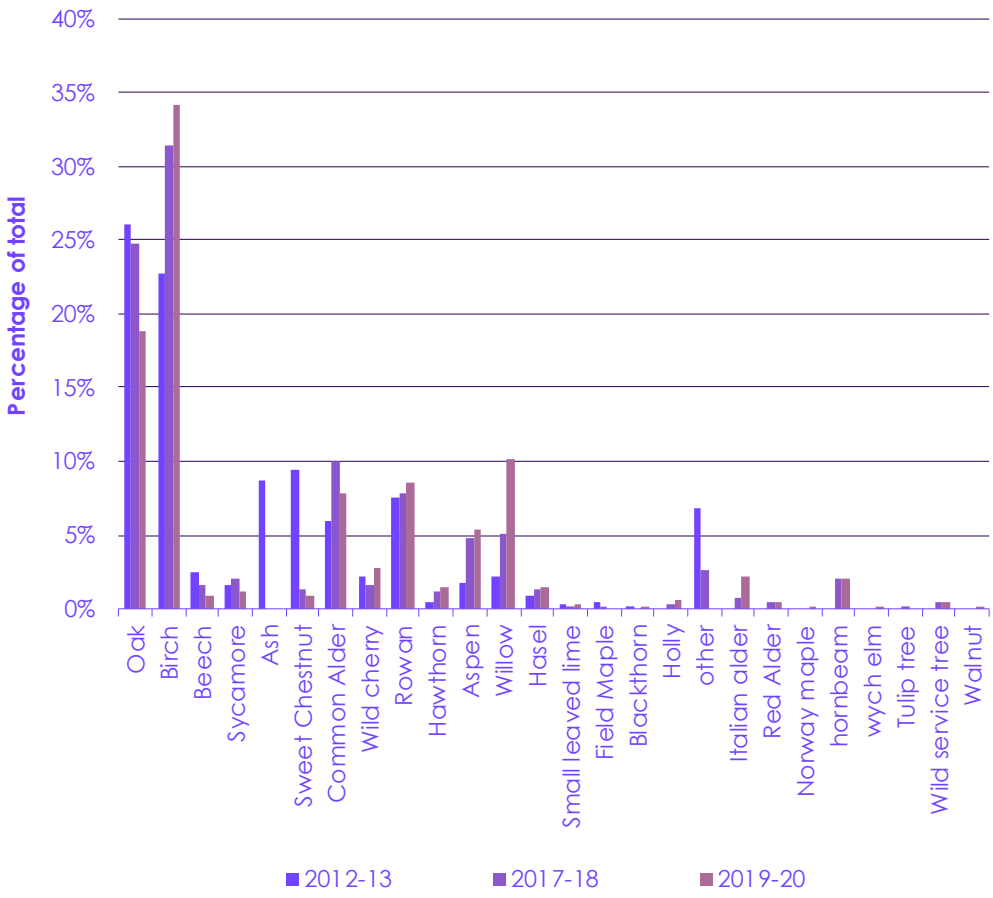
There has been a consistent increase in the diversity of conifer and broadleaved species being planted each year.

The number of different broadleaf species planted continues to rise; 23 major broadleaf species were planted in England's forests in 2019-20, up from 22 in 2017-18, and up from 17 in 2010-11 (see figure 2.18).

Increasing the diversity of tree species in new planting schemes is an important adaptation strategy designed to reduce threats from pests and diseases, and to help manage uncertainties around the suitability of particular species to future climate conditions.

There has been a consistent increase in the diversity of conifer and broadleaved species being planted each year.

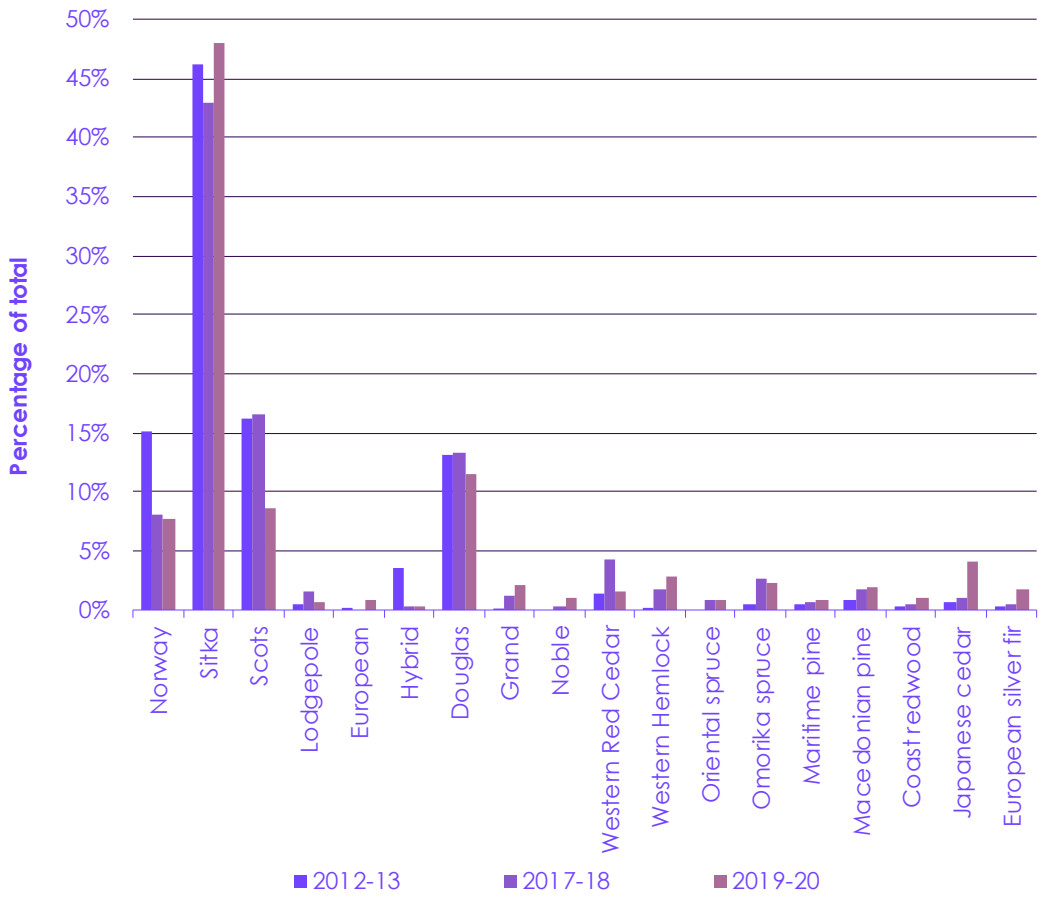
Figure 2.18 Percentage of broadleaf species planted in England's forests



Source: Forestry England.
Notes: Other species for 2017-18 include grey alder 1.3%, wild service tree 0.5%, eucalyptus 0.5%.

The trend has also been positive for the diversity of conifer species. In 2019-20, 17 different major species of conifer tree were planted by Forestry England in the Nation's forests, up from 14 in 2017-18, and up from 8 in 2010-11 (Figure 2.19).

Figure 2.19 Percentage of conifer species planted in England's Forests

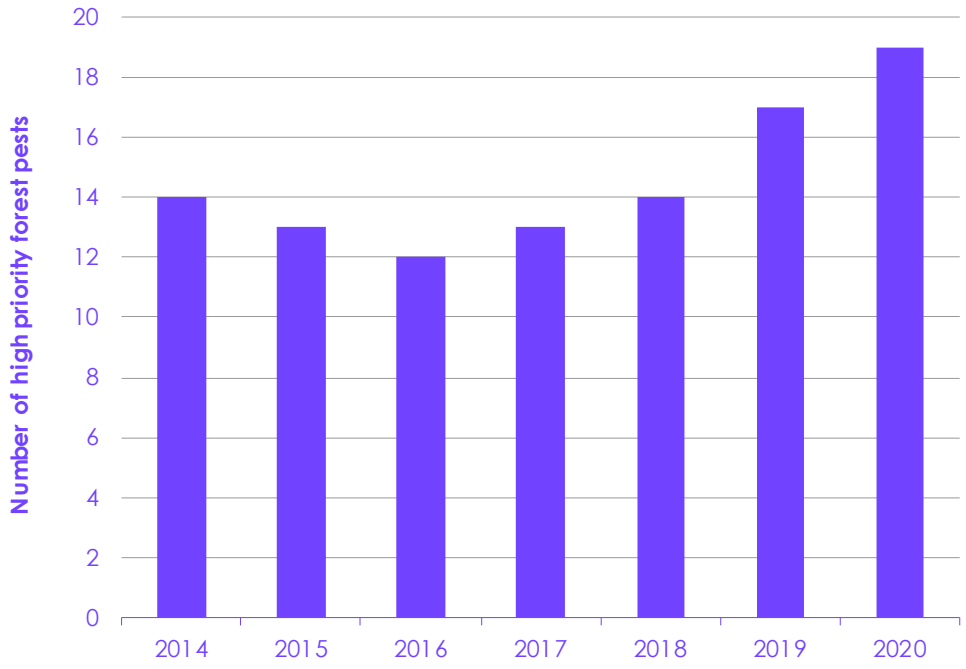


Source: Forestry England.

Data on the number of high priority forest pests indicates a rise over the short-term. Pests, pathogens and invasive non-native species present serious risks to forest productivity, with consequences for livelihoods and businesses, as well as for the multiple ecosystem services that forests provide. The relationship of this risk with climate change is complex. Each problem species or micro-organism has its own specific climatic and ecological sensitivities that can favour their increased incidence. This includes parameters related to maximum and minimum temperature, moisture (both precipitation and specific/relative humidity can have an influence), and potentially wind (notably direction); these typically act in combination and are also related to duration or frequency of outbreaks.[38]

Despite evidence of actions to build resilience of England's forests to pests and diseases, the number of high priority forest pests in the UK Plant Health Risk Register (UKPHRR) has increased sharply in recent years, rising from 12 in 2016 to 19 in 2020. Although the data presented in figure 2.20 are for the UK, the UKPHRR report that nearly all listed forest pests present in the UK will also be present in England.

Figure 2.20 Number of high priority forest pests in the UK Plant Health Risk Register (UKPHRR)



Source: Forestry England.

2.7 Agricultural productivity

Progress summary – Agricultural productivity		
2019 score:	**What has changed since 2019:**	**2021 score:**
1	**Plan score - low** • Defra still lacks a strategy to ensure the agricultural sector remains productive as the climate changes. ELM plans to date are still limited largely to flood risk management, and do not consider the broader range of climate impacts (e.g. drought, pests and diseases) on agricultural productivity. • There is some evidence of sector-led activity, although plans to date are narrow in scope (e.g. focusing only on drought and flood risks) and do not account for the effects of climate change under a range of future warming scenarios. **Risk management score – low** • Although there have been declines in water abstraction by farmers, it is not clear if this represents any reduction in vulnerability to water scarcity. Additionally, while there is evidence of actions taking place to build the resilience of the sector, there are few appropriate indicators (e.g. soil health, agricultural R&D) to support effective assessment.	1
Notes: See annex for full datasets Key Indicators: Wine Production - Area planted (ha) per year in England.		

The agricultural productivity adaptation priority considers how climate change could affect the ability of the land to support domestic food production in the future as the climate changes. This priority considers the degree of innovation and flexibility in agriculture, the resilience of crops and livestock to climate change impacts including pests and diseases, and the resilience of the underpinning natural assets as they are needed to support agriculture – soil and water. If climate change degrades land capability overall, agricultural production will not be able to take advantage of any potential benefits from longer growing seasons.

Summary of 2019 report score

In our last report, agricultural productivity scored a 1 (low plan score, low risk management score).
Analysis presented in the last report indicated there was a concerning absence of robust plans that considered the range of risks to and opportunities for the agricultural sector in England from climate change. Furthermore, a lack of effective indicators to monitor changes in the capability of agriculture in relation to climate change, meant that it was difficult to assess how the sector is managing current and future risk. As noted in the CCC's Sixth Carbon Budget report[39], measures involving technological and land use changes in agriculture (e.g. improvements in crop productivity) will play an increasingly important role in achieving Net Zero. Building the resilience of the sector to climate change will be vital for the successful delivery of such measures.

Has the plan score changed?

No – the score remains unchanged from 2019.

The agriculture sector still lacks a coherent strategy to ensure it remains productive under changing climatic conditions.

Defra still lacks a strategy to ensure the agricultural sector remains productive as the climate changes.

A long-term strategy is required to prepare the agricultural sector in England for the range of risks to and opportunities from climate change, particularly with regard to water and soil management, and improving the technological capability of the sector to respond to threats such as changing pest and disease risks.

As set out above, the Government's proposed Environmental Land Management (ELM) scheme includes climate change adaptation in the defined list of public goods but content on threats to agricultural productivity is limited largely to building resilience with regard to flood risk management. There is no detail (as yet) on what will be required in terms of adaptation to the full range of risks to agriculture identified within the second UK Climate Change Risk Assessment (CCRA2-2017), including higher temperatures, drought, and increases in the spread of pests and diseases.

There are partial plans in place for protecting against the ongoing loss of lowland peat soils, although most plans are still in development.

Lowland peat soils form part of the most productive agricultural land in England, but they are at high risk of loss as the climate changes.[40] Defra has created a new Lowland Agricultural Peat Taskforce with a remit to reduce the loss of lowland peat soils in England. The taskforce will help deliver the policy objectives outlined in the England Peat Action Plan (see section 2.2). Defra also concluded an internal evidence review of management practices with the potential to reduce soil loss and greenhouse gas emissions from lowland agricultural peatlands in England. The evidence will be presented as an input to the Task Force which is currently scheduled to report in July 2022.

Sector led plans indicate an increasing recognition of the need to adapt farming practices to the challenges of climate change, but gaps remain.

Agriculture shows generally low levels of proactive planned adaptation, with most actions driven mainly by reactive and short-term adjustments rather than long-term decisions.[41]

A 2021 report by the National Farmers Union (NFU) lays out a blueprint for an Integrated Water Management strategy. The document aims to promote the implementation of contingency planning on farms to tackle the dual risks of flooding and water supply disruption.

There is some evidence of long-term adaptation planning by the Agriculture sector, although plans to date focus on drought and flood risks, and do not as yet account for the effects of climate change under a range of future warming scenarios.

Case study examples are presented in the report of on-farm planning for impacts of drought and flood on specific agri-product lines, and the policies needed to build resilience of agri-water infrastructure to climate change are outlined. The report also profiles a range of actions farmers and growers can take, and in many cases are already taking, to build the resilience of their businesses to the impacts related to flood and drought risk. These include: increasing water storage capacity and the use of water-saving techniques; adopting improved soil cultivation techniques to lock moisture into soils; implementing on-farm flood and drought risk management and contingency planning; and Incorporating best practice in crop management.

While the report includes information on impacts to agricultural productivity from flood and drought risks, it does not consider the potential impacts and associated actions under 2°C and 4°C global warming scenarios. It is understood similar plans for the broader range of climate impacts (e.g. higher temperatures) are in the early stages of development by the NFU.

The Agriculture sector does not have a comprehensive plan to address the potential risks facing the agriculture sector from pests, pathogens and invasive non-native species.

There is still no comprehensive plan to address the potential risks facing the agriculture sector from pests, pathogens and invasive non-native species.
NAP2 includes actions to manage existing plant and animal diseases and lower the risk of new ones (see also section 2.2 Terrestrial habitats and species). As noted in CCRA3[42], climate driven increases in the spread of pests, pathogens and invasive non-native species (INNS) present serious risks to agricultural productivity. Large-scale outbreaks or invasions may have serious ramifications for food security. Adaptation actions can include research into building the resilience of crops grown through diversifying their genetic composition, and measures to improve control for pests and diseases. However, the agricultural sector in England currently lacks a strategic-level plan, which includes coordinated surveillance and monitoring, and improved risk assessments with space and time dimensions to evaluate changing dynamics of individual pests, pathogens and INNS.

The Government has provided some funding to support long-term research into the genetic improvement of arable crops and fresh produce via the development of Genetic Improvement Networks (GINS). Defra allocated £5.5 million in 2018 over a five-year period. The research includes work to identify crop varieties which have better levels of resistance to pest and disease. The GINs are required to report on research annually, to 2023.

Initiatives to develop research and improve agriculture efficiency should help boost the industry's resilience to climate change and reduce emissions.
Recent research initiatives relevant to improving resilience include:

- The Countryside Productivity Small Grant (CPSG) scheme provides funding for farmers to purchase equipment to improve the productivity of their farm. Eligible activities under the scheme include more efficient use of water for irrigation, and to secure water supplies for crop irrigation by the construction of on-farm reservoirs. The Government is providing a further £21m in 2021 bringing the total investment to £60m.

- A Farming Investment Fund to support innovation and productivity is being established where grants will be available for farmers to invest in equipment, technology and infrastructure with an aim to build the efficiency of farm businesses, including on-farm water storage. The fund was announced by Defra as part of a package of measures to support the transition from the Basic Payment Scheme towards the new ELM scheme. It is understood the fund is scheduled to launch in autumn 2021.

Has the risk management score changed?

No – the risk management score remains low.

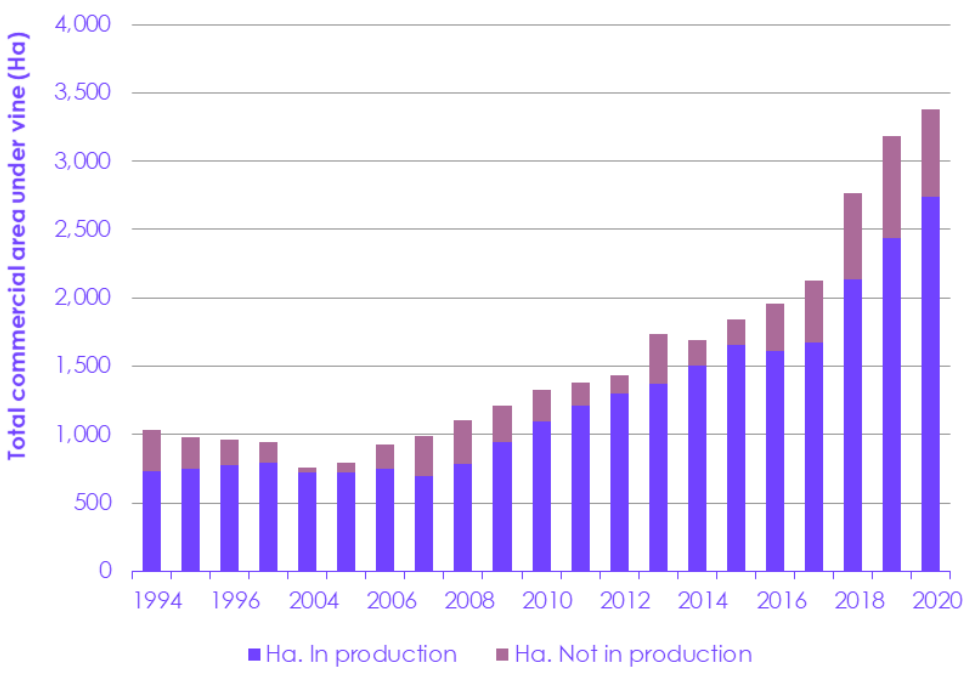
Indicators to measure how the capability of the agricultural sector is changing in relation to climate change remain very limited (e.g. lack soil health metrics). It is, therefore, not possible to conduct a robust assessment of changes in the vulnerability of agricultural production to climate change.

There is presently limited information on the establishment and spread of new crops.
Crops that are likely to become more viable commercially in the UK as the climate changes include peaches, apricots, tea, sunflowers, sweet potatoes, watermelons, walnuts, and truffles.[43]

While there is some evidence of actions taking place to build the resilience of the Agriculture sector, there are few appropriate indicators currently available (e.g. soil health, agricultural R&D in adaptation) to support effective assessment.

Commercial wine production is becoming viable over larger areas in England. The total commercial area under vine in England and Wales has more than doubled in the last decade from 1,384 hectares in 2011, to an estimated 3,380 hectares in 2020 (Figure 2.21). These values are for commercial vineyards only and do not include 'hobby vineyards' and 'abandoned vineyards*.

Figure 2.21 Wine Production - Area planted (ha) per year in England



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England.*

There is no indication in the datasets as to whether this increase in area is being driven by improving climatic conditions for the vines, or whether there are other economic reasons for the increase in area. However, it is anticipated that the climate is becoming more suitable for vine production and thus opening up an opportunity for growers interested in wine production.

Adaptation actions to improve monitoring and measuring of water (to ensure optimal use) and the identification of innovative techniques to reduce demand and reuse water are required both at a farm and catchment scale.
Long-term declines are evident in the volume of water abstractions from non-tidal sources for both agricultural and fish farming sectors (see section 2.8 and section 2.9). However, the reasons for this are not clear and on its own it does not suggest whether the vulnerability of the agriculture sector to water scarcity is changing.

* In 2020, 'hobby vineyards' and 'abandoned vineyards accounted for an estimated additional 66 hectares and 54 hectares respectively.

Better Indicators are needed to measure changes in the level of agricultural expenditure on adaptation.
The amount of investment in agricultural research and development (R&D) on climate-specific issues is a useful indictor of action. The Office for National Statistics (ONS) publishes annual data on R&D investment for agriculture, forestry, fisheries and hunting. At present, however, sub-industry data for this indicator are not available, meaning we are unable to assess changes specific to the agriculture portion of R&D investment.

Indicators are urgently needed to measure the ability of agricultural soils to support food production.
Better Indicators are needed to measure changes in the level of agricultural expenditure on adaptation, and the ability of agricultural soils to support food production.

Soil degradation, through erosion and reduced organic matter, could cause an irreversible decline in the productive capacity of the land. In the case of agriculture, soils are being degraded by intensive farming practices in some areas (such as the Fens), with deep ploughing, short rotation periods and exposed ground leading to soil erosion from wind and heavy rain.

Defra are considering the potential scope for a soil health action plan (see section 2.2). Draft plans include developing a new Soil Health Monitoring Scheme (SHMS) for England to produce a new robust data baseline. A healthy soils indicator will be developed to feed into the SHMS and will inform a future target for soil health under the Environment Bill. Separately, a new Soil Structure Measuring and Monitoring Scheme is being developed to enable visual assessments to be carried by farmers and land managers across all land use/soil types.

2.8 Water management

Progress summary – Water management		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • Revisions to the river basin management plans consider potential climate impacts under a range of warming scenarios. However, there is insufficient consideration of risks to water quality from higher temperatures in the current plans. • The Environment Agency's second Flood and Coastal Erosion Risks strategy also considers adaptation for a range of climate scenarios and emphasises the potential for nature-based solutions to manage risks of flooding, including to agricultural land. **Risk management score – medium** • There is a lack of appropriate indicators to show how the vulnerability of the freshwater environment for providing water for human use is changing. • Progress has been made in supporting sustainable abstraction of water from the environment through the Environment Agency's Restoring Sustainable Abstraction Programme. • The use of land for natural flood management remains poorly recorded.	5
Notes: See annex for full datasets Key Indicators: Progress made by Restoring Sustainable Abstraction Programme.		

This adaptation priority considers the regulating services related to the availability and quality of water in the environment, and flood risk management provided by the natural environment. Freshwater biodiversity is covered in Section 2.3.

Summary of 2019 report score

In our last report. water management scored a 5 (medium plan score, medium risk management score).
Our 2019 report highlighted that while plans are in place and actions are being implemented to address increased risks of water scarcity in vulnerable locations, there was insufficient consideration of risks from higher water temperatures. Furthermore, there were no goals set out in current policies for how land should be used to manage flood risk as the climate changes.

On progress in managing risk, the downward trend in abstraction of water for agriculture suggested a decline in vulnerability to future water deficits, although on its own it is a very limited indicator as change is influenced highly by demand. A lack of information on the use of land for natural flood management in England meant we were not able to assess progress in this area accurately.

Has the plan score changed?

No. The score remains the same.

Revisions to the river basin management plans lack sufficient consideration of risks to water quality from higher temperatures across the impacts identified.

Revisions to the river basin management plans (RBMPs) that consider the potential climate impacts under a range of warming scenarios will support adaptation decisions on the use of water to address future risk. However, there is insufficient consideration of risks to water quality from higher temperatures in current plans.
As part of the process of reviewing the RBMPs (see section 2.4), in 2020 the Environment Agency completed a 'Challenges and Choices' consultation. The consultation was used to raise awareness of the impact of climate change on water management in England and gather views from stakeholders on how to mitigate these risks. Climate related changes identified included: climate and biodiversity crisis, changes in water levels and flows, and invasive non-native species. This work has started a conversation around the challenges stakeholders and the communities they represent face in the future. The discussions have led to some initiatives to prepare for warmer water temperatures (e.g. keeping rivers cool project). However, there is still insufficient consideration of risks to water quality from higher temperatures across the impacts identified.

The Environment Agency has produced current and future pressure assessments for each of the RBMP challenges identified. The futures analysis component builds on current understanding by incorporating projections for climate change, population growth and land use change, and aims to improve such tools to inform future water planning.

The Government's water abstraction plan provides a framework to manage risks of water scarcity, but does not give adequate consideration to risks to water quality as outlined in CCRA3.[44]
The 25-Year Environmental Plan identifies the Water Abstraction Plan (WAP) 2017 as the Government's key tool to help meet its 'Clean and plentiful water' goal, and to meet the challenges of climate change both now and in the future. The plan has three main elements: addressing unsustainable abstraction; stronger catchment focus; and modernisation. The WAP refers to the link between climate change and sustainably abstracted water bodies and the benefits of a stronger catchment focus in delivering greater sustainability and access to water. It is understood outputs from the RBMP risk scenario assessments (see above and section 2.4) will feed into the WAP, but it is not clear how results will support appropriate actions.

The second Flood and Coastal Erosion Risk Management (FCERM) strategy emphasises the potential for nature-based solutions (NbS) to manage the risks of flooding.
Natural flood management (NFM) is a central feature in the Environment Agency's national FCERM Strategy, which makes several commitments to mainstream NbS citing the benefits of working with natural processes to manage current and future flood risk. The Environment Agency has also been developing evidence and knowledge sharing concerning NFM[45], including case studies on different NFM approaches, as well collaborating internationally with the US Army Corps 'Atlas' work on 'engineering with nature'.

The Environment Agency has allocated funding to natural flood management projects, but early lessons are only just emerging and further evidence of the success of projects is needed.

Funding has been allocated to natural flood management projects, but early lessons are only just emerging and further evidence of the success of projects is needed.
In 2017, the Environment Agency began a £15 million pilot programme to learn more about NFM, working with communities, land managers, catchment partnerships and coastal groups around England. The programme completed in April 2021, with 56 NFM projects across the country delivered with local community groups, and improving 4,000 hectares of habitat. Currently, the Environment Agency identifies 40 projects as part of their FCERM investment programme that

include NFM measures, but recognise that further learning about NFM is needed to increase confidence in its use.

As noted in NAP2, the Environment Agency has committed to producing a Natural Flood Management design manual by 2020.
The manual will assist practitioners in selecting appropriate NFM measures. CIRIA* has been commissioned to lead a project to develop the design manual on behalf of the Environment Agency. The project is scheduled to complete in winter 2021/22.

Has the risk management score changed?

No, the score has remained medium.

There is a lack of indicators to show how the vulnerability of the natural environment for providing water for human use is changing.

Some progress has been made in supporting sustainable abstraction of water from the natural environment.

Effective water management is a fundamental function of agricultural production, whether it be through water storage or sustainable abstraction for irrigation used to water crops. A changing climate is likely to bring greater variability in rainfall and higher temperatures. This could result in less groundwater recharge and larger seasonal variations in river flow as well as changes to when and how extended dry periods occur. Sustainably abstracted water bodies will be more resilient to changes in climate and drought pressures so addressing unsustainable abstraction will help improve resilience to climate change. As noted above, through the WAP, the Environment Agency is looking to reduce the amount of water that can be abstracted under a licence based on historical long-term average use.

Progress has been made in supporting the sustainable abstraction of water from the environment through the EA's Restoring Sustainable Abstraction Programme.
Through the Restoring Sustainable Abstraction (RSA) programme, launched in 2008, the Environment Agency has been investigating and changing permanent abstraction licences that have caused environmental damage, reduced biodiversity and undermined ecosystem resilience to climate change. The RSA programme identifies abstraction licences for which there were concerns about an impact on the environment and, where possible, identifies options to make the abstraction sustainable. This is either through voluntary agreement with licence holders or using compulsory legal powers. As of March 2020, 85% of the RSA Programme had been delivered, equating to changes to 320 abstraction licences.

Data to support the assessment of changes in the level of on-farm water storage capacity in England is no longer collected.
In our 2019 assessment, we presented information taken from Defra's Farm Business Survey on the percentage of farms sourcing water from various water sources, including from on-farm water infrastructure. Data on this ceased to be collected as part of the survey beyond the 2015-16 financial year, so we are unable to assess recent progress in developing on-farm water storage capacity for this report.

* Construction Industry Research and Information Association

2.9 Commercial fisheries and aquaculture

Progress summary – Commercial fisheries and aquaculture		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - medium** • The Fisheries Act 2020 includes a requirement for authorities in England to report on how objectives will be met to improve the ability of the Fisheries and Aquaculture industries to adapt to climate change. While adaptation plans for both sectors have now been published, neither plan considers climate impacts under a range of warming scenarios. **Risk management score – medium** • Overall, there are a greater proportion of marine stocks fished sustainably and within safe biological limits, both in the long and short term. However, existing metrics only include fish stocks covered by quota management.	5
Notes: See annex for full datasets Key Indicators: Marine fish (quota) stocks of UK interest harvested sustainably, Marine fish (quota) stocks with biomass at levels that maintain reproductive capacity.		

Summary of 2019 report score

Commercial fisheries and aquaculture scored a 2 in the 2019 report (low plan score, medium risk score).
Our 2019 report highlighted that without an adequate plan for aquaculture, existing plans for the sector did not represent a sufficient strategy for adapting the industry to climate change. Available indicators suggested some progress has been made under the EU Common Fisheries Policy in introducing sustainable fisheries measures, while substantial research into the effect of climate change was underway.

Has the plan score changed?

Yes. Medium levels plans are now in place for the sector.

The UK marine fishing industry was worth ca. £1.5 billion in 2017 (total catches were worth £980.1 million) and employed 23,000 people, although this is rather unevenly distributed between sectors and around the UK.[46]

Climate change is listed as one of the eight objectives under the Fisheries Act. 2020.

The Fisheries Act. 2020 contains provisions to improve the ability of the Fisheries and Aquaculture industries to adapt to climate change, including a requirement for authorities to report triennially on how objectives will be met.
The Fisheries Act (2020) replaces the EU's Common Fisheries Policy (CFP) in providing a framework for domestic fisheries policy governing foreign access to British fishing grounds, the licensing of fishing boats, and grants connected to fishing. The Act also extends the powers of national authorities with regard to marine conservation to the whole of the UK Economic Exclusion Zone (EEZ).

Climate change is listed as one of the eight objectives under the Act, notably reducing the impact of fisheries (e.g. through lowering emissions), and to fisheries (e.g. through improving its ability to adapt to the effects of climate change).

The Act itself does not set out the specifics of how climate change objectives will be achieved. Rather, it creates a legal requirement for the UK's four national fisheries policy authorities (e.g. Marine Management Organisation (MMO) for England) to produce a Joint Fisheries Statement (JFS) that will lay out how these objectives will be met. The Act requires these authorities to produce the JFS within two years of the Fisheries Act being passed (November 2022). The Act also includes provisions to report on the JFS policies every three years, and to review the JFS every six years. This aims to ensure the policies will be responsive, and remain fit for purpose in order to achieve the fisheries' objectives. It is not clear at this stage the extent to which the impacts of climate under different warming scenarios will be included in the JFS.

Policies to replace former EU protections must ensure gains made under the Common Fisheries Policy are maintained and built on.

To support adaptation, policies for fisheries and aquaculture need to achieve at least two key aims: sustainable yields for populations; and flexibility through time in what species are caught, to mirror the changing species diversity and abundance in UK waters as the climate changes. Previously under the CFP, a number of tools were used to manage UK fisheries including: minimum landing sizes; mesh sizes; effort control (limiting days at sea, or power of vessels); area closures; technical measures specifying aspects of the design of the gear; and landing restrictions. The setting of a Total Allowable Catch was the primary means of controlling the number of fish removed from a stock. It is likely that EU-exit will have major implications for these fisheries, most notably in terms of changes in fisheries policy (quota arrangements, regulations etc.). It is vital that the policies implemented under the Fisheries Act ensure the gains made in improving the sustainability of the UK fishing industry are both maintained and increased.

NAP2 includes the release of several reports by Seafish, the industry body with a remit to support the profitability and sustainability of the seafood industry.

Adaptation plans have been produced for the aquaculture and wild capture sides of the fisheries sector, but as yet neither plan considers climate impacts under a range of warming scenarios.

Seafish has produced a climate change adaptation report for the aquaculture side of the sector. The report considers the major impacts on the industry, from production to processing, that arise from five principal climate change drivers (sea level rise; changes in storms and waves; temperature change; ocean acidification; and changes in terrestrial rainfall) and sets out key areas for adaptation action. The report compliments a previous Seafish climate change adaptation report for the UK wild capture seafood side of the industry. The document also considered the major industry impacts arising from key climate change drivers and sets out major areas of adaptation action, and was produced in collaboration with key partners, for the UK Government under the first Climate Change Adaptation Reporting Power. However, while both reports comprehensively cover impacts from key climate threats, the assessments lack explicit consideration of 2°C and 4°C global temperature scenarios.

It is anticipated that evidence on climate change to inform potential responses will be collected on an ongoing basis for aquaculture in the form of an annual 'watching brief' as is currently the case for the wild capture seafood report.

Has the risk score changed?

No, the risk score remains medium.

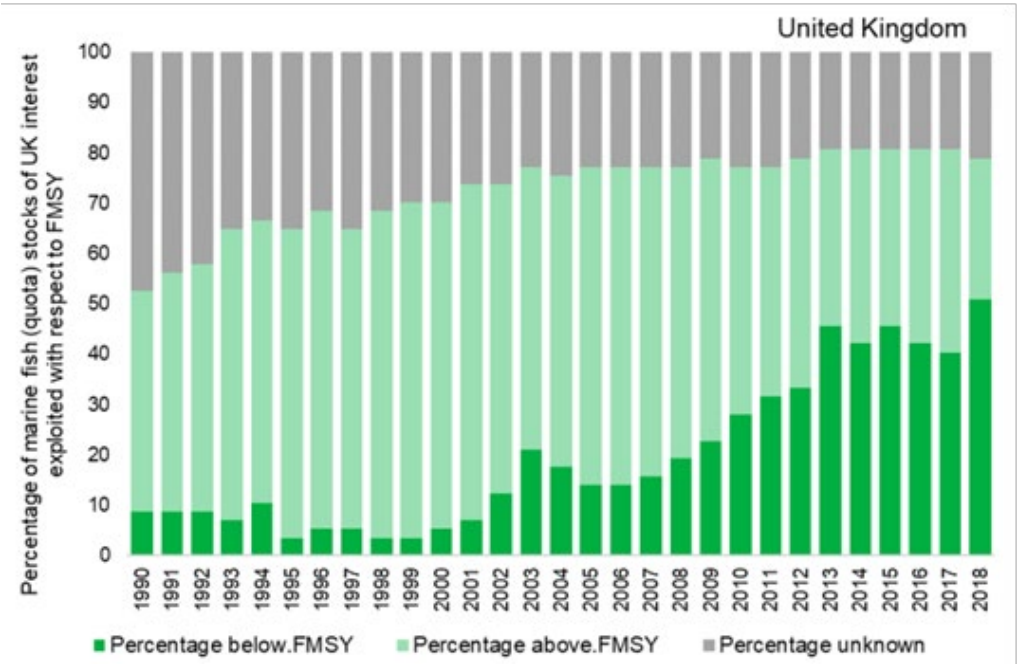
Climate change drives modifications in marine ecosystems that affect fisheries' productivity and food security. Fish are an integral component of marine biodiversity. They are an important element of the food chain for seabirds, seals and cetaceans (e.g. whales) and are a source of food and employment for people. [47]

There is increasing evidence of climate impacting on the off-shore fishing industry.

The Marine Climate Change Impacts Partnership 2020 Report Card 2020 showed increasing evidence of climate impacting on the off-shore fishing industry.
The report card states that fisheries productivity in some UK waters has been negatively impacted by ocean warming, including impacts to the timing of spawning among species, as well as substantial changes in fish communities in UK waters, linked to the appearance of warm-water species. There is also evidence to suggest warming, and associated oxygen solubility, appears also to be affecting the age at maturation, growth rates, and the maximum size fish can attain.

Indicators of the extent and condition of recorded fish stocks suggest long-term improvement, however, it is not possible to assess fish species that are not under quota management.
Maintaining sustainable fisheries helps to ensure marine ecosystems remain diverse and resilient, providing a long-term and viable fishing industry. The percentage of fish stocks at or below levels capable of producing maximum sustainable yield (MSY) has increased from 9% in 1990 to 51% in 2018 (Figure 2.22).

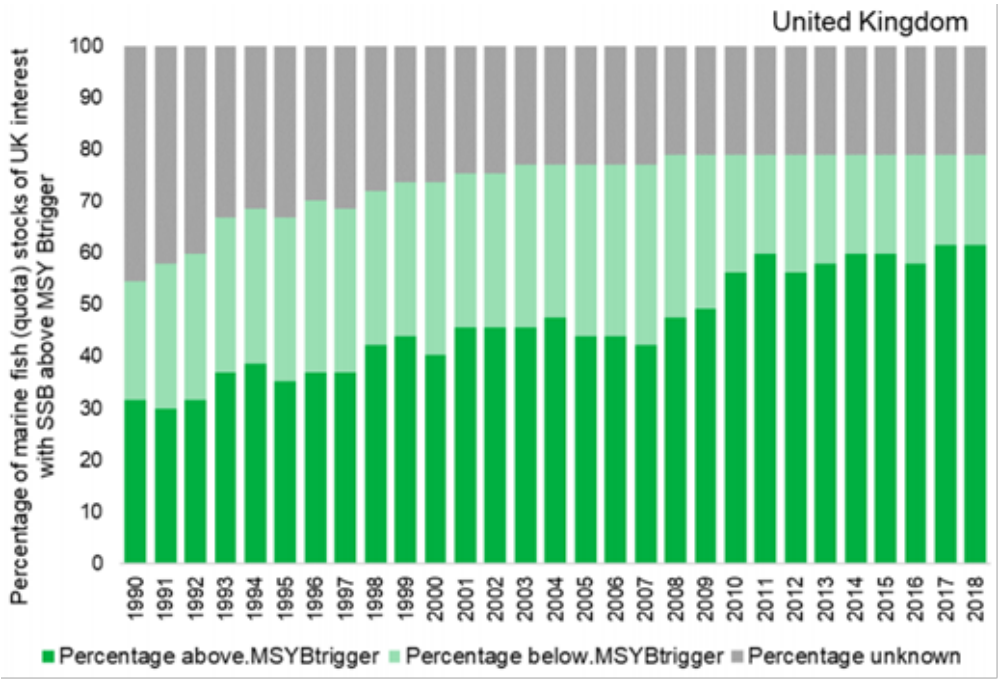
Figure 2.22 Percentage of marine fish (quota) stocks of UK interest harvested sustainably



Source: Defra biodiversity indicators 2020 update.
Notes: 1. The list of stocks used within the indicator was expanded in 2017, so publications of the indicator using data prior to 2017 are not directly comparable. Note that Defra first published this indicator using the expanded list of stocks in 2019. 2. Also, not directly comparable with previous publication; As data are added to time-series and stock assessment models are refit, small changes can occur in past estimates even if the model structure is not itself revised.

The spawning biomass (SSB) of each respective fish stock should be at or above a level capable of producing maximum sustainable yield if the reproductive capacity of stocks is to be maintained. The percentage of stocks achieving this goal has also increased, from 32% in 1990 to 61% in 2018 (see figure 2.23). For 2020, the UK will have 67% of its Total Allowable Catches set at Maximum Sustainable Yield (MSY) out of the total stocks with MSY assessments.[48]

Figure 2.23 Percentage of marine fish (quota) stocks of UK interest with biomass at levels that maintain full reproductive capacity



Source: Defra biodiversity indicators 2020 update.

Indicators show there are a greater proportion of marine stocks fished sustainably and within safe biological limits, both in the long and short term. However, existing metrics only include fish stocks covered by quota management.

The indicators presented in figure 2.22 and figure 2.23 only include UK fish stocks that are subject to quota management. Both are based on a group of 20 species in 57 stocks for which there are reliable estimates of fishing mortality and spawning biomass, together with MSY reference points for fishing mortality and biomass that allow the sustainability of the stocks to be evaluated. The indicator stocks include a range of local and widely distributed species of major importance to the UK fishing industry. Data limitations, however, mean It is not possible, to assess the extent and condition UK fish stocks that are not subject to quota management.

The absence of long-term monitoring datasets mean we are not able to assess the status of seafloor marine species.

The use of bottom trawling by the fishing industry can have widespread impacts on the condition, and therefore vulnerability to climate change, of marine habitats and species. Physical disturbance can affect seafloor habitats adversely, with shifts in sea floor community composition being reported.[49] These shifts are driven by the replacement of larger, long-lived, slow-reproducing species with small, fast-growing species.[50] Data limitations mean changes in the status of seafloor marine species are not included in the assessment.

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Chapter 3

People and the built environment

3.1 Introduction

The vast majority of people in England live in built-up areas, with about 92% of the population living in cities and towns.* The built environment therefore has a strong influence on how climate change will impact upon people and communities. For example, the level of flood risk to communities depends on: whether houses are built in areas exposed to flooding; the level of protection provided by flood alleviation schemes; and whether resilience measures are put in place at the individual household level. Housing quality determines whether people live in damp, excessively hot, or cold homes, with the health cost to the NHS of poor housing estimated to be around £1.4 billion per year.[1] The extent of permeable surfaces and urban green space impacts on the quantity and quality of water entering drainage networks and being discharged into watercourses. Green spaces also help to reduce temperatures in built-up areas.

The COVID-19 pandemic has led to people spending more time indoors – particularly their homes – potentially exacerbating exposure to other risks, including weather-related risks.[2] However, the impacts of COVID-19 may have raised awareness of the importance of understanding major threats that can disrupt lives and livelihoods, including low-probability, high-impact events (e.g. flood events).[3]

The third UK Climate Independent Assessment (CCRA3) has updated the evidence on the many, diverse climate change risks that impact upon people and the built environment. Most of these (55 out of 61 risks and opportunities) require more action or further investigation by Government.[4]

This chapter assesses whether climate change is being planned for, whether adaptation actions are taking place, and whether those actions are leading to reductions in vulnerability or exposure. Flooding (Section 3.2); coastal erosion (Section 3.3); water availability (Section 3.4); and health impacts from heat and cold, pathogens, and air pollution (Section 3.5), are all considered here as the key conduits for climate-impacts on people in the built environment. The capacity of responders to cope with climate-related emergencies is also considered (Section 3.6).

* According to Defra's Official Statistics on Rural population 2018, excluding people living in sparsely populated areas and those in villages and hamlets, 83% of the English population lives in cities and urban towns and nearly 9% in rural towns.

This section begins with an analysis of the overall flood risk and response, in the context of climate change. This is then followed by analysis of the CCC's more specific adaptation priorities: river and coastal flood alleviation; development in areas at risk of river or coastal flooding; surface water flood alleviation; development and surface water flood risk; property-level flood resilience; capacity of people and communities to recover from flooding.

The updated flood risk project for the third CCRA[5] found that 1,550,000 people in England currently face a 1 in 75 or greater flood risk (i.e. a 1.33% chance of flooding in any given year), and that direct Expected Annual Damages (EAD) to residential properties from flooding are currently £290 million. This covers all sources of flooding: river; coastal; surface water;* and groundwater.†

By the 2080s, the projections suggest 2,150,000 people will be at risk under a 2˚C scenario and 2,700,000 people under a 4˚C scenario.

Assuming no population growth and enhanced adaptation,‡ by the 2050s the projected number of people at a 1:75 year or greater risk rises to around 2,000,000 under a 2˚C scenario and 2,450,000 under a 4 ˚C scenario.[6] By the 2080s, the projections suggest 2,150,000 people will be at risk under a 2˚C scenario and 2,700,000 people under a 4˚C scenario. Direct EAD for residential properties is projected to rise by 25-46% in the 2050s and 36%-84% in the 2080s, depending on the climate scenario used in the analysis.

Is there a good quality plan that presents a response to England's overall flood risk?

Since 2019 the Government has published a National Policy Statement on flood and coastal erosion risk management, alongside the Environment Agency's national Flood and Coastal Erosion Risk Management (FCERM) Strategy and Action Plan (Box 3.1).
The Policy Statement and Strategy together aim to ensure that England is more resilient to flooding and coastal erosion in the long-term:

- The Policy Statement forms part of the Government's wider commitment to tackle climate change, with many actions directly relevant. It sets out a long-term approach to commit to making better decisions about the actions and investments taken which account for future risks in a changing climate.

- The FCERM Strategy was laid in Parliament in 2020, as a requirement of the Flood and Water Management Act (2010). It provides a framework to guide the operational activities and decision-making of practitioners, in support of the direction set by the Policy Statement and the 25 Year Environment Plan.

* Surface water flooding is considered separately from river and coastal flooding in this chapter. Different policies, plans, actors, and responses for these two categories, make their separation in this report, as well as in policy-making, convenient. However, there are also interactions and overlaps that should not be ignored. These include: policy (all flooding sources are covered in the FCERM and Policy Statement); shared flood defence and resilience funding streams; and shared physical drivers for different flooding sources such as high rivers and rising sea levels lead to blocking surface water drainage.

† Groundwater flooding is not examined in this report as there are few data and policies to examine. The issue requires further research.

‡ This 'current objectives+' scenario goes beyond the current implementation of policy (and recently introduced policy) to represent an enhanced whole-system approach to adaptation (i.e. implementation is in-line with the higher level of ambition).

It supports risk management authorities in considering a range of scenarios, including higher climate scenarios, such as a 4°C rise in global temperature.

- The FCERM Strategy Action Plan aims to help deliver the objectives set out in the Strategy with commitments from the Environment Agency, and a range of partners, that will be monitored, reviewed and updated every year.

The Policy Statement and Strategy should help to provide the required policy basis for increasing the level of ambition in tackling flood risk. However, it is too soon to tell what the resulting actions and subsequent risk reductions will be. Alongside this, while the updated flood risk projections for the third CCRA show that future risk can be reduced with continued adaptation action, residual risk remains high.

The FCERM Strategy and Policy Statement are revisited, where relevant, throughout this chapter. Section 2.7 (water management) in the Natural Environment chapter of this report refers to natural flood risk management.

Box 3.1
New commitments in the Government's Flood Policy Statement and Environment Agency's Flood and Coastal Erosion Risk Management (FCERM) Strategy

The Policy Statement sets out the Government's long-term ambition to create a nation more resilient to future flood and coastal erosion risk. The Statement outlines five policy themes, aiming to accelerate progress and increase resilience to flooding and coastal erosion, in the face of more frequent extreme weather due to climate change:

1. Upgrading and expanding national flood defences and infrastructure.
2. Managing the flow of water more effectively.
3. Harnessing the power of nature to reduce flood and coastal erosion and achieve multi-benefits.
4. Better preparing communities.
5. Enabling more resilient places through a catchment-based approach.

These policies are supported by over 40 actions to drive progress and create a more resilient nation. These actions include:

- Reforming local flood and coastal erosion risk planning by 2026, so that every area of England will have a more strategic and comprehensive plan, that drives long-term local action and investment.
- £5.2 billion to create around 2,000 new flood and coastal defences to better protect 336,000 properties in England and reduce national flood risk by up to 11% by 2027.
- £200 million for the Environment Agency's Flood & Coastal Resilience Innovation Programme, for testing and developing innovative approaches to flood and coastal resilience as well as adaptation.
- Doubling the number of Government-funded projects which include nature-based solutions to reduce flood and coastal erosion risk.
- Consulting on changes to the FloodRe scheme, to encourage greater uptake of Property Flood Resilience among households at high risk of flooding across the UK.
- Reviewing national policy for Shoreline Management Plans.
- Developing a national set of indicators to monitor trends and the impact of policies by spring 2022.

The FCERM 2020 Strategy supports the ambition with a range of practical measures to help England strengthen its resilience to flooding and coastal change, for example by enhancing guidance for appraisal of flooding and coastal change projects, so that

investment decisions can better reflect a wider range of resilience actions and climate change scenarios.

The strategy also commits to:

- Enhancing the understanding of all sources of current and future flood risk through improving the National Flood Risk Assessment.
- Developing adaptive approaches and pathways in local places which equip practitioners and policy makers to better plan for future flood and coastal change and adapt to future climate hazards.
- Delivering innovative solutions to flood and coastal resilience in 25 places across the country, through the £150m Flood & Coastal Resilience Innovation Programme.
- Mainstreaming property flood resilience measures and to 'build back better' after flooding.
- Transforming the flood warning and informing service to better reach people living, working or travelling through flood risk areas.

In May 2021 the Environment Agency launched its first FCERM Strategy Action Plan. The plan aims to deliver the strategic objectives set out in the Environment Agency's FCERM Strategy and provides a wide-ranging list of actions. These include the Environment Agency working with:

- The National Flood Forum to expand the network of community flood groups, to support residents and local businesses to develop flood response plans and train flood wardens.
- The Property Flood Resilience Roundtable, to deliver a national suite of training for the property flood resilience industry.
- Partners in the Thames Estuary, Humber Estuary, Severn Valley and Yorkshire, to develop long term plans for adapting to future flooding and coastal change and climate hazards.
- The Local Government Association and ADEPT, to run workshops to help local authorities attract private sector investment and green finance as a means of improving flood and coastal resilience.
- The Town and Country Planning Association, to develop on-line training materials for town planners on flood risk and climate change.

Source: HM Government (2020) Flood and coastal erosion risk management Policy Statement; Environment Agency (2020) National Flood and Coastal Erosion Risk Management Strategy for England; Environment Agency (2021) Flood and Coastal Erosion Risk Management Strategy Action Plan 2021.

Is progress being made in managing overall flood risk?

The Environment Agency's six-year FCERM investment programme has delivered a large number of risk management interventions.

Since 2015, the Environment Agency and partners have completed more than 700 projects to better protect more than 300,000 homes.

From April 2019 to March 2020, 176 FCERM schemes were completed, of which 73 improved protection from the risk of flooding from rivers and 36 improved protection from the risk of flooding from the sea. The schemes include interventions such as asset improvements and tidal flood barriers.[7] These schemes have helped to better protect nearly 50,000 homes from flooding and coastal erosion (3,900 of which were in areas of significant flood risk and economic deprivation). Since 2015, the Environment Agency and partners have completed more than 700 projects to better protect more than 300,000 homes, exceeding the programme's target to provide better protection for 300,000 homes between 2015 and 2021.[8]

A review conducted in 2017 focused on those schemes that accounted for a large proportion of the homes better protected.[9] This revealed that based on an improved Standard of Protection (SoP), most of the schemes were taking households from very significant risk, to low or moderate risk. Furthermore, most of

the schemes were increasing the existing SoP and allowed for increased risk due to climate change in the design.

Data regarding which risk bands homes have moved into and out of, for the different types of flooding, is not routinely collected and published.
Whilst there has been a review of schemes, this type of information needs to be continually collected. Without it, it will not be possible to tell if the continued rate of investment and protection is sufficient to maintain current levels of risk.

The Government has announced a substantial increase in the amount of capital funding for flood and coastal erosion risk management.

The capital funding for flooding will increase from £2.6bn for the period 2015 to 2021, to £5.2 bn for the period 2021to 2027.

In March 2020, the Government announced that the capital funding for FCERM would increase from £2.6 billion for the period 2015 to 2021, to £5.2 billion for the period 2021to 2027. Beyond the £5.2 billion capital investment programme, the Government has also announced other funding measures for flood and coastal erosion risk management over the past two years which include: [10]

- £170 million to accelerate the building of 22 shovel-ready flood defence schemes.
- £150 million (of a £200 million fund) between 2021 and 2027 for a flood and coastal resilience innovation programme, managed by the Environment Agency. The programme will support 25 local areas in urban, rural and coastal areas to trial innovative approaches which increase resilience to flooding and coastal erosion.
- £8 million between 2021 and 2027 for development and implementation of adaptation pathway plans to manage long-term flooding and coastal change and investment, in Thames and Humber estuaries, Severn Valley and Yorkshire.
- £120 million was made available to the Environment Agency to repair assets damaged by Storms Dennis and Ciara during the 2019/20 winter.
- £640 million for a Nature for Climate Fund which will contribute to tree planting and peatland restoration. The Government has stated it will examine ways to secure secondary benefits for flood risk management.

The National Audit Office (NAO) assessed in its 2020 report on flood management that the funding in the first two bullet points meant £5.6 billion of new capital funding had been announced for flooding and coastal erosion up to the end of March 2027. [11]

The Environment Agency's long-term investment scenarios (LTIS) set out the economic optimum level of investment for FCERM. It is expected that investment for the period 2021 to 2027 will exceed this, though some sources are determined on an annual basis and therefore provide insufficient long-term stability to manage climate risks.

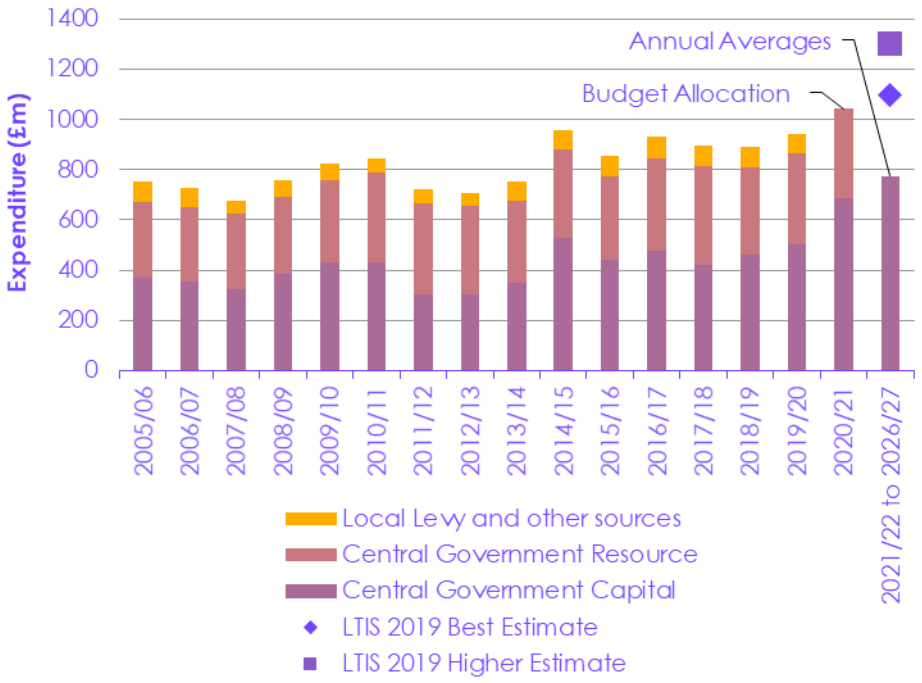
In real terms, the £5.2 billion of capital funding for FCERM is roughly £775m as an annual average for 2021/22 to 2026/27.

LTIS estimates the economic optimum level of investment for FCERM to be an annual average of £1.1 billion as a best estimate, possibly as high as £1.3 billion (both in real terms, 2019/20 prices), depending on policy choices, such as very high levels of protection and increased use of Property-level flood resilience (PFR) measures and natural flood management. [12] In real terms, the £5.2 billion of capital funding for FCERM is roughly £775m as an annual average for 2021/22 to 2026/27. LTIS includes flood and coastal capital schemes, asset maintenance and resource and investment associated with other flood and coastal risk management authorities.

Based on resource and other funding in recent years, similar amounts should fill the gap between announced capital funding and the optimum identified by LTIS as shown in Figure 3.1.*† However, except for the six-year capital programme, the level of resource funding for all other aspects of FCERM is determined on an annual basis and so remains uncertain.

The NAO stated in its 2020 report on flood management that Defra is confident that resource and other funding will exceed the optimum identified by LTIS. Investment in FCERM for the period 2015 to 2021 was consistent with the optimum identified by LTIS 2014, roughly £940 million (2019/20 prices) as an annual average based on a medium climate change scenario. By 2025 the Environment Agency will produce a new set of long-term investment scenarios to inform future policy and investment choices for achieving flood and coastal resilience.

Figure 3.1 Spending on flood risk in England and the optimum identified by LTIS 2019 (real terms, 2019/20 prices)



Source: Defra (2021) *Central Government Funding for Flood and Coastal Erosion Risk Management in England.* Environment Agency (2019) *Long-Term Investment Scenarios (LTIS) 2019.* National Audit Office (2020) *Managing flood risk.* HMT (2021) *GDP deflators at market prices, and money GDP March 2021(Budget).*

Despite the increase in capital funding, there remain concerns about other aspects of funding flood and coastal erosion risk management. Government should provide greater assurance that all aspects of funding will be set and maintained to

* These figures do not include partnership funding raised by other risk management authorities, Internal Drainage Board funding raised from drainage charges and special levies, or local authority funding from their Settlement Funding Assessment (SFA) spent on flood or coastal erosion risk management. See Defra (2021) in Figure 3.1 for further details.

† The announced £170 million and £200 million are not included in the annual average for 2021/22 to 2026/27. This is because there is no annual profile for this funding and LTIS does not make an explicit allowance for funding for innovation.

There may need to be 30% to 80% more investment in asset maintenance to address the greater potential for deterioration from the impacts of climate change.

manage the risk, taking the latest evidence on the impacts of climate change into account.

Recent reports by the NAO in 2020 and the House of Commons Environment, Food and Rural Affairs (EFRA) Committee in 2021, have highlighted concerns related to spending on flood risk.[13] The positive impacts of higher capital spending on flood risk could be undermined if spending on maintaining new and existing flood defence assets is not also increased. A research report published by the Environment Agency in 2017 on the impact of climate change on asset deterioration indicted that there may need to be 30% to 80% more investment in asset maintenance to address the greater potential for deterioration.[14] At present, it is uncertain what maintenance funding will be, since it is only determined on an annual basis.

The House of Commons EFRA Committee's 2021 report on flooding recommended that the Government should put in place a long-term resource budget settlement consistent with the capital investment programme, which would allow the Environment Agency and others to effectively plan and maintain flood and coastal erosion risk management assets. Government responded to this recommendation in April 2021.[15] The response stated that Government had significantly increased funding between 2015 and 2020 for the maintenance of assets and increased maintenance funding in 2020-21 relative to the previous year, with future spending to be determined by the 2021 Spending Review.

The NAO's 2020 report on managing flood risk stated that some beneficial projects are not being implemented because partnership funding is required but cannot be secured. This could lead to projects with partnership funding going ahead while other projects that offer better value for money (in terms of flood risk reduction benefits) do not. Analysis by the NAO in its 2020 report found that the Environment Agency secured £530m of partnership funding in the period 2015 to 2021, above its target of £390m, with £39 million or 7% of this from the private sector. Previous NAO analysis for the period April 2011 to March 2015, found the private sector accounted for £35 million or 25% of all partnership funding for that period.

The Environment Agency stated in its FCERM strategy that in the future there will need to be more partnership funding from non-public sources. There is no target or assessment of what proportion of partnership funding that non-public sources should account for, but Government amended the partnership funding rules in April 2020 and has since consulted on further improvements to increase contributions.

Capacity and skills shortages could affect delivery of flood and coastal erosion risk management if funding is inadequate.

Funding may also be required to help ensure that capacity and skills shortages do not affect the Environment Agency's ability to deliver the FCERM strategy and the ability of lead local flood authorities (LLFAs) to fulfil their role. A wide range of skills are needed for risk management authorities, like the Environment Agency and LLFAs, to deliver the FCERM strategy – engineering, programme management, spatial planning and community engagement skills.

The NAO stated in its 2020 report on managing flood risk that the Environment Agency may also require a 20% increase in the number of engineers it employs, despite independent research finding that Environment Agency engineer salaries are not competitive with salaries on the open market. This is further compounded by a general shortage of engineers in England. LLFAs have also reported concerns about resource funding for maintenance and more general capacity issues.

3.2.1 River and coastal flood alleviation

Progress summary – River and coastal flood alleviation		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - high** • The plan score has improved. Progress has been made in bringing together a policy statement and long-term strategy to support action on flood and coastal risk management. The Environment Agency's FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperature. Significant announcements have also been made to boost investment in flood defence schemes and supporting projects. **Risk management score - medium** • The risk management score remains the same. Good evidence exists of actions being taken through flood defence investment and the number of homes better protected, but there is a lack of evidence to quantify the resulting reduction in vulnerability or exposure of homes and people, which is needed to show good progress in managing future climate change risk. The Environment Agency failed to meet its target for 98% of 'high consequence' flood and coastal risk management assets to be in good condition in 2019/20. Long-term budgets are needed to ensure existing defences are maintained.	8
Notes: See annex for full datasets Key Indicators: Flood defence asset condition, Investment in flood defences, Annual damages from river and coastal flooding, Change in property risk bands (not yet available), Nationally consistent future flood risk maps (not yet available).		

Summary of 2019 report score

In our last report, river and coastal flood alleviation scored a 5 (medium plan score, medium risk management score).
Our 2019 report highlighted a series of plans at the time that considered long-term risks from climate change including 2°C and 4°C scenarios, but there was no overarching plan with associated outcomes and targets that brought together the different strands, linked to indicators to measure progress. On progress in managing risk, our previous report highlighted that, despite corporate Environment Agency indicators on flood defence investment and defence maintenance being met, there remained a lack of evidence to assess whether progress in protecting properties was keeping up with the rate of climate change. This is because data is not routinely collected regarding which risk bands better-protected homes have moved into and out of, for different types of flooding, including river and coastal.

Has the plan score changed?

Yes. The Committee's assessment is that progress has been made in bringing together a long-term plan to support action on flood risk management, and significant announcements have also been made to boost investment in flood defence schemes and supporting projects.

The Government has produced a new Policy Statement on flood and coastal erosion risk management, which sits alongside the Environment Agency's updated long-term Flood and Coastal Erosion Risk Management (FCERM) Strategy.

In May 2021 the Environment Agency launched its first FCERM Strategy Action Plan.

The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures. There are also several new commitments and additions that bring together disparate aspects of river and coastal flooding (see Box 3.1).

The Strategy has the objective to develop better evidence to inform future risk assessment and investment. This includes: a new national assessment of flood risk by 2024, that will help local areas better plan and adapt to future risks from all sources of flooding; a new set of long-term investment scenarios to inform future policy and investment choices; and developing adaptive pathways to enable local areas to better plan for future flooding and coastal change, and adapt to future climate hazards. It will also require Risk Management Authorities to make greater use of funding and financing from non-public sector sources, including trialling new and innovative financing to improve flood and coastal resilience.

In May 2021 the Environment Agency launched its first FCERM Strategy Action Plan. The plan will aim to deliver the strategic objectives set out in the Environment Agency's FCERM Strategy and provides a wide-ranging list of actions and monitoring of actions to be taken forward by the Environment Agency and a range of partners.[16]

While evaluation and monitoring of the Policy Statement is not yet in place, actions are underway to produce a new national set of indicators. Strictly speaking, the current lack of an effective monitoring and evaluation system should retain the plan score as medium according to the Committee's criteria (see Chapter 1), but given the significant advances elsewhere, the Committee's view is that the significant progress that has been made should be recognised through an improvement on the plan score. However, the challenge now will be to move from strategic aspirations to delivery on the ground. If, by the time of the Committee's next report in 2023, this system is not well established, the plan score may return to medium.

Has the risk management score changed?

No, the evidence available on managing risk remains the same as in 2019.

Good evidence exists of actions being taken through flood defence investment and the number of homes better protected, but there is a lack of evidence to quantify the resulting reduction in vulnerability or exposure of homes and people, which is needed to show good progress in managing future climate change risk. As set out above, the current six-year investment programme has met its target to provide better protection for 300,000 homes between 2015 and 2021. Under the Policy Statement, the Government has committed to further upgrading and expanding of national flood defences and infrastructure. The Government announced in 2020, that £5.2 billion (Figure 3.1) would be awarded over the next six-year spending period on flood and coastal erosion risk management, primarily on developing new flood defences. This funding will support schemes to better protect an estimated 336,000 homes.

It remains unclear how the quantified level of risk of homes in England will change, as the risk bands which homes move into and out of, through improvements to flood defences, are not recorded as standard. This information is needed to understand the extent to which risk is being managed or not, and thereby for our assessment to provide a high-risk reduction score.

The Policy Statement includes an action for Government to develop a national set of indicators by 2022 to monitor trends over time to better understand the impacts of policies and it would be beneficial for information on the risk bands of homes to be included within these.

The Environment Agency has not met its target for defences to be in a 'required condition'. Actions in the Policy Statement should improve how defences are monitored, inspected, and maintained. However, at present, future maintenance funding for defences is uncertain since this is determined on an annual basis.

Another key indicator of progress is the Environment Agency's 'high consequence' flood and coastal risk management assets that are in the required condition.* The 2018/19 target of 97.5% was exceeded.[17] The target was increased to 98% in 2019/20. However, the Environment Agency failed to achieve this, with 96.1% of assets in the required condition at the end of 2019/20.[18]

The Environment Agency failed to achieve its target with 96.1% of assets in the required condition at the end of 2019/20.

The position continued to deteriorate in 2021, with 94.5% in the required condition by Q4 of 2020/2021.[19] The Agency reported that this was due to increased asset damage during multiple significant flood events in November 2019 and February 2020. COVID-19 restrictions also impacted the delivery of inspection, repair and maintenance work. The Government has provided £120 million of additional funding for asset repairs that are now in progress or planned in 2020/21.

The Policy Statement includes actions to review statutory powers and responsibilities to map, monitor, inspect, and maintain all defence assets by the end of 2021. By 2024, as part of the FCERM Strategy, the Environment Agency will also develop guidance setting out a common approach for inspecting and managing all flood and coastal defences to improve resilience, information sharing and collaboration.

Whilst the Government has committed to doubling capital investment in flood risk management, it must also ensure that long-term resource spending aligns with this and is available to the Environment Agency and local authorities to be able to effectively plan for and maintain existing flood and coastal defences (see flood introduction section for more detail).

* The definition of 'high consequence' and the required condition, as well as the inspection process, is set out in Environment Agency (2014) Asset performance tools – asset inspection guidance.

3.2.2 Development in areas at risk of river or coastal flooding

Progress summary – Development in areas at risk of river or coastal flooding		
2019 score:	**What has changed since 2019:**	**2021 score:**
3	**Plan score – medium** • The plan score remains the same. National Planning Policy in England aims to steer development away from current flood risk areas and advises that future risk should be considered. However, there is a lack of resources in local authorities, and no clear policy for how local authorities should effectively account for future flood risk in plans and development decisions with a 2°C or 4°C rise in global temperature. It is positive to see some actions set out in the recent FCERM Strategy and Policy Statement that aim to ensure future development is safe from flooding. However, unclear proposals in the Government's White Paper planning consultation may make adaptation more difficult to achieve if implemented. **Risk management score – low** • The risk management score remains the same. The number of new homes granted planning permission against Environment Agency flood risk advice has increased; although in the vast majority of cases, the Agency's advice is followed. Whilst limited building in Flood Zone 3 will not create a large present day increase in flood risk, it still increases exposure in the event of defence breaches and future climate and population changes. If building on the floodplain continues at the current level the funding required to maintain existing defences and build new ones will continue to rise.	3
Notes: See annex for full datasets Key Indicators: Planning permissions not in line with Environment Agency advice, Development in Flood Zone 3, Nationally consistent future flood risk maps (not yet available).		

Summary of 2019 report score

In our last report, development in areas at risk of river or coastal flooding scored a 3 (medium plan score, low risk management score).
Our 2019 report highlighted that processes are in place to restrict development in areas of significant river or coastal flood risk, although advice from the Environment Agency on where to restrict development can be overruled. These processes do not consider the increased risk from climate change consistently, as there is no national map showing future flood risk that can be used for planning. On progress in managing risk, our previous report highlighted that exposure to flooding through new development is increasing.

Has the plan score changed?

No, the score remains the same.

There are several new commitments in the new FCERM Policy Statement and updated FCERM Strategy on guiding the design and location of new development.
These include in the Environment Agency's FCERM Strategy:

- Producing a National Flood Risk Assessment (NaFRA2) system to deliver a single, scalable assessment of flood risk that to be rolled out to in 2024.

When published, this should help places better plan and adapt to future risks from flooding from rivers, the sea and surface water.

- Environment Agency and coastal protection authorities advising planning authorities on how shoreline management plans can better inform planning policies for the coast, including designation of coastal change management areas.

In the Government's Policy Statement:

- Plans to review policy for building in areas of flood risk, to ensure that future development will be safe from flooding and assess whether current protections in the National Planning Policy Framework (NPPF) are adequate. A review and assessment of the NPPF has been undertaken by MHCLG but not yet published at the time of writing.

- Reviewing the effectiveness of existing planning policy on Coastal Change Management Areas (CMAs).

- Identifying what more could be done in cases where Environment Agency's advice on planning applications is not followed and considering ways to boost transparency, data collection, and reporting where Environment Agency or Lead Local Flood Authority advice is given.

While national planning policy in England should steer development away from current flood risk areas and advises that future risk should be considered, at present there is no standard, national map of future flood risk and no clear policy for how local authorities should effectively account for flood risk with a 2°C or 4°C rise in global temperature in plans and development decisions.
Planning applications that are subject to river and coastal flood risk have a series of logical tests applied to them. In 2021, MHCLG published a consultation to make some changes to the National Planning Policy Framework (NPPF).[20] The proposals include:

- Clarifying that all sources of flood risk should be accounted for in Local Plans.

- Strengthening the wording around opportunities provided by new developments (e.g. through use of green infrastructure and natural flood management).

- Moving the Flood Risk Vulnerability Classification from Planning Practice Guidance into the NPPF.

The consultation does not take the opportunity to make the significant changes to the approach to planning for flood risk that the Committee thinks are needed and does not take account of the Government's promised review of policy for building in areas at flood risk.

The Environment, Food and Rural Affairs (EFRA) Committee review of flooding in 2021 found that local planning authorities lack the knowledge and/or resources to effectively factor the impacts of climate change into their local plans and development decisions.[21] The EFRA Committee recommended that the Government must ensure that all local planning authorities have the powers, resources and information they need to perform this function, including properly trained, dedicated staff and funding.

As part of the 2021 Spending Review, the Government is considering the priorities for local government finance reform, including how to allocate funding to councils.[22] This should include flood and coastal erosion risk management functions. The 2021 FCERM action plan includes an action for the Environment Agency to work with the Town & Country Planning Association to develop online learning to help planners better account for flood risk and climate change.

The 2020 Planning White Paper proposals set an aim to provide better quality homes and places that enhance the environment, health, and the character of local areas. However, the paper as published will not achieve this for climate resilience. More information is needed to understand the Government's intentions with the forthcoming Planning Bill.

Planning reform provides an opportunity to improve the approach to planning for climate change and introduce greater clarity in planning policy and guidance. In August 2020 the Government consulted on a significant reform to planning in England.[23] The White Paper sets out three designated categories for land, with areas at risk of flooding excluded from the 'growth' area category, unless mitigation measures can be put in place. However, it is not clear what level of flood risk will trigger these protections, or what is included within the definition of 'mitigated flood risk'.

The White Paper proposes introducing legally binding housing targets for each local authority, set by Government. There is no detail on how these targets will take account of land constraints in each local authority area, outside of the green belt, including land that is at risk of flooding but also for land that is not suitable for development because it has very high biodiversity or amenity value.

The paper also proposes to roll all planning policy into the Local Plan, while making it shorter and quicker to produce. The Committee is supportive of looking at planning in a more integrated way but is concerned that capacity to consider complex issues such as climate change, will be materially reduced in a system aiming to prepare plans more quickly and making them shorter. Alongside this, removing the 'duty to cooperate' could make adaptation action across local authority areas more difficult to achieve. More information is needed on the plans for the forthcoming Planning Bill and how the proposals in the White Paper are to be achieved in practice. MHCLG, must therefore publish the policy recommendations from the internal review of planning policy for building in areas of flood risk, as soon as possible.

Recommendation

Ensure that all types of current and future flood risk are included in policies to assess flood risk to new developments. Housing targets for local authorities should take account of flood risk, amongst other environmental issues. Assessments and management of flood risk in new developments must include as a minimum:

- Evidence that the development will be safe over its full lifetime, with a consideration of the downstream interactions and impacts of new developments i.e. not increase flooding in any other areas.
- An assessment of current and future flood risk under both a 2°C and 4°C global climate scenarios.
- Assess and manage the risk of flooding to local infrastructure as well as housing.
- A consideration of better preparedness as set out in the Government's recent FCERM Policy Statement.
- Ensure there are properly funded and trained staff in local authorities.

Department: MHCLG, Timing: 2022.

Has the risk management score changed?

No, the evidence available on managing risk remains the same as in 2019.

The number of new homes granted planning permission against Environment Agency flood risk advice has increased; although, in the vast majority of cases, the Agency's advice is followed.

Whilst the Environment Agency is a statutory consultee on development proposed in proximity to a main river, in Flood Zones 2 or 3,* or in areas with critical drainage problems, it is not a statutory consultee in relation to sources of flooding other than rivers and the sea. Nor is it a statutory consultee on development in Flood Zone 1† even when such areas are identified as being at future risk of flooding from rivers and the sea due to the predicted impacts of climate change.

Between April 2019 and March 2020, 866 homes (~2.4% of new homes proposed in planning applications) were granted permissions against Environment Agency advice.

Between 1 April 2019 and 31 March 2020, fewer than 5% of planning applications per year were approved against Environment Agency advice, which is comparable to previous years.[24] During this time, 866 homes (~2.4% of new homes proposed in planning applications) were granted permissions against Environment Agency advice. This is up from less than 1% of new homes proposed in 2018-19.[25] Where local authorities wish to grant permission for major development‡ against Environment Agency advice, they are required to refer cases to the MHCLG Secretary of State. However, it is not clear if this process is always followed. Some of those developments built against Environment Agency advice could therefore be at significant risk now or in the future if advice to reduce flood risk has not been followed.

The Environment Agency publish a list of flood risk objections.[26] Local Planning Authorities also have an obligation under the Single Data List to report to Defra about planning permissions granted against Environment Agency advice.[27] In 2021, the Agency are planning to publish more information where local authorities have granted planning permission against their flood risk advice.[28]

There is relatively limited building of new homes in Flood Zone 3. However, while it will not create a large present increase in flood risk, fundamentally, it still increases the exposure of people and buildings to current and future flooding in the event of a weakening of planning policy, defence breaches or fails, or future climate and population changes.

In 2017-18, 9% of new residential addresses were built in Flood Zone 3, up from 7% in 2013-14.

Approximately 10% of land in England is classified as within Flood Zone 3 by the Environment Agency. In 2017-18, 9% (17,580) of new residential addresses were built in Flood Zone 3 (Figure 3.2), up from 7% in 2013-14.§ [29]

Whilst there is relatively limited building of new homes in Flood Zone 3, the Environment Agency's Long Term Investment Scenarios calculate, based on population growth projections, and the resultant need for new homes, that England is likely to see almost double the number of properties in Flood Zone 3 - an increase from 2.4 million to 4.6 million - over the next 50 years.

* Flood Zone 2 covers areas with between a 1:100-year risk (1% annual probability) and 1:1,000-year risk (0.1% annual probability) of river flooding or between a 1:200-year risk (0.5% annual probability) and 1:1,000-year risk (0.1% annual probability) of sea flooding. Flood Zone 3 covers areas with a greater than 1:100-year risk (1% annual probability) of river flooding or a greater than 1:200-year risk (0.5% annual probability) of flooding from the sea.

† Flood Zone 1 covers areas with a less than 1:1,000-year risk (0.1% annual probability) of river or sea flooding.

‡ Major housing development is where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more.

§ The effect of flood defences is not considered in this calculation.

This work suggests that as long as local planning authorities implement national planning policy effectively, the increase in future property damages from flooding should be relatively modest at 4%, compared to a scenario where there is no new development on the flood plain. However, if national planning policy or its local implementation is weakened, the outlook could be very different, with property damages potentially increasing by over 30% during this period. In addition, if building on the floodplain continues at this level the funding required to maintain existing, and to build new defences will continue to rise (See Section 3.2.1 for cost estimates).

There is also concern that a spatial shift in flood zones as a result of climate change will result in more homes built over the last decade ending up in higher flood zones over their lifetime without further action.

Analysis of new homes in Flood Zone 3 found a greater proportion of new development on the floodplain takes place in the most socially vulnerable communities (~1.5% greater).[30]

One study has found that a disproportionately higher number of homes built in 'struggling or declining' neighbourhoods between 2008 and 2018 are expected to end up in areas at a high risk of flooding over their lifetime as a result of climate change.[31]

Figures for new addresses in Flood Zone 3, taking account of flood defences and the condition they are in have been published for the first time for 2017-18 (Figure 3.2).*

In 2017-18, 3% of all new residential addresses were built in areas at risk of medium or high flooding within Flood Zone 3.

In 2017-18, 3% (5,860) of all new residential addresses were built in areas at risk of medium or high flooding within Flood Zone 3. While the yearly rates of new homes in flood zones have increased only moderately on the national level, differences between regions exist. For a few regions, there is little land within the region that is not on a floodplain so local authorities have few options but to build there in order to meet housing targets. It is not known if these developments are being built with appropriate protection measures in place for current and future flood risk (for example at the property level – see Section 3.2.5).

* Land assessed as having a chance of flooding from rivers and the sea presented in categories taking account of flood defences and the condition, they are in. High Risk: each year, there is a chance of flooding of greater than 1 in 30 (3.3%). Medium Risk: each year, there is a chance of flooding of between 1 in 30 (3.3%) and 1 in 100 (1%).

Figure 3.2 Proportion of new residential addresses created in National Flood Zone 3, 2013 – 2018

Source: MHCLG (2020) *Land Use Change Statistics (LUCS) residential address-based change table 2017-2018.*

The high number of static caravans located along the eastern coastline of the UK are particularly vulnerable to current and future coastal flood risk.
During 2020 there were applications to extend occupancy rights of caravan sites at high risk of coastal flooding, running the risk of creating permanent settlements in locations which would not normally receive planning permission. Any development will increase risk if it allows people to occupy caravans in high risk areas over winter months when coastal flooding is more likely:

- Updated flood projections for the third UK Climate Change Risk Assessment show that the expected annual damages from coastal flooding in eastern regions of England is projected to increase by 50% over the next 30 years, even with the benefit of current flood mitigation plans.* [32]

- Static caravans are more vulnerable than permanent dwellings during a flood, not least because they provide no upper floor refuge, and are prone to movement, damage or even collapse in flood events.

- Static caravan owners or occupiers may be less familiar with an area if they are not permanent residents, and therefore they could be less aware of potential flood risks, flood mitigations or evacuation routes.

* Assuming 4C scenario with low population and including direct and indirect damages.

3.2.3 Surface water flood alleviation

Progress summary – Surface water flood alleviation		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - medium** • The plan score has improved. Progress has been made in bringing together a policy statement and long-term strategy to support action on flood and coastal risk management, including surface water flooding. The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures. The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptative planning. Actions mostly draw on building up guidance and re-committing to previous actions. All LLFAs now have surface water flood management strategies published but there has still not been an assessment of the quality and consistency of those plans. **Risk management score - medium** • The risk management score remains the same. A third of recently completed FCERM schemes are focussed on surface water flood risk management. Water companies are investing in reducing risk of sewer flooding to homes and money is being invested to improve forecasting and maps of risk. However, the number of properties at risk of surface water flooding is projected to increase, even with adaptation action. Better data on sewer capacity, number and type of SuDS being installed and collection of information of surface water incidents is needed.	5
Notes: See annex for full datasets Key Indicators: Area of permeable and impermeable land within all urban areas in England, Number of people and properties at risk of surface water flooding (for return period of 1/30 or 1.33% per year), Number, type and location of SuDS installations in new builds and retrofits (not yet available), Metrics of sewer network capacity and spills as outlined in Water UK's Capacity Assessment Framework (not yet available), Water company investment in retrofitting SuDS (not yet available), Number of people or properties benefitting from SuDS (inc. green infrastructure) (not yet available), Number and cost of surface water flooding events (not yet available).		

Summary of 2019 report score

In our last report, surface water flood alleviation scored a 2 (low plan score, medium risk management score).
Our 2019 report highlighted that the systems for managing surface water flood risk are fragmented but plans and processes are coming together. However, climate change is missing from those plans. On progress in managing risk, our previous report highlighted that water companies are investing in retrofitting sustainable drainage systems (SuDS) for some existing homes. However, limited capacity in the sewer network means that the significant increase in surface water flood risk that is projected is unlikely to be managed adequately based on current action.

Has the plan score changed?

Yes. The Committee's assessment suggests progress has been made in bringing together a long-term plan to support action on flood risk management, including surface water flood risk.

The Government has produced a Policy Statement on FCERM supported by the Environment Agency's updated long-term FCERM Strategy (see chapter introduction). The FCERM Strategy puts in place measures that will allow for climate adaptation, seeking to better prepare for a 2°C rise in global temperature, as well as planning for higher scenarios, such as a 4°C rise in global temperatures.

The new FCERM Strategy has several commitments for the Environment Agency to work with Ofwat, water companies and other Risk Management Authorities to improve resilience to surface water and drainage flood risks and encourage long-term adaptative planning. In terms of surface water flooding, actions mostly draw on building up guidance and re-committing to previous actions, for example:

- The Environment Bill will require water companies to develop Drainage and Wastewater Management Plans[33] by end of 2022 to improve drainage and environmental water quality. Climate change should be a key component considered within water company drainage plans. The 21st Century Drainage Programme Capacity Assessment Framework sets out the need to use a range of climate scenarios.[34] The publication of these may improve the score for the 2023 Progress Report, although it is important that other Risk Management Authorities feed into the plans.

- Water companies will invest more than £1 billion between 2020 and 2025 to protect the environment, homes, business and drinking water from flooding, and have committed to reducing sewer flooding incidents.

The Policy Statement commits to taking forward the actions in the Surface Water Management Plan and publishing an update on progress made to implement the plan for spring 2021.[35] Actions include working with lead local flood authorities (LLFAs) to develop guidance to set out the best practice for local flood defence management and record keeping.

An independent review of the arrangements for determining responsibility for surface water and drainage assets was published in May 2020.[36]
The Government agreed to implement 12 of the recommendations in order to make responsibility for surface water and drainage assets more efficient, straightforward and effective which is a positive step, although it will be important to see these recommendations put into action. Recommendations include those which aim to improve clarity over roles and responsibilities, ensure flood investigation reports consider the views of residents and businesses and that lessons learned are shared widely. It also recommends that better advice is made available to homes and businesses at risk of surface water flooding to help them improve their own protection and resilience. The actions should build upon those in the FCERM Strategy and Policy Strategy and the Surface Water Management Action Plan.[37]

As reported in 2019, all LLFAs now have surface water flood management strategies published. However, there has still not been an assessment of the quality and consistency of those plans.

Has the risk management score changed?

No. The evidence available on managing risk remains the same as in 2019.

Around 30% of FCERM schemes are focussed on surface water flood risk management and water companies are investing in reducing risk of sewer flooding to homes.

31% of the 176 schemes completed between April 2019 and March 2020 aimed to better protect people and homes from surface water flooding.

The data linked with the Environment Agency's six-year FCERM programme show that 54 (31%) of the 176 schemes completed between April 2019 and March 2020 aimed to better protect people and homes from surface water flooding. This is up from April 2017 to March 2018 when 24% of schemes were for surface water flood management.[38] In April 2020, the Government announced changes to how the Government funding is allocated to flood projects including the introduction of a new risk category which will enable schemes that prevent surface water flooding to qualify for more funding.[39]

The Environment Agency publishes an annual report on the environmental performance of the nine water and sewerage companies operating mainly in England. Between 1 April 2019 and 31 March 2020, water companies invested:[40]

- £132 million to reduce the risk of sewer flooding to homes (down from £187 million in 2018-19).
- £300 million to maintain the public sewer system to prevent blockages and flooding (up from £288 million in 2018-19 and £111 million in 2017-18).
- £2 million in property-level measures to reduce the risk of sewer flooding in homes (down from £4.7 million in 2018-19).

Money is being invested to improve forecasting and produce new maps of risk.

The Surface Water Management Action Plan has invested £2 million since April 2019 to enable lead local flood authorities (LLFAs) to update their flood risk maps - covering over 1500km^2, which includes just under 225,000 properties and 2.7 million people at risk of flooding. The FCERM Strategy says that by 2024 the Environment Agency will produce a new national assessment of flood risk that will help places better plan and adapt to future risks from flooding from rivers, the sea and surface water. This should help improve the ability to assess vulnerability changes.

£1.2 billion is also being invested to improve severe weather and climate forecasting which will help to more accurately predict storms that lead to flash flooding.[41] The release of higher resolution data as part of the latest update to the UK Climate Projections should also enable improvements to research on future changes in the frequency, intensity and spatial distribution of the severe storms that often drive surface water flooding.

The updated flood risk project for the third CCRA highlighted that around 420,000 properties are currently at significant risk from surface water flooding in England.[42]

The number of properties at significant (1/30 year, or 3.3%) risk will increase by 59% by 2050, and 83% by 2080 under a scenario of a 2˚C global temperature rise.

Projections show that even under an extended adaptation scenario* with low population rise, the number of properties at significant (1/30 year, or 3.3%) risk will increase by 59% by 2050, and 83% by 2080 under a scenario of a 2˚C global temperature rise. This increases further under a 4˚C scenario with an increase of 91% by 2050 and 137% by 2080s.

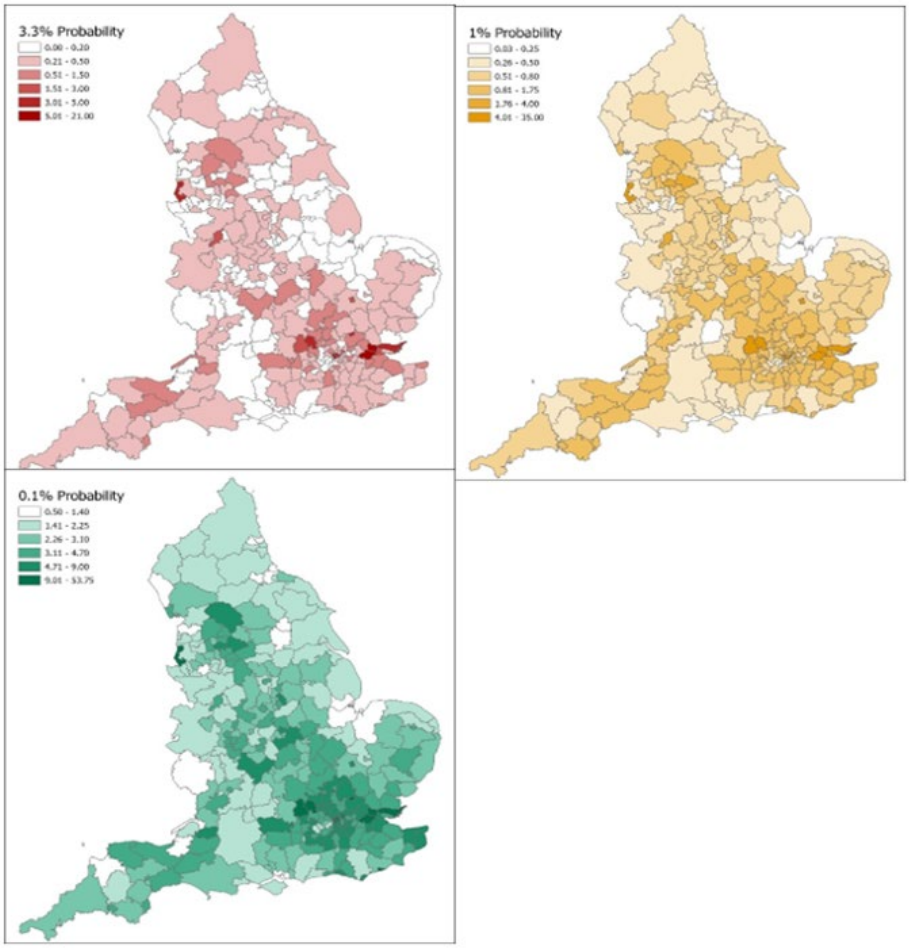
Research for the CCC found that across all flood risk levels, the south-east has a high percentage of properties at risk of surface water flooding, although all parts of the country are at risk (Figure 3.3).

* This 'current objectives+' scenario goes beyond the current implementation of policy (and recently introduced policy) to represent an enhanced whole system approach to adaptation (i.e. implementation is in-line with the higher level of ambition).

There remains a need for better data on sewer capacity, asset management and standards, SuDS and collection of information on surface water incidents.[43]

A co-ordinated approach to identifying, incentivising and managing opportunities for installing retrofit SuDS is also required. This should ensure they are not missed and that relevant parties fully understand how SuDS can help them to achieve their own objectives, for example by sharing the cost of the scheme or by qualifying for a reduction in sewerage charges.

Figure 3.3 Percentage of properties in each Local Authority with a 3.3% (a), 1% (b) and 0.1% (c) probability of flooding from surface water in England.



Source: ADAS for the CCC (2021) *Research to update indicators of climate-related risks and actions in England.*

3.2.4 Development and surface water flood risk

Progress summary – Development and surface water flood risk		
2019 score:	**What has changed since 2019:**	**2021 score:**
1	**Plan score - low** • The plan score remains the same. There is no plan to address development and surface water flood risk which takes into account a 2°C rise in global temperature, with consideration of 4°C. The planning system has inherent issues for dealing with surface water and ensuring that multi-beneficial SuDS are installed. Planning Practice Guidance and non-statutory SuDS standards have not yet been updated. **Risk management score - low** • The risk management score remains the same. Surface water flooding remains a concern in new developments due to the rising level of risk in a changing climate. Homes are being built in areas at risk of surface water that may not have had any expert flood mitigation advice. The data that could show whether the planning system is reducing risk are not collected and there are no other indications that such a reduction is happening. The proportion of urban areas made up of impermeable surfacing, has increased since 2001, but remained stable since 2018.	1
Notes: See annex for full datasets Key Indicators: Area of permeable and impermeable land within all urban areas in England, The number of properties built in areas of surface water flood risk (not yet available), Number, type and location of SuDS installations in new builds and retrofits (not yet available)		

Summary of 2019 report score

In our last report, development and surface water flood risk management scored a 1 (low plan score, low risk management score).
Our 2019 report found that there are no plans or processes that ensure new development in areas of surface water flood risk does not increase overall exposure or vulnerability. On progress in managing risk, our previous report highlighted that there is little evidence that 'green' sustainable drainage systems are deployed in new developments and that practitioners had little confidence that this was taking place.

Has the plan score changed?

No, the score remains the same.

The planning system has inherent issues for dealing with surface water and ensuring that SuDS are installed. Although wording has been strengthened in the National Planning Policy Framework and the uptake of sustainable drainage systems has improved in recent years, the installation of high-quality SuDS that deliver multiple environmental benefits may still be insufficiently incentivised.
In 2019, the Committee recommended that the National Planning Policy Framework (NPPF) and planning practice guidance (PPG) should be updated to ensure that Sustainable Drainage Systems (SuDS) installations maximise their impact in terms of flood risk reduction and their co-benefits, such as biodiversity and amenity value. This could be done by aligning the NPPF and PPG with the aims of

Schedule 3 of the Flood and Water Management Act (2010).* In 2020 the Committee again made similar recommendations.[44]

In its response, the Government acknowledged the importance of encouraging natural flood management approaches, such as green sustainable drainage systems (SuDS), to ensure flood risk is managed effectively locally and nationally. MHCLG committed to publishing a revised PPG clarifying how green SuDS can reduce impacts of flooding and deliver additional benefits for biodiversity and the environment and set out how new drainage systems must comply with the Environment Agency's climate change allowances for rainfall intensity.[45] As yet, there have been no updates to the PPG, where issues of 'grey' vs 'green' SuDS, their adoption and wider benefits of green infrastructure could be dealt with more explicitly than in the NPPF. Also, Schedule 3 of the Flood and Water Management Act that sets out SuDS standards, an approval process, rules on adoption and changes to the right to connect to public sewers, was never enacted nor its requirements aligned with planning policy.

Several local authorities have produced their own guidance and standards to be followed, but nation-wide standards defining how to implement SuDS are currently non-statutory, only apply to developments of 10 or more properties and do not promote green SuDS. Defra has commissioned research to explore whether updating the Non-statutory Technical Standards for SuDS (NSTS) could help deliver SuDS that provide multiple benefits beyond managing surface water runoff, contributing to improved climate adaptation, health and wellbeing and better places and spaces.[46] The research also considers what the requirements to update the standards for the integration of high-quality multiple benefit SuDS might be.[47] The research report is due to be published in 2021.

The Government's Storm Overflows Taskforce, set up to eliminate harm from storm overflows, will consider a number of drainage issues, such as Sustainable Drainage Systems, including Schedule 3, and section 106 of the Water Industry Act 1991—right to connect to the public sewer. The taskforce will be reporting to Government in summer 2021.[48]

Recommendation
To address the issue of increased risk of surface water flooding in new developments, commit to ensuring that new developments do not put more water into the public sewers than what was there before, taking into account climate change. To incentivise this, end the automatic right to connect to the public sewer; planning reforms should enact Schedule 3 of the Flood and Water Management Act (2010); and technical SuDS standards should be made mandatory and be updated to deliver SuDS that provide multiple economic, social and environmental benefits. Department: MHCLG, Timing: 2022.

New rules (April 2020) mean that SuDS elements such as swales, basins, soakaways, and ponds, are officially recognised as 'surface water sewers' and can be adopted by water and sewage companies in England.[49]
Sewers For Adoption will support water companies to take on responsibility for these types of measures. However, it doesn't cover all type of SuDS features and is confined by what is defined as a sewer (e.g. permeable paving is not covered).

* Schedule 3 of the Flood and Water Management Act (2010), would require all new developments to include SuDS features that comply with national standards.

There are a range of other plans and policies that provide an opportunity for surface water flood resilience and other wider benefits by improving and increasing green space and green infrastructure.
It is not clear whether the steer in recent and upcoming policies to undertake more urban greening are being fully realised or taken up by developers yet.

- The Environment Bill: If enacted, will require developers to deliver at least a 10% improvement in biodiversity value (biodiversity net gain). This could be through a green roof or an on-site nature reserve, which could also act as a means of sustainable drainage, adjacent to a new housing development.

- Net Zero: Policies to reduce greenhouse gas emissions and improve air quality may also provide natural flood risk management in urban areas (see Chapter 2). For example, increased tree planting and green spaces for safer pedestrian and cycling access routes.

- Green Recovery: The Natural Capital Committee has highlighted the importance of access to green space. It can be beneficial to health and well-being, in terms of physical and mental health but also by reducing urban heat islands (see Section 3.5.1).[50]

- Sewage Inland Waters Bill: Proposed mitigation for sewage spills (such as nature-based solutions to manage water flow) could also lead to increased flood mitigation.

Has the risk management score changed?

No. The evidence available on managing risk remains the same as in 2019.

The data that could show that the planning system is reducing risk are not collected and there are no other indications that such a reduction is happening.
It remains unclear how much preference is being given to 'green' sustainable drainage systems (SuDS) in new developments. There is no readily available national dataset on the number of planning applications in areas at risk of surface water flooding, nor the impact of any advice given to developers and no monitoring of the uptake of SuDS. This means it is not possible to assess the effectiveness of current planning policy and whether 'green' SuDS are being installed.

Recommendation
To help improve the information on SuDS and surface water flood risk, urgently begin collecting data on sewer capacity and SuDS location, type and capacity. This would bring the level of information in line with that for river and coastal flood risk defences. Department: MHCLG, Timing: 2021.

Homes are being built in areas at risk of surface water that may not have had any expert flood mitigation advice. There remain no statutory consultees (such as the Environment Agency) for assessing major new developments in areas at risk of surface water flood risk.

Between 2013 and 2018, around 23,000 new properties were built in areas at medium or greater risk of surface water flooding (1 in a 100 chance of flooding each year)

Between 2013 and 2018, around 23,000 new properties were built in areas at medium or greater risk of surface water flooding (1 in a 100 chance of flooding each year). [51] Environment Agency analysis added a 5m buffer around these at risk areas as an indication of likely increases in flood risk due to climate change, and to take account of errors in mapping.

Including the buffer, this increases the number of properties to around 67,800, approximately 6.7% of new addresses between 2013-2018.

Given the lack of a statutory planning consultee on development in areas at risk from surface water flooding, there is a high likelihood that a significant proportion of these homes will have been granted planning permission without appropriate expert advice, and may therefore not incorporate the flood mitigation measures needed to make the development safe and resilient over its lifetime.

Recommendation
The consultation process for surface water flood risk must be improved. This should be done by adding statutory consultees for all development type and sizes. Consultees must have the appropriate skills to provide advice on surface water flood mitigation. Ensure that local authorities fully justify planning decisions where applications can proceed either without or going against formal flood risk mitigation advice. Department: MHCLG, Timing: 2022.

The total area of impermeable surfaces in urban locations has increased since 2001.[52]

The CCC's previous indicator showed an increase in impermeable areas from 477,000 hectares in 2001 to 621,000 hectares in 2018, remaining constant from then to 2020. The impermeable fraction of the total urban area increased from 37% in 2001 to 45% in 2020.

The CCC now has access to an improved indicator (which includes larger areas of greenspace within cities and towns, not captured in the original indicator). Data from this indicator is only available since 2016. The new indicator shows that:

- Impermeable surfaces have increased 1% between 2016 and 2020. This increase is made up of a 4% rise in manmade surfaces (making up 75% of total impermeable area in 2020) and a 7% fall in multiple surfaces that are impermeable, such as partially paved domestic gardens and road verges, for example (making up 25% of total impermeable area in 2020).

- Since 2018, the overall impermeable area fraction has remained stable at 40% of the total urban area.

Research for Yorkshire Water has assessed the impact of reducing impermeable areas in 10 catchment areas.[53] It found that reducing impermeable surfacing can help reduce future flood risk, but that other interventions will also be required.

3.2.5 Property-level flood resilience (PFR)

Progress summary – Property-level flood resilience (PFR)		
2019 score:	**What has changed since 2019:**	**2021 score:**
3	**Plan score - medium** • The plan score remains the same. There has been progress in planning for how to increase the uptake of PFR. New measures in the FCERM strategy and a new Code of Practice, and proposed amendments to the Flood Re Scheme if implemented should all have a positive impact on the uptake and effectiveness of PFR. However, there remains a need for targets for large-scale implementation of PFR measures, with effective monitoring and evaluation built in. **Risk management score - low** • The risk management score remains the same. The current rate of PFR implementation remains low and could leave many homes vulnerable to flooding that would benefit from PFR.	3
Notes: See annex for full datasets Key Indicators: Number of homes that would benefit from PFR, Number of homes installing PFR per year.		

Summary of 2019 report score

In our last report, property-level flood resilience (PFR) scored a 3 (medium plan score, low risk management score).
Our 2019 report identified important aspirations outlined by Defra in their PFR Action Plan and work by Flood Re and others on approaches to encourage homeowners to put PFR in place, such as a Code of Practice and Certification Scheme. However, there were no clear plans for targets for large-scale implementation and PFR plans did not consider interventions in the context of climate changes of any magnitude.

The rate of PFR implementation was low when compared to indicative analysis from the Environment Agency's latest flood risk investment analysis.

Has the plan score changed?

No, the plan score for PFR remains medium. There has been positive progress, but to improve this score, targets for large-scale implementation of PFR need to be set out with effective monitoring and evaluation built in.

The Environment Agency's FCERM Strategy aims to mainstream PFR measures and encourage homes and businesses to build back better after flooding. An Action Plan published in May 2021 has provided further details on progress and planned action.
The FCERM Strategy sets a strategic objective that between now and 2040, risk management authorities will work with the finance sector and other partners to mainstream property flood resilience measures and to 'build back better' after flooding.[54] This objective is supported by two measures. The first measure is that from 2021, risk management authorities will work with the finance sector, Flood Re and the property flood resilience industry to increase the uptake of property flood resilience measures in communities at highest risk.

The second measure is that by 2025 the Environment Agency will work with government and other partners to tackle the policy, financial and behavioural barriers to mainstreaming property flood resilience measures and 'building back better' after flooding.

Government is also investing £3 million to support three regional property flood resilience pathfinder projects to learn lessons which could be applied more widely. This is supporting new research initiatives, demonstration centres and advice portals that will help local communities in Yorkshire, the Oxfordshire to Cambridge Arc, and Devon and Cornwall, to learn about the benefits of installing property flood resilience measures in their homes.

In May 2021 the Environment Agency published an Action Plan which provided further detail on the progress made against measures in the FCERM Strategy as well as planned further action up to April 2022.

In May 2021 the Environment Agency published an Action Plan which provided further detail on the progress made against measures in the FCERM Strategy as well as planned further action up to April 2022.[55] The planned actions for PFR included:

- In July 2021, the Environment Agency will publish additional research to fill PFR knowledge gaps.
- By summer 2021, the Association of British Insurers (ABI), the British Insurance Brokers Association and Flood Re will publish a new specialist directory of brokers and insurers to support customers that are unable to get flood insurance cover.
- By November 2021, the Environment Agency will launch a new PFR Framework of suppliers.
- By December 2021, the Environment Agency and Chartered Institution of Water and Environmental Management (CIWEM) will support the PFR industry to develop a system of independent PFR training and accreditation.
- By March 2022, the National Flood Forum and the Environment Agency will publish lessons learnt on the measures needed to install property flood resilience.
- By April 2022, the Environment Agency will develop a bespoke tool for better valuing the economic benefits of PFR to local communities.

The Government's FCERM Policy Statement committed to several actions to improve the uptake of PFR among homes at high risk of flooding.
The Government published a Policy Statement on Flood and Coastal Erosion Risk Management in July 2020.[56] This included a commitment to explore ways to provide greater clarity about the use and effectiveness of property flood resilience measures for homes and businesses at high risk of flooding, including how the benefits can be recorded. It stated that Government would build on the three regional pathfinder projects to boost uptake of PFR, including through Government's new £200m innovative resilience fund. It also announced plans to consult on improvements to the efficiency and effectiveness of the Flood Re scheme to encourage greater uptake of PFR among households at high risk of flooding across the UK, which has since been published.

The Government has consulted on changes to the Flood Re Scheme to increase the uptake of PFR. The current regulations underpinning the scheme are preventing Flood Re from creating incentives for an acceleration of uptake of PFR, which the consultation is aiming to rectify.

Based on proposals in Flood Re's Quinquennial Review published in 2019, the Government published a consultation in 2021 on amendments to the Flood Re Scheme.[57] These proposals included:

- The ability for Flood Re to offer discounted premiums to households that have fitted property flood resilience measures, such as airbrick covers or non-return valves.
- Building an evidence base on the uptake and impact of PFR and, if suitable, using the data to stimulate the insurance industry to take account of reductions in damages due to PFR.
- The ability for Flood Re to reimburse insurers, and in turn property owners, up to £10,000 to build back better in order to reduce the future risk of the property flooding and/or the cost of repair.
- Enabling Flood Re to spend any surplus it accrues (beyond what it requires to operate and meet its regulatory requirements) on further activities to support the transition to a risk reflective home insurance market, including accelerating the uptake of PFR.
- Further reducing the cost of its cheapest premiums to ensure it is affordable for low income households.

New proposals from Government would help address some of the barriers that contribute to the low rate of PFR installation if implemented.

These proposals would allow better use of Flood Re's funds to address some of the barriers that contribute to the slow rate of PFR installation, detailed in the section below. A review of Flood Re's Quinquennial Review by the Government Actuary's Department (GAD) found that 'based on the modelling and wide range of scenarios, the financial elements of the QQR recommendations are affordable.'[58]

Defra has also published a call for evidence on local factors in managing flood and coastal erosion risk and Property Flood Resilience.[59] The consultation suggests that a number of enablers need to made effective to increase the uptake of PFR. Respondents were asked to provide their views on enablers such as: financing and incentives, planning policy, building regulations and standards, training and technical expertise, evidence and data sharing and communication and understanding.

As a result of their 2020 'Bricks and Water' inquiry, Policy Connect and Westminster Sustainable Business Forum recommended that 'given the limited uptake of property flood resilience measures and continued development within the floodplain, Government should either extend the Flood Re scheme to cover residential buildings constructed after 1st January 2009, or put in place an alternative scheme. This should be evaluated as part of the ongoing Blanc review into flood insurance.' The Inquiry also recommended that performance targets should be included in the forthcoming Future Homes Standard.

The Blanc review of flood insurance in Doncaster (following the flooding that took place in November 2019) found some gaps in existing coverage.[60] The review found significant differences between owner-occupiers and tenants; with most tenants being poorly protected. In addition, 6% of buildings insurance and 6.5% of contents insurance for owner-occupiers did not cover flooding. The review made a series of recommendations including for Defra to carry out a larger survey of the

proportion of buildings and contents insurance policies that do not cover the risk of flooding. It is important that measures to address gaps in insurance coverage are consistent with achieving an increase in the uptake of PFR.

A new Code of Practice and guidance for PFR has been published. A new report has also assessed that Flood Performance Certificates would help address barriers to PFR and help increase the rate of installation.
A Code of Practice and guidance for property flood resilience was developed by Kelly et al. and published by the Construction Industry Research and Information Association (CIRIA) in 2020.[61] It contains six standards covering requirements for stages from hazard assessment to operation and maintenance, and acts as a PFR benchmark. The guidance notes that risks to the property may increase due to factors such as urbanisation and climate change, and that to ensure a level of protection for a property, PFR measures need to be operated and maintained following the guidance provided in a handover pack.

Policy Connect and Westminster Sustainable Business Forum also recommended in their 2020 'Bricks and Water' inquiry that Part C of the Building Regulations should be updated to require all properties at risk of flooding to include property flood resilience measures and that these measures should be specified and installed in accordance with the industry Code of Practice for property flood resilience.

Flood Performance Certificates for property owners could be made mandatory in the future to help increase PFR uptake.

Flood Re commissioned WPI Economics to produce a report on Flood Performance Certificates which was published in December 2020.[62] This is a document for the homeowner and any potential purchasers or renters of the property which sets out the severity of its flood risk and steps that could be taken to mitigate the risk. The report assesses that this would help address existing barriers and provide greater incentives for improving household resilience. It also suggested that following consultation and supporting legislation, a scheme could be opened in 2022 and made mandatory towards the end of the decade.

Research on applying behavioural insights to property flood resilience was published by the Environment Agency in September 2020 as part of the FCERM R&D Programme.[63] The project identified several factors such as adoption among peers, removing points of 'hassle' in the process and referencing social norms in messaging, which could be taken into account to help increase the uptake of PFR.

The Government also extended its grant scheme in 2020 to help flood-hit homes and businesses make properties more resilient to future flooding.
In September 2020 the Government also announced the extension of the £5,000 grant scheme available to those affected by flooding in the winter of 2019/20 to take into account delays to repair work and the additional pressures placed on local authorities by the COVID-19 pandemic.[64] The grants of up to £5,000 are a contribution towards making a property more resilient to future flooding, such as putting in flood doors and raising electrics from ground level. Flood-hit homes, businesses and charities in communities with over 25 properties flooded were eligible to apply. It remains at Government's discretion as to whether this or similar grant schemes are activated after future flooding events.

Has the risk management score changed?

No, the risk management score for PFR remains low. While the positive developments detailed in the 'Has the plan score changed?' section should increase the uptake of PFR, the most recent data on installation rates still suggest that many homes that could benefit from PFR would not have it installed for a long time. This rate needs to increase and be measured against an explicit target for the score to improve.

The current rate of PFR installation is approximately 500 to 2,000 homes per year based on limited data.

The current rate of PFR installation is approximately 500 to 2,000 homes per year based on limited data. The estimate of 500 homes is based on data sourced from the Environment Agency's programme of PFR schemes for 2015/16 to 2020/21.[65] The estimate of 2,000 homes per year is based on a statement by Defra in its 2021 call for evidence that there have been around 23,000 publicly funded installations of PFR since 2008, which includes residential and non-residential properties.

It is difficult to get an accurate number of installations because: a) centrally funded schemes don't necessarily report how many properties are adapted; b) recovery grants issued following flood events may or may not be used for PFR; and c) individuals may install PFR measures independently of any Government funding scheme. Given that, according to the response to 2018 parliamentary question, over 11,000 recovery grants were approved in 2015/16 alone it is likely that the data sourced from the Environment Agency's programme of PFR schemes underestimates the current rate of PFR installation.[66] This highlights the need for better data collection in this area.

Although the data are limited, the current rate of installation could leave many homes vulnerable to flooding that would benefit from PFR.
In the FCERM strategy, the Environment Agency states that 'The long-term investment scenarios show the potential for an estimated 200,000 homes in England to be fitted with property flood resilience over the next 50 years.' The figure of 200,000 homes is an approximation and requires more robust information on flood depths to give a more accurate estimate of where PFR needs to be installed. However, it gives an idea of the scale of the challenge given the current rates of installation. There are a range of options which communities can consider to increase resilience, but PFR presents a significant opportunity to reduce the numbers of properties which are vulnerable to the impacts of flooding.

Alongside better data collection this highlights the need for targets for large-scale PFR implementation to assess whether actions are proving effective and to monitor progress. There is an opportunity for the updated long-term investment scenarios in 2025 to make use of the richer information in the new national flood risk assessment to provide better evidence about the potential for PFR installation. This evidence should be used to set smart targets with timescales.

Recommendation

Work with the Environment Agency to set out the measures being taken to improve the uptake of property-level flood resilience (PFR) following stakeholder responses to its PFR call for evidence and consultation. This should include improved data collection to monitor progress. Plans for the new national flood risk assessment and 2025 long-term investment scenarios must ensure that the evidence they provide can be used to identify the most effective locations for PFR, and smart targets for their installation with timescales.

Department: Defra, Timing: 2022.

3.2.6 Capacity to recover from flooding

Progress summary – Capacity of people and communities to recover from flooding		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • The plan score remains the same. Local resilience forums have developed response and recovery plans for flooding, and there is now evidence that most LRFs include climate change in local plans and risk registers. It is not known if local authorities have considered how they will manage the long-term recovery of people and communities who have been flooded. The FCERM Strategy sets a commitment for people to receive the information and support they need to prepare and respond to flooding and coastal change by 2030. **Risk management score - medium** • The risk management score remains the same. The Government can provide financial assistance for homes which are flooded, and at-risk homes built before 2009 remain insurable through the Flood Re scheme. However, the time it takes to recover from flooding and return home is based on several complex factors and there can be significant impacts to health and well-being due to flooding. There remains no available national data that allow an assessment of risk or the proportion of homes or businesses that have insurance. Environment Agency figures show that the number of people signed up to the flood warning service in England has increased.	5
Notes: See annex for full datasets Key Indicators: Number of flood warnings by type, Flood warning registrations, Mental health impacts from flooding, Number of homes installing PFR per year, Properties that have flood insurance (not yet available), Number of successful insurance claims within x time of flooding (not yet available), Uptake of/spending on flood recovery grants (not yet available), Length of time people are out of their homes following flooding (not yet available).		

Summary of 2019 report score

In our last report, capacity of people and communities to recover from flooding scored a 5 (medium plan score, medium risk management score).
Our 2019 report found that Local Resilience Forums have developed response and recovery plans for flooding based on present-day risk but did not consider how the risk from flooding might be changing now due to climate change. On progress in managing risk, our previous report highlighted that repair and renew grants are available from MHCLG for selected flood events. In severe flood events, insurance claims can take up to a year to settle which has a significant impact on recovery time and well-being of those affected, but more data was needed to understand rates of recovery.

Has the plan score changed?

No, the score remains the same.

The FCERM Strategy (Box 3.1) sets a commitment for people to receive the information and support they need to prepare and respond to flooding and coastal change by 2030.
This includes the following actions:

- From 2020 the Environment Agency will continue to work with Local Resilience Forums to develop flood plans that better coordinate preparing and responding to incidents.

- By 2022 the Environment Agency will have expanded its flood warning service to all places at high risk of flooding and coastal change from rivers and the sea.

- By 2023 the Environment Agency will work with partners to transport its warning and information services to better reach people living, working or travelling through flood risk areas.

- By 2025 risk management authorities will support people living in places at high risk of flooding and coastal change to set up flood groups, where they are wanted, and to develop and test local flood plans.

The Government's Policy Statement commits to supporting communities, including when flooding happens and during recovery afterwards. This includes undertaking a full review of the Flood Recovery Framework (at the time of writing this is underway) to improve its effectiveness, evaluating the most recent Property Flood Resilience Recovery Support Scheme, and supporting the voluntary sector to improve their capacity and capability to help local communities in the event of a flood.

Once implemented these steps should help towards improving future scores.

Local Resilience Forums (LRFs) have developed response and recovery plans for flooding based on present-day risk, and there is now evidence that LRFs include climate change in local plans and risk registers. LRF's feel like they are better prepared for river and coastal flooding compared to surface water flooding.
A survey of Local Resilience Forums found that most responders included climate change in Local Resilience Plans and/or Risk Registers to some extent (see Section 3.6).* The survey also found that several LRFs felt like they were prepared for river and coastal flooding due to increased knowledge and experience of dealing with events previously and the availability of forecasts. Responders however, did not feel as prepared for surface water flooding events. The reasons provided included that surface water flooding is more difficult to forecast, and impacts can occur in areas not previously impacted or covered by flood warnings.

It is not known if local authorities have considered how they will manage the long-term recovery of people and communities who have been flooded. As recently recommended by the EFRA Committee, the Government needs to develop a properly resourced action plan with local partners for the long-term physical, economic, and psychological recovery of communities impacted by flooding.

Has the risk management score changed?

No. The evidence available on managing risk remains the same as in 2019.

* Based on results of CCC survey of Local Resilience Forum. There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England.

The costs of flooding to health services have been estimated at £1,878 per adult per flood event with internal depths up to 30cm, rising to £4,136 with depths more than 1m.

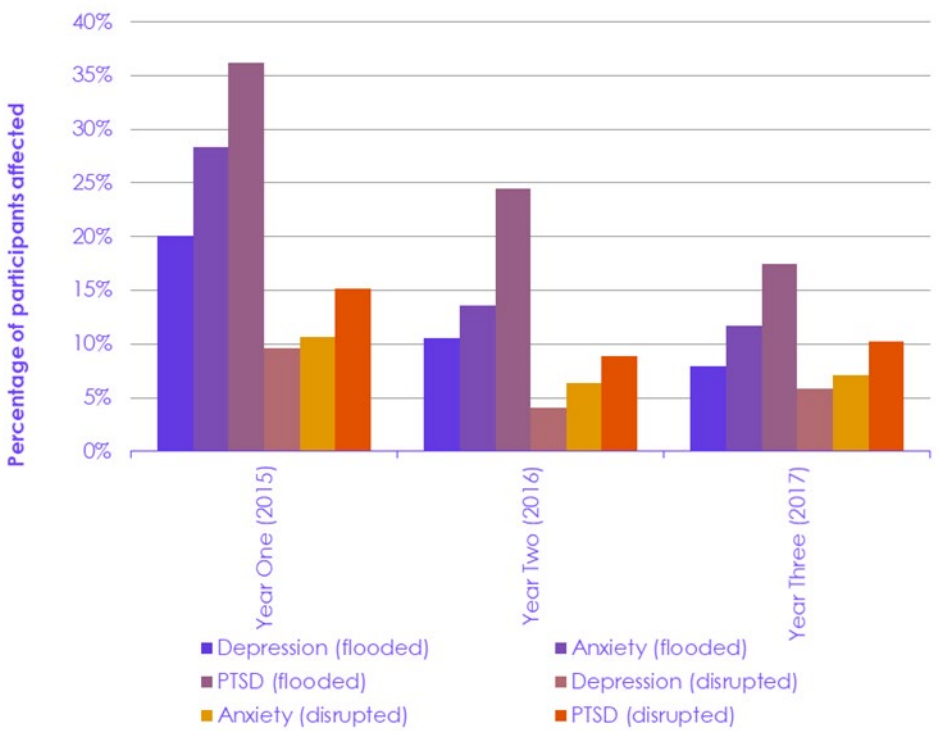
Impacts from flooding on health and well-being remain.
One of the greatest burdens of ill health from flooding is likely to be due to the impacts on mental health. Research has found that after one year following a flood, the prevalence of probable depression amongst homes flooded was 20.1%, anxiety 28.3% and PTSD 36.2% (Figure 3.4). [67] This compares with the general prevalence of depression amongst adults in Great Britain of 10% in 2019/20 (before theCOVID-19 pandemic). [68] Three years after being flooded, mental health impacts still existed, although were reduced. Evacuation and displacement, particularly without warning, increases the risk of anxiety and post-traumatic stress disorder.

The COVID-19 pandemic may add to the already significant impacts for those displaced from their homes due to flooding in 2020 and 2021. Displacement from flooding combined with dealing with the impacts of the pandemic (e.g. potential illness, economic challenges and social isolation) are likely to be considerable. The staff needed to help support flooded households may also have reduced capacity whist dealing with response to the pandemic.

The costs of flooding to health services were calculated in a recent study.[69] Costs were found to increase with depth of flood water inside the home. Costs increase from an average of £1,878 per adult per flood event with internal depths up to 30cm, to £4,136 where the depth is more than 1m deep.

In April 2020, the Government announced changes to its funding formula for flood defences, to include new evidence on the overall impacts of flooding, such as mental health and wellbeing.[70]

Figure 3.4 Mental health outcomes after flooding



Source: BMC Public Health (2020) *The English National Cohort Study of Flooding & Health: psychological morbidity at three years of follow up;* BMC Public Health (2018) *The English National Cohort Study of Flooding & Health: the changes in the prevalence of psychological morbidity at year two;* BMC Public Health (2017) *The English National Cohort Study of Flooding & Health: cross-sectional analysis of mental health outcomes at year one.*
Notes: The chart shows the prevalence of mental health outcomes after one, two- and three-years following flooding, for participants who either had their homes flooded, or were disrupted due to flooding.

The time it takes to recover from flooding and return home is based on several complex factors.
Recovery from flooding events is a combination of interacting factors, including: the depth of the flood water as well as duration of the flood; how contaminated the flood water is; the length of time it takes to dry out a property; having financial assistance, through insurance and grants, to repair and renew property; the availability of builders and other actors in the recovery process; having access to social support networks; and the medium- and long term strategies to return people to their homes and to manage the physical and mental health impacts.

Alongside these, other factors are discussed elsewhere in this report, such as being well-protected where appropriate (see Sections 3.2.1 on flood alleviation and 3.2.3 surface water flood alleviation); the effectiveness of the immediate emergency response (see Section 3.6); and having flood resilience measures in place to minimise impact (see Section 3.2.5).

Further research and data collection are still required to understand the scale of this risk in terms of recovery time, how climate change will alter it, and what the most effective mix of social, economic and technical responses are to manage it in the future.
Returning home from flooding can be a slow process, however monitoring is not routine or formalised (particularly in terms of contextual hazard data, such as depth and duration of flood), so the Committee cannot assess the differences between different flood events over time and whether recovery times are getting better or worse. It is important that monitoring begins to also identify the factors that cause the longest delays, so that future efforts to reduce recovery times can be implemented efficiently.

The Government can provide financial assistance for homes which are flooded and Flood Re has allowed at-risk homes built before 2009 to be insurable. However, no data is available on how many homes have insurance that covers flood risk.
Flood recovery grants continue to be made available following major flood events under the Flood Recovery Framework. Flood-hit households following Storm Denis and Ciara in 2020 were able to claim £500 and 100% council tax relief. Under the Bellwin scheme, local authorities dealing with the effects of the event can apply to have 100% of the eligible costs they incur above a threshold reimbursed by the Government.

There remains no available national data that allow an assessment of the proportion of homes or businesses that have insurance to cover flood risk. An independent review of the availability of flood insurance for homes and businesses flooded in Doncaster in 2019 found that 28% of owner-occupiers were not covered. If replicated across the country this could mean tens of thousands of vulnerable households who are unnecessarily unprotected against flooding and missing out on the support that has been set up to help them.

Flood Re has improved the ability of households built before 2009 that have previously been flooded to access affordable insurance. Defra has consulted on several changes to Flood Re which aim to improve its uptake, efficiency and effectiveness (see Section 3.2.5).

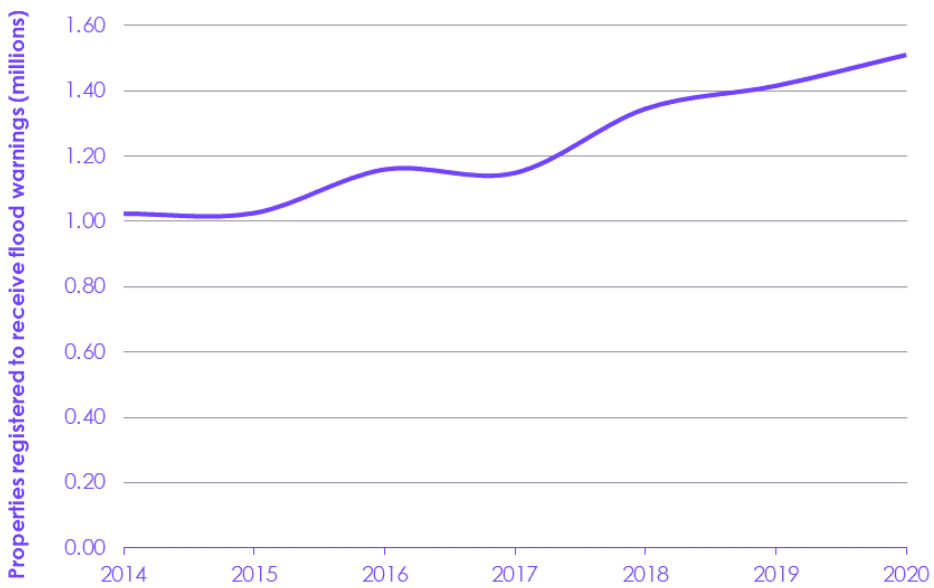
Environment Agency figures show that the number of properties signed up to the flood warning service in England has increased (Figure 3.5).
The ability to prepare for flooding in terms of keeping safe and minimising damage to property and possessions relies on high quality forecasts, which are received and acted upon. Between April 2019 and March 2020, the number of properties registered to received flood warnings rose by 7% from the previous year.

Between April 2019 and March 2020, the number of properties registered to received flood warnings rose by 7% from the previous year.

An increasing number of users are accessing flood warning information through digital channels. In 2020, 6.2m users viewed over 65m pages, a more than threefold increase since 2018.

The FCERM Strategy commits the Environment Agency to expanding its flood warning service to all places at high risk of flooding from rivers and the sea. The Environment Agency's Expanding Flood Warnings project is working to provide all properties at high risk of flooding with warnings by 2022. By the end of 2022, the project aims to add 62,000 properties in England to the flood warning service.

Figure 3.5 Flood warning registrations



Source: Environment Agency

3.3 Coastal erosion risk management

Progress summary – Coastal erosion risk management		
2019 score:	**What has changed since 2019:**	**2021 score:**
3	**Plan score - medium** • The plan score remains the same. Flood and Coastal Erosions Risk Management (FCERM) strategy indicates the Environment Agency is currently in the process of refreshing the evidence (including climate change projections) and technical guidance, which underpin Shoreline Management Plans (SMPs). The SMP Refresh is anticipated to initiate a new planned implementation cycle, however, it is not yet clear how this will change plan outcomes (including for both climate change responses and protecting habitats and species). Furthermore, the non-statutory status of SMPs limits their robustness as long-term plans as it is not clear if the measures outlined in them will be sufficiently funded. **Risk management score - low** • The risk management score remains the same. It is not possible at present to conduct a robust assessment of progress in managing vulnerability. Information to track the rate of delivering SMP policies against SMP ambitions is not available. Furthermore, despite the irreversibility of properties lost to coastal erosion (in contrast to flooding), there is still no national dataset of properties lost, meaning it is not possible to assess the change in exposure, or the viability of the coastal local plans that use the SMPs.	3
Notes: See annex for full datasets Key Indicators: Grants for demolition and removal due to coastal erosion.		

Summary of 2019 report score

In our last report, Coastal erosion risk management scored a 3 (low plan score, medium risk score).
Our 2019 report highlighted that while Shoreline Management Plans (SMPs) had the potential to form a long-term, sustainable plan to address coastal erosion if they were implemented and sufficiently resourced, in practice, this was not the case. Existing plans did not include the full scale of future climate change risks from coastal erosion and thus could not plan long-term adaptation responses that could manage those risks. On progress in managing risk, we highlighted that the absence of a national dataset of properties lost to coastal erosion or data tracking the implementation of SMPs meant it was not possible to assess the change in exposure or the viability of the coastal local plans that use the SMPs as their evidence base.

Has the plan score changed?

No – the plan score is unchanged from 2019. Ongoing work to refresh the Shoreline Management Plans in England includes a requirement to assess SMPs against the latest climate evidence, however, it is not clear yet how this will be reflected in plan outcomes. In order for the score to increase the policy the Committee's view is that SMPs must be made statutory.

More clarity is needed on how new evidence on climate change will be included in the process to refresh Shoreline Management Plans (SMPs) in England.
SMPs remain the key mechanism for coastal defence management planning at both the regional and local level.[71] In England, there are 20 SMPs produced and updated by coastal groups in consultation with local communities and local partners.[72] The Environment Agency is currently working with coastal groups to refresh the SMPs in England. As specified in its FCERM strategy, the scope of the project includes the need to assess SMPs against the latest climate evidence, including impacts under a 2°C rise in global temperature, with consideration of 4°C.

It is understood the technical review phase of the SMP Refresh has been completed and outputs (Supplementary SMP Guidance covering UKCP18 and adaptation, plus individual 'health check' reports for each SMP) distributed to local authorities and Defra agencies. These will be discussed locally and SMP Action Plans updated with new priorities. However, details of how this will be factored into revised plan outcomes (including for both climate change responses and protecting habitats and species) is not currently clear. It is, therefore, not possible at present to determine how the SMP Refresh process will change existing SMP plans or their implementation in practice.

The Shoreline Management Plan Refresh is anticipated to kickstart a new planned implementation cycle.

The SMP Refresh is anticipated to kickstart a new planned implementation cycle.
SMPs outline preferred coastal management decisions in the short-term (0–20 years), medium-term (20–50 years) and long-term (50–100 years). These epochs are defined based on the start of the current (i.e. second-round) implementation cycle, which commenced over a decade ago (2009-11), rather than being incrementally updated; the current short-term epoch will end in the next few years. The SMP Refresh process is anticipated to initiate a rebasing of the implementation cycle to present day, which should help foster SMP policies based upon up-to-date data. However, SMPs remain advisory rather than statutory instruments meaning that in practice policy decisions are not necessarily funded or implemented.

Policy decisions within SMPs must be made statutory to ensure they are implemented.

The Committee's view is that the policy decisions within SMPs must be made statutory to ensure they are implemented.
The non-statutory status of SMPs severely undermines their effectiveness as the main vehicle that coastal authorities have to outline and implement their long-term strategy for coastal defence management.

Defra has announced it will conduct a review of national policy for SMPs.
Alongside the refresh of SMPs, Defra in its FCERM Policy Statement has committed to a review of the national policy for SMPs, which will focus on ensuring local plans are transparent, continuously evaluate outcomes and enable local authorities to make robust decisions for their areas.[73] The review will also assess current mechanisms and legal powers that Coastal Protection Authorities can use to manage the coast. This will include exploring the availability and role of financial products or services that can help people or businesses to achieve a managed transition away from areas at very high risk of coastal erosion.

The Government has committed to increasing the use of nature-based solutions to address risks from coastal erosion.
The FCERM Strategy and accompanying Policy Statement include a commitment to 'double the number of Government funded projects which include nature-based solutions to reduce flood and coastal erosion risk' (see also section 2.7). However, as yet no further information as to the scale or location of these projects is available.

NAP2 includes an action to update the National Coastal Erosion Risk Map (NCERM) and ensure this remains freely available as open data online.
The scope has been developed for a comprehensive NCERM update, with associated improvements to model architecture. The project will also revise assessments of property and infrastructure at risk in the future and explore combining NCERM within the national SMP Explorer being developed as part of phase 2 of the SMP Refresh.[74]

The requirement for SMPs to underpin coastal development strategies in England has been removed from the 2018 revision of the National Planning Policy Framework (NPPF).
Instead, the Planning Practice Guidance (PPG) now includes the requirement that local planners should use SMPs as the evidence base for their local plans, a move which may be considered to give it lesser importance.[75]

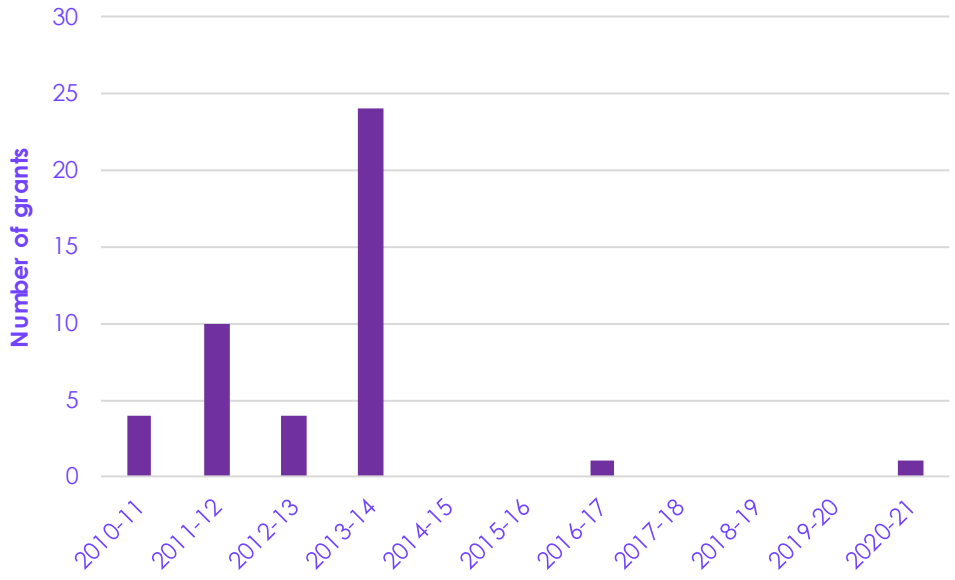
Has the risk score changed?

No. The evidence available on managing risk remains the same as in 2019. It is not possible to assess robustly progress in managing coastal erosion risk in England due to a lack of baseline data on properties lost to coastal erosion and the implementation of SMP policy.

The Government does not currently offer direct compensation for individual properties at risk from coastal change, and losses are generally uninsurable.
The irreversibility of properties lost to coastal erosion means the potential risk impact for affected households is extreme, particularly as losses are uninsurable.

Defra's Coastal Erosion Assistance Grant (CAEG) provides £6,000 per property to assist local authorities with the demolition and removal costs associated with homes at imminent risk of loss from coastal erosion. Since 2010-11, 44 grants have been awarded with the majority of incidents concentrated around the east coast of England (e.g. Great Yarmouth and North Norfolk). Only two grants have been awarded since 2014-15. While it is not clear what has driven the drop, this could be a feature of the intermittency of coastal erosion events, such as cliff falls, or other factors linked to the administration or awareness of the grant scheme.[76] Furthermore, while data suggests incidents are currently low, particularly relative to flooding, the irreversibility of properties lost to coastal erosion means the potential risk impact for affected households is extreme, particularly as losses are uninsurable.

Figure 3.6 Grants for demolition and removal due to coastal erosion



Source: Environment Agency
Notes: Number of successful applications for Coastal Erosion Assistance Grant, each representing one property

The Environment Agency's new Flood and coastal resilience innovation programme will allocate £150 million across 25 local areas, funded by Government.
The funding will target projects that demonstrate how practical innovative actions can work to improve resilience to flooding and coastal erosion. The aims of the programme are to:

- encourage local authorities, businesses and communities to test and demonstrate innovative practical resilience actions in their areas
- improve the resilience of 25 local areas, reducing the costs of future damage and disruption from flooding and coastal erosion
- improve evidence on the costs and benefits of the innovative resilience actions and demonstrate how different actions work together across geographical areas
- use the evidence and learning developed to inform future approaches to, and investments in, flood and coastal erosion risk management

The absence of a national dataset of properties lost to coastal erosion or tracking of SMP policy implementation mean it is not possible to monitor progress in managing coastal erosion risk.
It is vital that the Government allocates resources to the collection of these baseline data if the change in exposure or the viability of the coastal local plans that use the SMPs as their evidence base is to be assessed.

3.4 Water demand in the built environment

Progress summary – Water demand in the built environment		
2019 score:	**What has changed since 2019:**	**2021 score:**
8	**Plan score – high** • The plan score remains the same, with a number of positive developments since our last assessment. The Environment Agency National Framework strengthens planning with a move to strategic regional planning on drought resilience, reducing long term water use and reducing leakage. The latest water company plans set new targets for personal water consumption and metering. The Government consulted on measures to reduce personal water use in 2019 and is expected to announce a statutory target on overall demand for public water supply encompassing targets for leakage, personal consumption and non-household consumption in 2021. An updated water resources planning guideline has been published and the next set of company plans are expected to use UKCP18 climate projections. **Risk management score – medium** • The risk management score remains the same. There remains a need for an increase in demand-side measures and stricter targets for reducing household water use. There has been no significant change in average household per capita consumption over the last 5 years. The percentage of homes with water meters continues to increase, however. The latest projections of future water availability show that current demand-side adaptation measures may not be sufficient to ensure risk is kept at least constant. The outcome of the consultation on measures to reduce personal water use and faster progress in actions to reduce demand will be crucial in determining whether risks of water availability are being managed.	8
Notes: See annex for full datasets Key Indicators: Per capita consumption (l/h/d) – no significant change, Percentage of households with water meters – improving.		

Summary of 2019 report score

In our last report, water demand in the built environment scored an 8 (high plan score, medium risk score).
Water companies are required within their Water Resource Management Plans (WRMPs) to develop plans that are tied to their investment cycle for adapting to the risks of future water scarcity, including the effects climate change. This includes plans for demand management which is a critical aspect of ensuring resilient water supplies.

While a broad range of actions were being taken to reduce consumption, the Committee concluded that the level of progress in recent years and ambition in company plans may not be adequate to address future risks, particularly in the context of a 4°C global temperature rise scenario.

Has the plan score changed?

No, the plan score remains high - there have been a number of positive developments since our last assessment.

The Environment Agency National Framework for Water Resources is being implemented. The framework looks at climate change pressures on public water supply using UK Climate Projections 2009 (UKCP09) datasets and sets an expectation for water company's regional plans to reduce demand to 110 litres per person per day by 2050. [77] The new National Infrastructure Strategy recognises that future requirements to increase resilience in water supplies and reduce the overall demand for water are key to better managing supply requirements.[78]

The latest water company plans set new targets for personal water consumption and metering.
Water companies produce water resource management plans (WRMPs) every five years which look 25 years ahead. The Ofwat 2019 Price Review for 2020-25 requires water companies to help customers reduce personal consumption to 131 l/p/d by 2025 through their latest plans (WRMP19).[79] They also show that meter penetration will increase to 83% by 2045. WRMP19 plans use climate change projections from UKCP09. The latest plans show that, in the current regulatory environment, companies expect consumption to reduce to an average of 120 litres per person per day by 2045.[80] A further reduction to 110 litres per person per day will need to be achieved by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

Water companies expect consumption to reduce to an average of 120 litres per person per day by 2045. A further reduction to 110 litres per person per day is needed by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

The Government consulted on measures to reduce personal water use in 2019.
The consultation on measures to reduce personal water use included consideration of demand-side measures including extending metering (including the use of smart meters), water efficiency labelling and amendments to building regulations.[81] An independent review by the Energy Savings Trust in 2019 of the costs and benefits of water labelling options in the UK recommended that the UK Government consider implementing a mandatory water labelling scheme linked to building regulations and minimum standards.[82] The Environment Bill policy targets paper proposed setting a statutory target on overall demand for public water supply encompassing targets for leakage, personal consumption and non-household consumption.[83] Choosing the right mix of acceptable measures will be vital to increasing the resilience of water supplies. The outcome of the consultation has been delayed due to departmental constraints imposed by COVID-19. Government is expected to announce its next steps to reduce per capita consumption in 2021.

An updated water resources planning guideline has been published and the next set of company plans are expected to use UKCP18 climate projections.
Government consulted on the water resources planning guideline in 2020 and published the updated guideline in 2021.[84] In assessing the risk and possible impact of climate change, the guideline asks companies to consider the updated projections of future water availability produced for the third UK Climate Change Risk Assessment.[85] These projections are considered further below. Supplementary guidance on climate change is also being developed. Water companies are now developing cross company plans for 2024 using UKCP18 projections.

Has the risk management score changed?

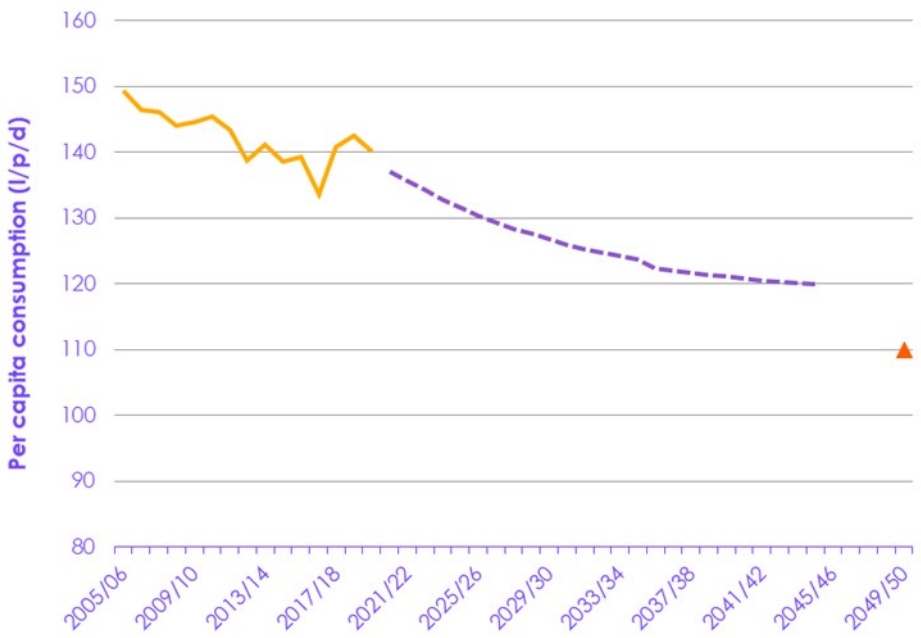
No, the risk management score remains medium. Further action is needed to manage risks of future water shortages, through an increase in demand-side measures and stricter targets for reducing household water use.

There has been no significant change in average household per capita consumption over the last 5 years.

Per capita consumption is a key measure for how efficiently we are using water. Weighted average* per capita consumption per household in England was 140 l/h/d in 2019-20 (Figure 3.7). Consumption fell by 2% between 2018-19 and 2019-20. Overall, there has been little change in personal water use in the last 10 years although COVID-19has reportedly influenced short term consumption patterns, with an increase in household consumption and a decrease in non-household consumption.[86]

There has been little change in personal water use in the last 10 years.

Figure 3.7 Weighted average water consumption per capita for households in England 2005-2020 and forecast to 2044-45

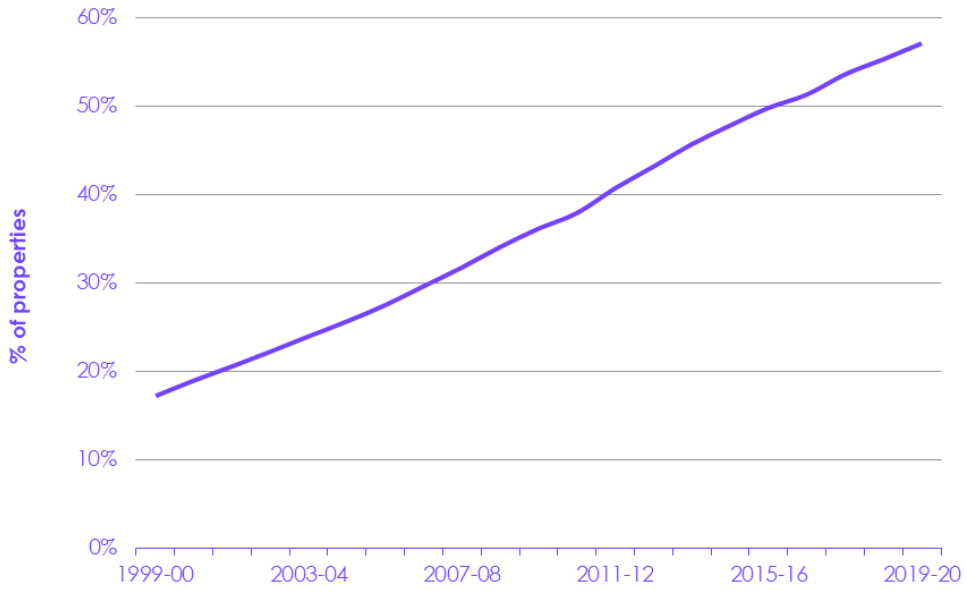


Source: Summary of actual and forecast data from Water Resource Management Plans (WRMP19) for all water companies in England. Data provided by the Environment Agency.
Notes: Forecast data to 2045 based on WRMP19. The target of 110 l/p/d represents the required level of per capita consumption by 2050 to meet the expectations set out in the Environment Agency's National Framework for Water Resources.

The percentage of homes with water meters continues to increase.
In 2019-20, 57% of households in England (and Wales) had water meters (Figure 3.8). This represents a 7% increase in metering since 2017/18. The latest water company plans show metering will increase to cover 83% of households by 2045. Over 2020-25, companies will invest £650 million in installing at least 2 million new water meters.[87] In the National Infrastructure Assessment, the National Infrastructure Commission recommended compulsory metering by the 2030s beyond water stressed areas, which could increase metering to 95% by 2050.

* Weighted PCC is PCC weighted by water company population.

Figure 3.8 Proportion of properties with water meters from 1999-00 to 2019-20



Source: Consumer Council for Water (2020) *Water, water everywhere? Water and Wastewater Resilience Report 2019/20.*
Notes: Data is for all meters including smart meters.

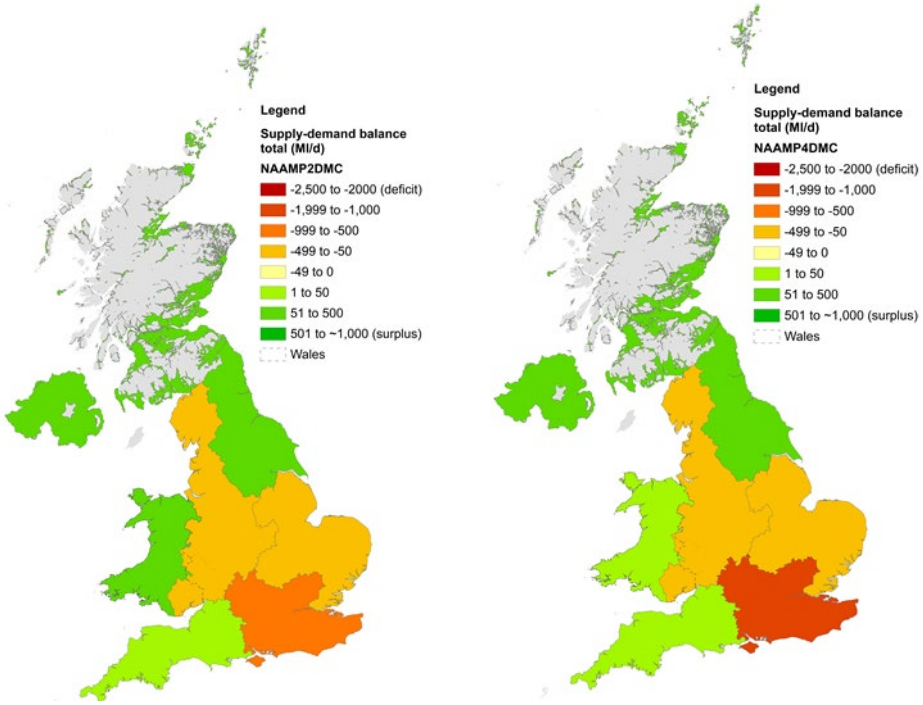
Recent analysis by Waterwise and Arqiva found that fitting one million smart water meters in the UK each year for the next 15 years could result in saving at least one billion litres of water a day (1,000 Ml/d) by the mid-2030s, as well as reducing the UK's current greenhouse gas emissions by 0.5% (2.1MtCO_2e).[88] Metering can also help with the management of water usage and supplies during peak demand, and help water companies identify and fix leaks.[89] The Government is expected to announce its approach to metering in 2021 as part of the new package of measures to reduce personal water use.

Although metering is a useful tool to help encourage lower water use by helping customers understand their usage, this may only occur if meters are visible to customers so they can track usage in real time. Meters are often placed out of sight, for instance underneath manhole covers in driveways. Metering also needs to be used in conjunction with other measures such as water labelling and messaging in order to achieve the reduction needed. Choosing the right mix of acceptable measures will be vital to increasing the resilience of water supplies.

The latest projections of future water availability show that current demand-side adaptation measures may not be sufficient to ensure risk is kept at least constant. The updated projections of future water availability produced for CCRA3 use the latest UKCP18 climate projections. In the current and announced adaptation scenario, reductions in demand and leakage are modelled in line with announced targets by government and the latest water resource management plans. Demand in England and Wales falls from around 140 to 118 l/h/d and leakage is reduced by around 50% by 2050. Under current and announced levels of adaptation, the latest projections of water availability indicate deficits in the Water Resources South East, Water Resources West and Water Resources East regions by the mid-century, in both 2°C and 4°C warming scenarios (Figure 3.9).*

* Under central population projection and assuming no additional adaptation action.

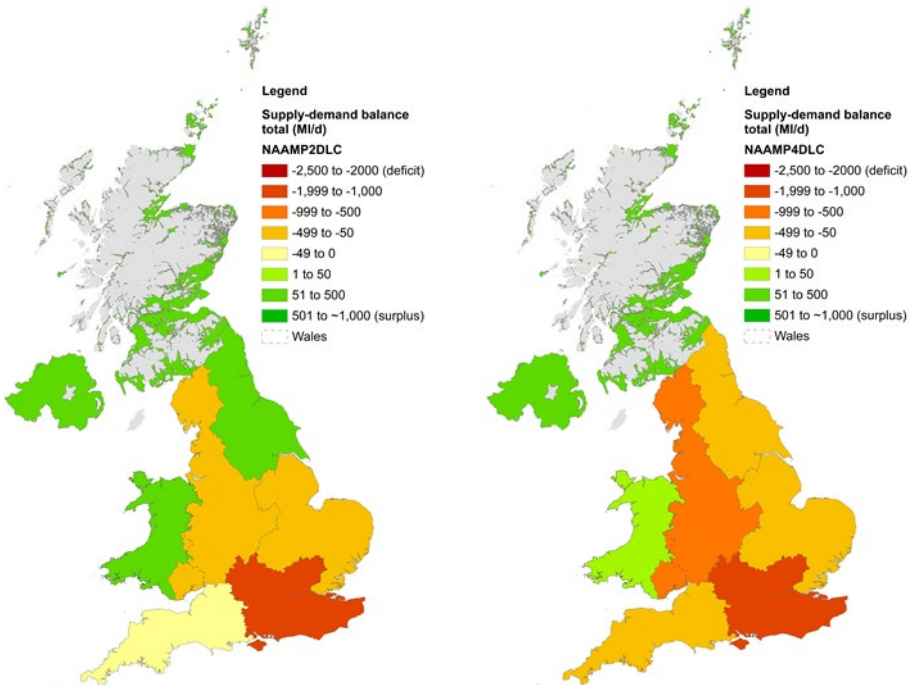
Figure 3.9 Mid-century supply-demand balance for UK Water Resource Regions



Source: HR Wallingford (2020). *Updated projections of future water availability for the third UK Climate Change Risk Assessment Technical Report.*
Notes: Supply-demand balance in the mid-century, in a 2°C (left hand side) and 4°C (right hand side), central population projection and assuming no additional adaptation action, at the regional scale (HR Wallingford, 2020). Grey indicates areas reliant on private supply.

By the late century, the projections show that in a 4°C world, all water resource regions in England are in deficit (Figure 3.10).

Figure 3.10 Late-century supply-demand balance for UK Water Resource Regions



Source: HR Wallingford (2020). *Updated projections of future water availability for the third UK Climate Change Risk Assessment Technical Report.*
Notes: Supply-demand balance in the late-century, in a 2°C (left hand side) and 4°C (right hand side), central population projection and assuming no additional adaptation action, at the regional scale (HR Wallingford, 2020). Grey indicates areas reliant on private supply.

There remains a need for an increase in demand-side measures and stricter targets for reducing household water use.
The outcome of the consultation and faster progress in indicators will be crucial in determining whether risks of water availability are being managed.

3.5 Public health and wellbeing

The impact of high temperatures poses a significant threat to people's health and wellbeing now and in the future. High temperatures affect a very wide range of health and social outcomes. The heatwaves in recent summers have caused thousands of excess all-cause deaths and disruptions to daily activities (including hospital services and education).

The impacts of heat from climate change will, to a significant degree, be determined by how well the built environment is adapted to the future climate. Lock-in is a key concern for capacity to adapt to future risks.* Adaptation could be limited by housing and planning policies if they do not sufficiently consider climate change. This also has implications for the future delivery of health and social care as trends indicate a move to more home-based care. To tackle these issues requires cross-government coordination.

There are also more uncertain impacts on air pollution levels from changes in the climate (rather than changes in emissions which will have a very large effect) and threats from climate-sensitive infectious and non-infectious diseases. These changes are likely to alter the weather-related burden on human health and wellbeing in England.

The COVID-19 pandemic has shone light on resilience and capacity for action in Government departments, but particularly for those who deal with people, the built environment and business. The pandemic may have increased risks associated with high temperatures and poor indoor air quality as people have had to spend more time indoors during hot weather.[90] The impacts on health of both high temperatures and COVID-19 are disproportionately higher for vulnerable groups such as older persons, those with underlying conditions, and particularly people in residential care. Further work is required to explore how the concurrent risk of COVID-19 and heatwaves may have intersected to possibly amplify the number of deaths.

COVID-19 has also significantly affected the ability of health agencies to make progress in other areas of work, including climate change. Health bodies have seen a redeployment of staff and the unavailability of key stakeholders. Ongoing business as usual activities have been reoriented towards assessing and managing concurrent risks of COVID-19 and extreme weather events.[91]

* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

3.5.1 Health impacts from heat and cold

Progress summary – Health impacts from heat and cold		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - low** • The plan score remains the same, but some progress has been made. MHCLG has proposed to introduce a new regulatory requirement for addressing overheating in new homes, alongside new statutory guidance. However, at the time of writing this is still part of a consultation and not yet policy. There remains no plan to understand overheating risk and adaptation needs in existing homes, nor action to retrofit existing buildings. There is also still no plan to address the lack of understanding of the extent of overheating risks in care facilities or how a move towards home-based care may alter the risks to patients and healthcare delivery from extreme weather. There has been some better planning for 2˚C and 4˚C scenarios in policies for schools and prisons. **Risk management score - medium** • The risk management score remains the same. Cumulative excess all-cause mortality related to heatwaves in summer 2020 was higher than that observed in England during the 2003 pan-European heatwave and 2006 heatwave event. Research since 2019 has found further evidence of overheating occurring in homes. Better indicators would help to understand the extent of overheating in existing homes. While increasing heat is a major climate risk to health, cold related deaths will remain significant and mitigation action to improve the thermal comfort of homes in winter as well as summer remains urgently needed. There is increased evidence of overheating in hospitals and new research into the occurrence and cost of summertime overheating in care homes. The proportion of urban greenspace, which can lessen the urban heat island effect has fallen since 2016.	2
Notes: See annex for full datasets Key Indicators: Area of urban greenspace, Number of heat and cold-related deaths per year, Number of hospitals/care homes/surgeries that experience overheating (not yet available for care homes and surgeries), Temperature and air quality monitoring in new and existing homes including the number of overheating exceedances and the number of homes currented adapted to overheating (not yet available), Number of / spending on passive cooling measures and air conditioning uptake in different building types (residential, care homes and healthcare facilities) (not yet available)		

Summary of 2019 report score

In our last report, health impacts from heat and cold scored a 2 (low plan score, medium risk management score).
Our 2019 report found that adaptation plans to mitigate the long-term risks of heat impacts on health were missing, despite CCRA2 highlighting the risks to health from heat as an urgent priority. Plans were in place to review the Building Regulations, but there had not been any significant shifts in policy to ensure that new buildings are being designed with the future climate in mind and no policies exist to help adapt existing buildings. On progress in managing risk, our previous report highlighted that actions are taking place; however, there was little evidence the risk was being managed. The Committee recommended that regulations be strengthened for overheating to prioritise passive cooling measures in existing and new buildings and a need for increased and improved data collection in healthcare facilities, as well as better indicators to monitor overheating in homes.

This priority includes subsections for: housing; schools and prisons; health and social care delivery; and greenspace. Whilst there are also potential heat impacts to people using public transport, these have not been included as it is not known what the national-level picture is for overheating on transport.

Has the plan score changed?

No, the score remains the same although some progress has been made which could lead to an improved plan score in the next year or two.
A key issue with tackling heat risk is that ownership of the issue is shared across Government departments. There is a lack of cross-departmental coordination in dealing with the multiple health outcomes from overheating and utilising the multiple adaptation options available for mitigating risk.

The following sections are therefore split roughly by policy/impact area.

Buildings – Housing

MHCLG has proposed to introduce a new regulatory requirement for overheating mitigation, alongside new statutory guidance, with the aim of reducing overheating risk in new-build residential buildings.
The Committee have previously reported that high levels of energy efficiency installed in new and existing homes can increase the retention of heat and airtightness of the building. This can increase the risk of overheating and exposure to indoor air pollutants if appropriate adaptation and ventilation measures are not implemented at the same time. In 2019, the Committee therefore recommended that the Government needed to publish an integrated plan to reduce overheating risk in existing and new homes alongside decarbonising domestic heating and planning for at least 2°C increase in global temperature, with consideration of 4°C. The Government response supported the need for regulation on overheating but had not set out plans for an integrated plan.

In January 2021, MHCLG published the Future Buildings Standard consultation which included proposals for an overheating standard within Building Regulations. The consultation proposed to introduce a new regulatory requirement for overheating mitigation, alongside consideration of usability and new statutory guidance for occupiers, with the aim of reducing overheating risk in new-build residential buildings (including houses, flats, care homes and residential educational buildings). The methodologies proposed take account of climate change and use high emissions scenarios from UKCP09. The Committee have welcomed this consultation as a significant step forward in addressing one of the most urgent climate risks. The overheating requirement and the required guidance address previous CCC recommendations to have an overheating standard in place, to mitigate using passive adaptation measures and to ensure that developers consider energy, ventilation and overheating together.

If introduced, the overheating requirement will come into force at the same time as changes to Part L of the Building Regulations in June 2022.

However, the consultation does not propose to include retrofits of existing buildings or conversions from non-domestic to residential. On the latter, there is evidence that permitted development conversions seem to create a worse quality residential environment than conversions that occur through regular planning permission in relation to several factors widely linked to health, well-being and quality of life for future occupants (see risk section below).[92] [93]

These are mainly related to the internal design aspects such as space standards, window arrangements and access to amenity space, and are worse for 'office to residential' conversions – with evidence that adaptation measures such as external shading are being discouraged in some instances.[94] The regulation should therefore be expanded to refurbishments of existing buildings and conversions of non-domestic buildings to residential.

Recommendation

Implement a strong set of standards - with robust enforcement - that ensure both new and existing buildings are designed for a changing climate and deliver high levels of energy efficiency and low-carbon heat. Including:

- Publish robust definitions of the Future Homes Standard and Future Buildings Standard which are legislated in advance of 2023 and ensure no fossil fuels are burnt in new buildings. This must include coordination with DfE, MoJ, DHSC as well as BEIS and HMT.
- Regulate the overheating requirement as set out in the Future Buildings Standard consultation. Expand the requirement to cover refurbishments of existing buildings and conversions of non-domestic buildings to residential.
- Work with BEIS on the Heat and Buildings Strategy and use standards to set a clear direction for retrofit across the buildings stock.
- Ensure that the remit of the new building safety regulator covers climate change mitigation and adaptation, strengthened through an explicit responsibility for sustainability; and is fully equipped to monitor and enforce compliance with buildings standards.
- Work with HM Treasury to ensure that local authorities are properly funded to enforce buildings standards.
- Close loopholes allowing homes to be built which do not meet the current minimum standards for new dwellings. This includes provisions around the expiry of planning permission and permitted development rights relating to change of use. Make accurate performance testing and reporting widespread, committing developers to the standards they advertise.

Department: MHCLG, Timing: 2021.

It is not clear how much overheating risk for new developments is being considered within local planning of most local authorities.
Local planning policies can reinforce the need for new developments to be planned and designed to manage internal temperatures (for example with regards to orientation, shading, building materials, window design, ventilation and green spaces).

The Greater London Authority (GLA) has made positives steps by requiring overheating mitigation, in accordance with a cooling hierarchy, through the London Plan for major developments.[95] This includes using dynamic overheating modelling to assess internal overheating, taking a design-led approach to mitigation (such as prioritising dual aspect dwellings to enable cross-sector ventilation), and avoiding overheating without reliance on energy intensive mechanical cooling systems.

However, analysis by the CCC has found that most local plans (outside of Greater London) which have been drafted or adopted since 2018 do not include similar requirements for managing overheating risk.

Millions of people have worked from home, rather than offices in 2020.

Despite some progress on addressing risks in new build residential buildings, there remains no plan to increase understanding of overheating risk and adaptation needs in existing homes, nor action to retrofit existing buildings.

The majority of homes in England that will be present in 2050 have already been built. The COVID-19 pandemic has increased the amount of time people spend in their homes as millions of people have worked from home, rather than offices.[96] For those people living in modern, urban flats these often have high glazing with little shading, limited natural ventilation, are single aspect, and many have no easy access to outdoor green space.[97]

The Government's plans for reducing emissions in existing homes also do not include climate adaptation as a key priority, which is a missed opportunity to include passive cooling in retrofit programmes, especially given the risk of increased energy efficiency standards potentially exacerbating the risk of overheating.*

Further research is needed to gain a better understanding of the extent of overheating risk in existing homes (see risk section below), while overheating and ventilation should be considered alongside programmes for energy efficiency retrofit.

Various steps are also needed to enable and encourage the uptake of adaptation measures for overheating in existing homes (Box 3.2), particularly for vulnerable or lower-income groups or those living in homes where it is difficult to make modifications.

Box 3.2
Encouraging the uptake of adaptation measures for overheating in existing homes

- High quality advice and information is critical for enabling measures:
  - Green Building Passports could provide holistic guidance to householders and unlock green finance at scale.
  - Home retrofit plans are a tailored approach which could also bring in wider dimensions of comfort, aesthetics, and affordability as well as adaptation needs.
  - Combining these with the opportunity of smart meter data in a digital Green Building passport could unlock green finance at scale by providing a robust, quality source of information to raise finance against, track progress and help make standards enforceable for both climate adaptation and mitigation.
- Finance and addressing upfront costs of adaptation measures. This could be achieved through a combination of private (including 'green') finance (such as via low cost 'green mortgage products, or grants) and public funding targeted at low-income households and to support the vulnerable, along with other priority areas such as public buildings and social housing.
- Skills remain a further critical enabling measure. The CITB (the industry training board for the construction sector) have identified pace of change as a key challenge, necessitating Government intervention. It is vital that the policy framework also scales up inspections and enforcement activity to ensure householders get what they have paid for.

* For example, the Energy White Paper (2020) and Green Homes Grant (2020).

Recommendation

Improve understanding of and support action on overheating in existing residential buildings and encourage retrofit of passive cooling measures. The Heat and Building Strategy must consider overheating risks. The following steps are needed:

- Further research to understand when overheating occurs in existing homes, including: ongoing monitoring of temperatures in the housing stock, monitoring of overheating exceedances in homes, and number of homes currently adapted.
- Guidance and information for homeowners with the steps that can be taken if their homes overheat. This should include an outline of behaviour options and the measures that can be installed to reduce internal temperatures. Green Building Passports and home retrofit plans could provide holistic guidance and help to unlock green finance.
- Overheating risk considered and mitigated against if necessary when doing energy efficiency retrofit programmes.
- Making finance available to install adaptation measures. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income or vulnerable households alongside energy efficiency retrofit.

Department: BEIS and MHCLG, Timing: 2022.

The Government is working to reform building safety and regulation.
Climate change is a building safety issue, both in terms of the health and safety of residents and users and because of the contribution buildings make to emissions and hence to the health and safety of the wider population.

The reforms in the Buildings Safety Bill create a framework to improve the efficacy of building regulations, including those relating to climate change mitigation and adaptation.[98] This should be strengthened through an explicit responsibility for sustainability alongside buildings safety and performance. It will be important to ensure the buildings safety regulator is sufficiently equipped to monitor and enforce compliance across all building regulations and to ensure that local authorities are properly funded for enforcement activities.

Buildings – schools and prisons

There has been better planning for 2˚C and 4˚C in schools and prisons.
The general set of adaptation interventions for schools are similar to those for other buildings, although there are additional low regret options for behavioural responses and emergency plans. Adaptation measures are essential to avoid lock-in with building designs and adapt to the future risks of overheating, flooding and other climate hazards.* The Department for Education (DfE), along with the GLA, provide guidance on climate change and aim to prioritise passive measure over mechanical cooling to mitigate overheating risk.[99] [100]

There has been better planning for 2˚C and 4˚C in schools and prisons.

DfE are in the process of revising design standards in 'Specification 21' to adapt to a 2˚C global warming scenario and future proof to a 4˚C scenario (as far as possible) on all new or refurbished projects. This update is being informed by research carried out by the Chartered Institute of Building Services Engineers (CIBSE) Schools Design Group which has modelled the two scenarios against the 'BB0101' adaptive thermal comfort overheating risk assessment which identified the severity of risk.[101]

* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

In addition to this, the DFE have carried out further research on their resilient schools project and Gen Zero (Construction innovation Hub funded research project) and well as a number of pilots testing the scenarios with industry.

School-specific long-term climate adaptation plans could be useful for the health well-being and safety of students and staff, as well as to promote a more resilient, biodiverse and vibrant school environment. Having a school-specific climate adaptation plan could deliver multiple positive outcomes including reduced bills, increased learning opportunities, improved biodiversity and better air quality.

In relation to prisons, the recent Ministry of Justice's Adaptation Strategy requires that sites assess risks using UKCP18 and use this assessment to inform adaptation plans/actions. A set of measures are recommended, but there is no analysis of costs and benefits.[102] The strategy says that sites should:

- Build in more natural ventilation, solar shading and natural cooling.
- Improve Building Management System (BMS) controls.
- Have emergency plans in place that consider the likely intensity and frequency of heat.
- Deliver against objectives through an action plan to be used to monitor progress of initiatives and actively support the strategic objectives and continuous improvement throughout the estate.

Since 2019 it is a requisite for all newly built prisons to be awarded an Excellent BREEAM 2018* rating with a costed option to be designed to the 'outstanding' level. Prison builds due to complete within the next year have been assessed against the BREEAM 2014 scheme and are currently on course to meet an Excellent rating. MoJ has included BRE's "designing for future thermal comfort" as a mandatory credit for new build programmes.

Health and social care

There is still no plan to assess the extent of current and future overheating risks in care facilities, or how a move towards home-based care may alter the risks to patients and healthcare delivery from extreme weather under current conditions and future projections.
In 2019 the Committee recommended that DHSC produce a plan to address the risks of overheating in care homes and care facilities, including consideration of home-based care by 2021. The Government disagreed that a plan was needed, stating that current guidance and the Heatwave Plan for England are in place. However, a review of the Heatwave Plan found little evidence that it had helped reduce general summertime impacts of heat on health since it was introduced. Barriers to adaptation also remain, including access to long-term, strategic funding.†

CQC's #TempAware campaign raised awareness of the importance of ensuring people in care homes and healthcare facilities are appropriately monitored and their health supported during hot weather, and directs providers to resources such as PHE's 'Beat the Heat' materials and the Care Provider Alliance's guidance on 'Developing Contingency Plans for Adult Social Care Services'.

* Building Research Establishment Environmental Assessment Methodology.

† As reported during stakeholder discussions.

The Department of Health and Social Care have promised to work with CQC and other relevant agencies to determine whether there is further guidance which can be highlighted.[103]

Recommendation
Assess health sector vulnerability to existing and future climate risks, particularly, for care homes and home-based care. Following this, develop a cross-sector approach to address risks. This cross-sector approach should include input from CQC, PHE, NHS, MHCLG and local level public health bodies. Department: DHSC, Timing: 2022.

Health providers are required to have in place a Green Plan including adaptation, but the percentage of NHS Trusts completing a plan is low.[104] Greener NHS will release green plan guidance, which includes requirements for adaptation planning, and are due to report in the third round of the Adaptation Reporting Power.
The third Health and Social Care Sector Adaptation Report should:

- Review progress on health and social care sector adaptation since the previous report.
- Identify the level of risk and readiness across the health and social care sector, building on the second UK Climate Change Risk Assessment (CCRA2-2017) and UKCP18 Climate Projections.
- Provide practical recommendations on local, national and systemic actions to mitigate these risks and build resilience.

The heat and cold health alert systems/weather plans are being revised into a single year-round plan.
While the current Heatwave Plan for England is central to the acute public health response to heatwaves, the number of heat-related deaths in recent years (see below) indicate more strategic prevention action is required from a range of actors.

Hot weather causes an increase in deaths and emergency hospital admissions. The current Heatwave and Cold Weather Plans for England provide guidance to health, social care and community practitioners and the public in order to protect vulnerable people in hot weather. They do not take a long-term view of risk although the new year-round all-weather plan is aiming to do this (See also Section 3.6 on emergency planning).

The Department of Health and Social Care (DHSC) commissioned an independent evaluation of the implementation and potential effects of the HWP in 2019 which is now published.[105] Our previous report discussed the findings in more detail in our 2019 Progress Report. The evaluation found that there is no evidence that general summertime relationships between temperature and mortality and between temperature and emergency hospital admissions have changed substantially in the years since the introduction of the first HWP in 2004. Evidence did suggest that the Heatwave Plan was good at protecting people during the alert periods (the hottest days), but not so good in hot weather where no alert was issued.

There are plans and policies which will provide an opportunity to increase and improve green space and therefore could lead to reduced outdoor temperatures (especially in urban areas).
However, it is not clear whether the multiple benefits from individual policies are being fully realised and taken up by developers (see Section 3.2.3 above).

Has the risk management score changed?

No. The evidence available on managing risk remains the same as in 2019.

The number of excess all-cause mortality associated with heatwave events in summer 2020 was higher than observed in England during the 2003 pan-European heatwave and 2006 heatwave event.

There were an estimated 2,556 all-cause excess deaths (excluding deaths from COVID-19) during episodes of heat across all ages during three heatwave periods in summer 2020 in England.

PHE has reported that there were an estimated 2,556 all-cause excess deaths (excluding deaths from COVID-19) during episodes of heat across all ages during three heatwave periods in summer 2020 in England (Figure 3.11).* This is the highest heatwave associated all-cause excess mortality observed in England since the introduction of the Heatwave Plan for England in 2004.

Whilst the third episode of a heatwave in the summer was prolonged, with very high temperatures recorded (day and night-time) (causing 1,734 total excess deaths, 68% of total heatwave excess mortality), the severity and intensity of the meteorological conditions alone does not fully explain the magnitude of the impacts observed. Epidemiological analysis conducted by PHE has found that:

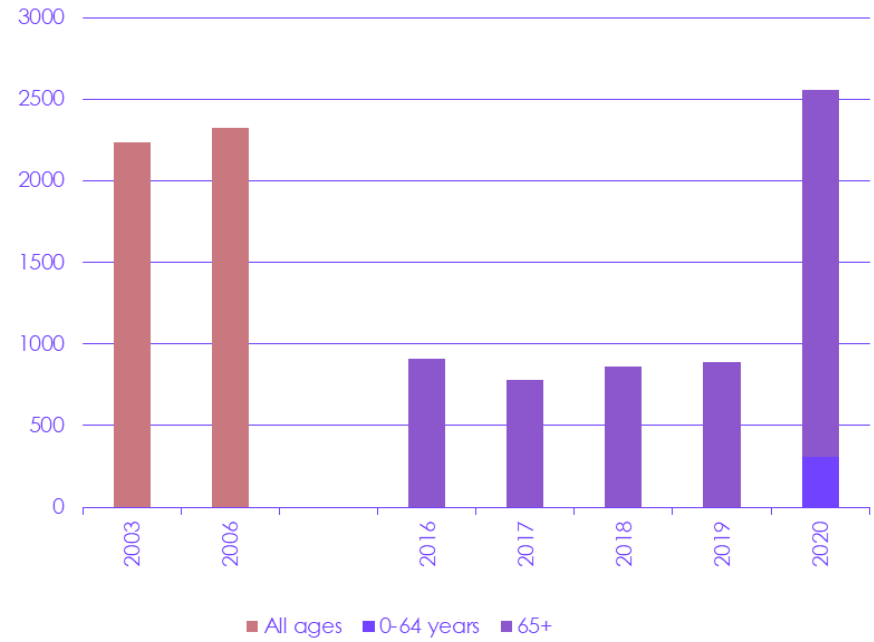
- Notably, significant excess mortality was observed in the 45 to 64 years age group in the August heatwave, compared with previous years where, at a national level, significant excess deaths in younger age groups (<65) during heatwaves were not evident.
- Significant excess mortality was observed in deaths at homes and in care homes for the 65+ age group. Significant excess mortality in this age group was also seen in hospitals during two of the three heatwave periods observed in summer 2020.
- Deaths at home and in hospitals increased significantly in the <65 years group during the third heatwave period compared to non-heatwave days in 2020.
- The COVID-19 pandemic has been associated with a general shift in where deaths have been taking place, with more deaths at home when compared to previous years.
- Excess deaths due to circulatory and respiratory causes, Alzheimer's and Dementia all increased significantly across all three heatwave periods in the 65+ group.

The identification of place and cause of deaths is important for highlighting where to target interventions, particularly for those unable to adapt their indoor environment or their behaviours in response to heat and are reliant on others for their care. However, further work is required to explore how the concurrent risk of

* Excess all-cause mortality was calculated by comparing the average number of all-cause deaths (corrected for delays in registration) on heatwave days with the average from the combination of the 7 non-heatwave days preceding and subsequent to the heatwave period, having subtracting the estimated number of deaths attributed to coronavirus (COVID-19) on those days.

COVID-19 and heatwaves may have intersected to possibly amplify the number of deaths.

Figure 3.11 Excess heat deaths during heatwaves



Source: PHE (2020) *Heatwave mortality monitoring reports 2016-2020.*
Notes: Data split by age range is not available for 2003 and 2006. 2020 data does not include COVID-19 related deaths.

Buildings – Housing

Since 2019, there is further evidence of overheating occurring in residential buildings.
Research for the Energy Follow Up Survey 2017 study, due to be published by BEIS in 2021, monitored temperatures in homes between October 2017 and April 2019.[106] The findings from the study were based on data collected from temperature loggers, interviews conducted during 2017 and 2018, and a mobile phone survey undertaken during a hot period in the summer of 2018. The study found that:

A recent study found overheating occurred in 19% of bedrooms and 15% of living rooms during 2018 (the hottest English summer to date).

- Of the homes included, overheating occurred in 19% of bedrooms and 15% of living rooms during 2018 (the hottest English summer to date), with average temperatures reaching 26.9˚C in bedrooms.*
- The prevalence of monitored overheating was found to be significantly greater in homes occupied by those aged over 75 compared to those under 65. In contrast, those over 75 were significantly less likely to report overheating compared to those under 65.
- Households reported issues with building fabric, the weather, internal heat and ventilation as being the main reasons for overheating.

* The measured overheating assessment used temperatures monitored in the living room and main bedroom during summer 2018. Adaptive temperature thresholds (that recognise that people adapt to warmer temperatures), were used to calculate if overheating had occurred. The adaptive criteria method was expanded to enable the vulnerability of occupants to be taken into consideration by using a lower adaptive temperature threshold for vulnerable groups.

- An adaptive criteria approach to measuring overheating was found to be a credible approach to overheating assessment and could enable targeted approaches to mitigating overheating among the types of dwellings and households most at risk.

A study has found room temperatures reaching up to 47.5˚C in a permitted development flat when no shading was present.

Research published in 2019 to evaluate passive mitigation methods for reducing the risk of overheating has found evidence of significant overheating occurring in a permitted development flat.[107] The study was conducted in a south-west facing, single aspect retrofit (office to residential conversion) apartment building in London between August and October 2016. The study found that when no shading was present room temperatures could reach up to 47.5˚C.

Better indicators would help to understand the wider prevalence of overheating in existing homes.
As well as target appropriate mitigation measures and allow progress in managing risks to be measured. Useful indicators include ongoing monitoring of temperatures in the housing stock; monitoring of overheating exceedances in homes; and number of homes currently adapted.

While increasing heat is a major climate risk to health, cold related deaths will remain significant and mitigation action to improve the thermal comfort of homes in winter as well as summer remains urgently needed.
An integrated approach to housing and thermal comfort is required. A major programme to retrofit energy efficiency measures in homes needs to be delivered over the next 10-15 years in order to prepare homes for low-carbon heat, and improve comfort and health, particularly for the fuel poor. To ensure year-round comfort and health benefits are realised, retrofit programmes should include work to adapt properties to possible overheating and ventilation risks, as well as providing an opportunity to address flood risks and improve water efficiency.

Buildings – schools and prisons

There is limited evidence regarding the prevalence of high indoor temperatures in schools and educational buildings across the country. However, local studies and evidence from pupils and staff have identified some current serious issues:

- Schools in London have reported that concentration levels of children had been affected as a result of high temperatures in recent years (GLA, 2020).

- A survey of teachers found that 90% reported taking additional measures to reduce classroom temperature, including purchasing portable air conditioners (Environmental Audit Committee, 2018a). The majority of respondents reported that high temperatures had an impact on student performance; with half reporting that the reduction in productivity was 'significant'.

- Some new student residences have experienced internal temperatures above 30°C, partly because window openings were inadequate.[108]

Current research projects aim to provide refurbishment scenarios to assess the impact on overheating in the existing school stock: * [109] [110]
The GLA has also recently released some guidance to support schools and academies adapt to climate change.[111] The increase in research in COVID-19 aerosol transmission risk has meant that the role of ventilation design in schools is being reviewed by a number of groups from the risk perspective of the transmission of respiratory disease as well as for climate change adaptation risks, including the

* Through UCL, ARID, NERC, ASPIRE, and EPSRC.

risks of overheating and poor indoor air quality as well as air quality from traffic and other pollution.

The policies set out above are positive steps towards managing overheating risk in the future, particularly for new and refurbished schools. More work is needed to understand the extent of overheating in existing school buildings and take appropriate mitigating action to reduce risk. It would also remain beneficial for schools to have their own adaptation plans.

UK prisons are vulnerable to high ambient temperatures.
The CCRA3 Technical Report found that:[112]

The Ministry of Justice received nearly 500 reports and complaints of overheating in 2016-17.

- HM Inspectorate of Prisons' report included concerns from inmates during inspections which included difficulty of breathing, continuous heating, high ambient temperatures in cells and limited oxygen from poor ventilation.
- The Ministry of Justice (MoJ) received nearly 500 reports and complaints of overheating in 2016-17.
- Solutions such as air-cooling technologies have been suggested to be not acceptable for prison conditions.
- Currently, there is no systematic evidence monitoring the indoor temperatures inside prisons in the UK.

Health and social care

There is increased evidence of overheating in hospitals.
Data on the number of NHS Trusts that experience overheating is now available for four years from the Estates Return Information Collection (ERIC).* In 2019-20 there were 3,600 recorded instances of overheating down from 4,482 in 2018-19.[113]

As data is only collected on an annual basis it is difficult to identify seasonal trends. Greener NHS plan to collect overheating data informally on a quarterly basis.

In 2019-20 there were 3,600 recorded instances of overheating across NHS Trusts.

In 2019, the Sustainable Development Unit commissioned a survey† in health care settings not covered by ERIC which found that in the last three years heatwaves have impacted other healthcare settings:

- 35% of homecare services
- 36% of primary care
- 45% of residential care

COVID-19 may have compounded risk in hospitals and care homes experiencing overheating. This would have a far more significant impact on staff in full PPE.

* Estates Return Information Collection, 2017-2020. ERIC is a mandatory collection for all NHS Trusts. The overheating item of the survey records where wards, for each of the 236 trusts, exceeded a daily maximum temperature of 26˚C. The count provided in the survey includes each occupied ward or clinical area having a daily maximum of over 26˚C as one incident. At any time of the year where temperatures are found to exceed 26˚C, a risk assessment should be carried out and appropriate action taken to ensure the safety of vulnerable patients.

† Commissioned report by SDU, 2019. Questions covered years 2016-2019 and engagement was undertaken with stakeholders across the NHS and social care including frontline providers. 249 primary and social care providers engaged in the survey and while the response rate was low, the data provides an insight into providers' experience of and preparedness for extreme weather events. It should be noted that those who experienced the impacts of severe weather may be more likely to respond to a survey that addresses these issues.

There has been new research into overheating in care settings (Box 3.3).

Box 3.3
Overheating studies in care studies

Care Homes Overheating Audit Pilot Project

The GLA piloted an audit process to produce evidence-based recommendations for reducing the occurrence of summertime indoor overheating and exposure to elevated temperatures in care settings by residents, as well as an easy-to-use Best Practice Overheating Checklist.

The audit results and findings aim to provide consideration by the Care Quality Commission (CQC) to include the risk of overheating due to the impact of climate change in their inspection assessment of care homes.

Care homes could benefit from simple measures incurring minimal or no costs (or possibly cost savings), such as switching off unnecessary heat sources, applying rules for window opening and use of curtains, to highly efficient albeit more complex and expensive solutions that could be implemented in the longer term. These include the application of external shading, high albedo finishing materials and green roofs. Key lessons learnt will be used to inform the establishment of a longer-term process that could be replicated in the future. These include:

- Data monitoring during the heating season can provide valuable insights when studying overheating, as heat exposure and heat related mortality can occur all year round, even when external temperatures are low.
- The all-round effectiveness of summertime overheating adaptation measures should always be considered, as improving one area may cause significant unintended consequences in other areas, including possible impacts on annual heating loads.
- Adaptation measures are best implemented at the design stage, however existing buildings can also benefit significantly from a variety of measures that can be implemented under varying timescales, budgets and other requirements.
- Occupant behaviour plays a significant role in overheating reduction and thus training care home residents and staff on how to best operate the building to keep cool is critical.

Mortality benefit of building adaptations:

Initial work has been undertaken to explore a cost-benefit evaluation of building adaptations designed to protect against heat risks to residents of care homes in England. The work found that various physical adaptations have the potential to be cost-effective and reduce heat risk and should therefore be considered as an important complement to operational responses. In one case study, external window shading was estimated to reduce mean indoor temperatures by 0.9 °C in a 'warm' summer and 0.6 °C in an 'average' summer. In this case, for a care home of 50 residents, over a 20-year time horizon and assuming an annual discount rate of 3.5%, the monetized benefit of reduced Years of Life Lost (YLL) would be between £44,000, and £230,000 depending on which life-expectancy assumption is used. Although this range represents appreciable uncertainty, it appears that modest cost adaptations to heat risk may be justified in conventional cost-benefit terms even under conservative assumptions about life expectancy.

Source: UCL, OBU and LSHTM (2021) ClimaCare project; Ibbetson, A. et al. (2021) Mortality benefit of building adaptations to protect care home residents against heat risks in the context of uncertainty over loss of life expectancy from heat.

Greenspace

The proportion of urban greenspace has not changed in recent years.[114]
The Urban Tree Challenge Fund £10 million fully committed to support the planting of 134,000 trees (above the target of 130,000 trees).[115] However, the proportion of urban greenspace is not increasing. The CCC's previous indicator showed a decrease of permeable urban areas (greenspace) from 821,000 hectares in 2001 to 763,000 hectares in 2020. [116] The permeable fraction of the total urban area has decreased from 63% in 2001to 55% in 2020.

The CCC now has access to an improved indicator (which includes larger areas of greenspace within cities and towns, not captured in the original indicator). Data from this indicator is only available since 2016.

The total proportion of urban greenspace in England declined between 2016 and 2018 from 62% to 60% of urban areas.

The new indicator shows that the total proportion of urban greenspace in England declined between 2016 and 2018 from 62% to 60%, with no change between 2018 and 2020. As well as concerns over the amount of urban greenspace, access to greenspace is not equal across the population.[117]

Recommendation

Introduce an urban greenspace target to reverse the decline and ensure towns and cities are adapted to more frequent heatwaves in the future and that the 25-Year goals are met.

Department: MHCLG, Timing: 2022.

3.5.2 Risks to people from pathogens

Progress summary – Risks to people from pathogens		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - low** • The plan score remains the same. There is no coordinated plan in place which takes account of the impact of climate change on human pathogens. The new Health Security Agency provides an opportunity for climate change to be considered in the context of disease spread. Government are encouraging pro-environmental policies, such as maintaining or expanding urban green and blue space, to include a consideration of increased pathogen prevalence, but it is unclear what the take up of the guidance has been. **Risk management score - medium** • The risk management score remains the same. Warmer weather is contributing to increases in tick abundance and the potential exposure of people to tick-borne diseases. Vector abundance of some mosquito species is increasing and spreading through Europe. There is a major risk of lock-in for vectors and pathogens, as once they are established, they are very difficult to eradicate. Resilience must be built proactively before new pathogens become established. While existing surveillance programmes, risk analysis and contingency planning are in place, the current level of surveillance of pathogens such as ticks and mosquitoes should be improved and expanded. This requires additional resources and investment from Government.	2
Notes: See annex for full datasets Key Indicators: The distribution of ticks in the UK, The distribution of the Asian Tiger Mosquito in Europe, Geographical spread of other climate-sensitive pests and pathogens (not yet available), Funding for national surveillance mechanisms (not yet available).		

Summary of 2019 report score

In our last report, risks to people from pathogens scored a 2 (low plan score, medium risk management score).
Our 2019 report found that strategies to tackle invasive species – such as new mosquito species - do not consider human health and wellbeing. Other plans do not consider the long-term risks from climate change. On progress in managing risk, our previous report highlighted that existing surveillance programmes, risk analysis and contingency planning is in place, but the current level of surveillance could be improved. The report also found that more research was needed to quantify the impact climate change has on exposure to vector-borne-diseases compared to other influential factors.

Has the plan score changed?

No, the score remains the same.

There is no coordinated plan in place which takes account of climate change scenarios and the impacts of health from pathogens.
Since our report in 2019 the National contingency plan for invasive mosquitoes has been led by PHE. It highlights that the unprecedented change in status of vector-borne diseases (VBD) in Europe in recent decades is mainly due to increased globalisation and changes in climate and the environment acting on vector abundance.

This is likely to continue and therefore VBD risk in the UK is likely to increase. The plan sets out some actions for surveillance of invasive mosquitoes. However, it does not appear to include an assessment of how these actions relate to different climate change scenarios, although there are various papers published on climate change and pathogens.*

As reported in 2019, other plans such as NAP2, the 25 YEP, the non-native species strategy, National Risk Register do not take account of the effects of future long-term climate change on human health and well-being due to VBDs.

The multi-agency cross-government group on surveillance (Human Animal Infections and Risk Surveillance group – HAIRS), acts as a forum to identify and discuss infections with the potential for interspecies transfer.
A system of horizon scanning is used to identify emerging zoonotic and vector-borne infections which may pose a threat to UK public health. Risk assessments have been done for tick-born encephalitis, West Nile virus, Chikungunya virus, and Zika virus since 2017.

Government are encouraging pro-environmental policies, such as maintaining or expanding urban green and blue space, to include a consideration of increased pathogen prevalence.
Green and blue infrastructure and wetland areas (including in urban areas) that could reduce flood risk and urban heat islands, could potentially increase the risk of tick-borne infections or mosquito breeding grounds. PHE have published a wetland mosquito survey handbook on how to assess Wetlands.[118] To avoid local land-use conflicts, it aims to ensure that decision makers and those with day-today-responsibilities for wetland management consider the public and veterinary health implications of mosquito populations. It is unclear what the take up of the guidance has been, including by local authorities.

In 2021 it was announced that a new UK Health Security Agency will be set up to plan, prevent and respond to external threats to health.
This provides an opportunity for climate change to be considered in the context of disease spread.

Has the risk management score changed?

No. The score remains the same as in 2019.

Warmer weather is contributing to increases in tick abundance and the potential exposure of people to tick-borne diseases.
The distribution of ticks has changed over time which may have contributed to an increased number of confirmed cases of Lyme disease in the UK and an increased risk of other tick-borne diseases. Climate change could be a cause of this change due to milder winters and warmer temperatures leading to increased tick-human contact patterns.

Climate change models suggest a northern spread of TBE in Europe.

For example, since 2019 tick-borne encephalitis has been found to be present in Thetford Forest in the East of England and on the Hampshire/Dorset border.[119] Two probable cases of TBE infection have since been diagnosed due to tick-bites in the UK. Climate change models suggest a northern spread of TBE in Europe.[120]

* For example, Metelmann S et al. 2018.

As well as climate change, non-climate drivers such as agriculture, land use, tourism and wild animal populations could be a dominant influence on the incidence and distribution of ticks. Attribution of the different drivers, including climate change is not possible, and more research is needed to understand the links.

There is a UK wide tick surveillance scheme, however it is constrained by a lack of resource.
The UK's Tick Surveillance Scheme (TSS) began in 2005, run by PHE. Ticks are not routinely screened for pathogens and surveillance is constrained and would benefit from additional resources. The scheme still processes ~1,000 submissions per year and constitutes the best available data on UK ticks. Dedicated, local monitoring of tick activity would be useful to better understand how local weather conditions impact tick activity. This is currently being done in a small number of locations but could be rolled out and provide useful climate change indicator data.

The Asian Tiger mosquito (*Aedes albopictus*) is spreading northwards across Europe (Figure 3.12).
Since 2016, the Asian Tiger mosquito (*Aedes albopictus)* has been found (without confirmed establishment) in a few locations in Kent and west London.[121] This mosquito is an invasive species which can transmit dengue, chikungunya and zika virus, though there is no evidence that the mosquitoes found in the UK were capable of carrying disease (known as vector competence).

Responses to detection have been rapid and well-coordinated by PHE local health protection teams. However, the area where the mosquito is established in Europe has shifted northwards, across much of Italy and into mid and northern areas of France. Italy has experienced an epidemic of chikungunya in 2017 (Box 3.5). A recent study has found:[122]

The suitable area for the Asian Tiger mosquito will spread in the future and within 50 years much of England and Wales may have a suitable climate.

- The local climate may be sufficient, in small pockets, around the Thames to sustain the Asian Tiger Mosquito currently.
- The area will spread in the future and within 50 years much of England and Wales may have a suitable climate.

Invasive mosquitos are likely to be found in increasingly challenging sites, such as urban areas. Recommendations have been made in a recent study around improving training of pest controllers and environmental health, incorporating PHE's mosquito surveillance schemes into routine local authority activities and developing local mosquito control plans.[123]

Box 3.5
Asian Tiger Mosquito (*Aedes albopictus*) in Europe

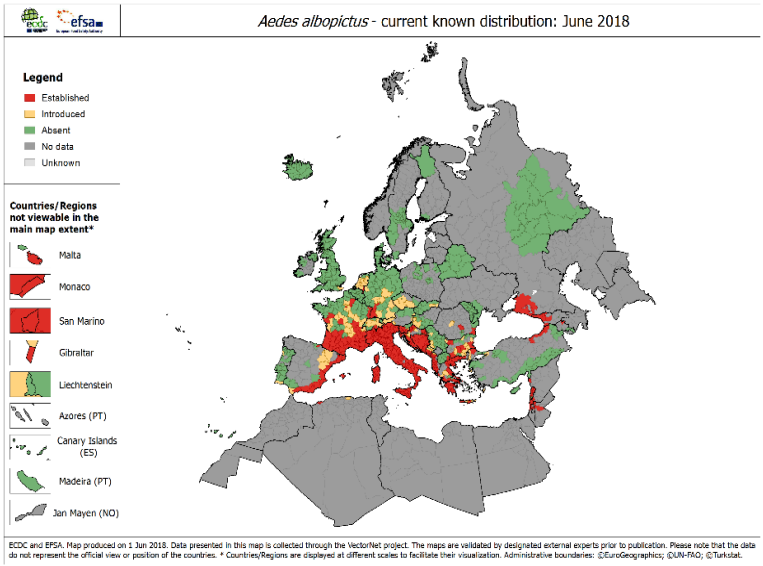
The Asian tiger mosquito (*Aedes albopictus*) has been reported in multiple European countries in recent decades. As a known vector of dengue and chikungunya, this species of mosquito is considered a serious health threat by the European Centre for Disease Prevention and Control. It has become established in most areas of Italy less than 600m above sea level. It is also prevalent in Southern France and Corsica and known to be spreading across Greece, Spain and the Balkan countries (Figure 3.12).

In France, following the establishment of *Aedes albopictus*, a national preparedness and response plan to prevent and control local transmission of chikungunya and dengue was developed in 2006 and is updated annually.

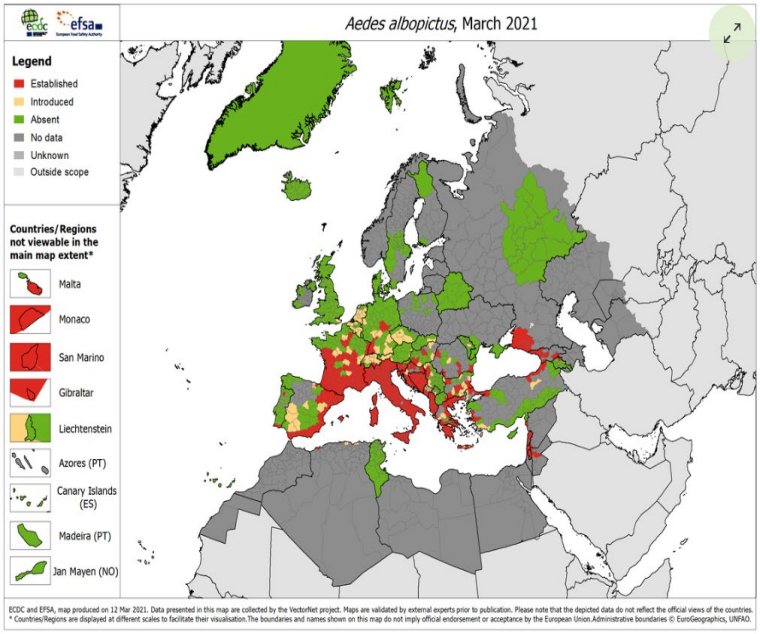
The plan focuses on entomological and epidemiological surveillance, with increased surveillance between May and November as well as increasing awareness among the population and health professionals of the risks. Since implementation, it has led to the detection and containment of several episodes of local transmission of chikungunya and dengue, including a small outbreak of autochthonous cases of Dengue in the city of Nimes in the South of France in 2015 and Chikungunya in Var, South-Eastern France in 2017.

Source: European Centre for Disease Prevention and Control, Aedes Albopictus Factsheet for Experts; European Centre for Disease Prevention and Control (2021) Seasonal active surveillance for invasive mosquitos over 2017-2019.; Succo, T. et al. (2016). Autochthonous dengue outbreak in Nîmes, South of France, July to September 2015. Eurosurveillance: bulletin europeen sur les maladies transmissibles = European communicable disease bulletin. 21. 10.2807/1560-7917.ES.2016.21.21.30240.; European Centre for Disease Prevention and Control. Cluster of autochtonous chikungunya cases in France – 23 August 2017. Stockholm: ECDC; 2017

Figure 3.12 Asian Tiger Mosquito distribution in Europe



June 2018



March 2021

Source: European Centre for Disease Prevention and Control (2020), *Mosquito maps*.
Notes: June 2018 distribution compared to March 2021 distribution.

Surveillance of invasive mosquitoes takes place across UK ports and in some motorway stations and truck stops (59 locations largely focussed on south-east England, where the risk of mosquitoes entering and establishing are greater). There is a major risk of lock-in for vectors and pathogens.* Resilience must be built proactively before new pathogens become established.
There is uncertainty around if or when pathogens will become established however, if introduced, it is extremely difficult for a zoonotic pathogen to be eradicated, as it will become established within the population in the native fauna. The pathogens can also become adapted to their new hosts. There is not only an impact on people's health but also a potentially large economic cost to local and central governments to monitor and control disease spread.

Climate change and vector-borne disease is an increasing problem, that must be fully addressed and invested in sufficiently. The new health agency provides an opportunity to expand surveillance across the UK, model and monitor species of concern and the mechanism by which invasive species arrive in the UK and provide suitable indicators to measure vector abundance. The Government must ensure such surveillance is appropriately funded.

Recommendation
Fund the strengthening and widening of vector and pathogen surveillance and early warning mechanisms, due to the increasing risk of disease spread as a result of climate change and other factors. Department: DHSC, Timing: Now and ongoing.

* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

3.5.3 Air quality

Progress summary – Air quality		
2019 score:	**What has changed since 2019:**	**2021 score:**
3	**Plan score - medium** • The plan score remains the same. The Clean Air Strategy includes long-term targets to reduce the levels of some outdoor air pollutants and these should fall further as a result of the implementation of Net Zero policies. However, there is no consideration of the impact of climate change itself on air quality. Cleaner Air is one of Public Health England's (PHE's) top ten strategic priorities, as set out in PHE's Strategy 2020-2025. The benefits of additional adaptation (to target climate induced changes in outdoor air quality) are likely to be low, but more research is needed on pollution and health monitoring and modelling during different weather events. The Government proposed changes to Part F (ventilation) of Building Regulations in 2019-2021, to simplify and clarify guidance on ventilation in homes to ensure good indoor air quality and comfort to occupants. **Risk management score - low** • The risk management score remains the same. Poor air quality causes significant harm to health. Vulnerability to outdoor air pollution, measures by the total number of people living with chronic respiratory conditions (COPD and asthma), has continued to increase. There is little evidence of monitoring of indoor air quality occurring in existing homes.	3
Notes: See annex for full datasets Key Indicators: Number of people with chronic respiratory conditions, Instances of poor air quality in homes (not yet available), Number of installations of functional mechanical ventilation systems in buildings (not yet available).		

Summary of 2019 report score

In our last report, health impacts from air quality scored a 3 (medium plan score, low risk management score).
Our 2019 report found that plans and long-term targets are in place to reduce levels of air pollution, but these do not consider the impact of climate change of future air quality levels. On progress in managing risk, our previous report highlighted that research to address the CCRA2 research priority to understand the future impact of climate change on air quality was postponed, and vulnerability to air pollution has continued to increase.

Has the plan score changed?

No, the score remains the same.

The Clean Air Strategy includes long-term targets to reduce the levels of some outdoor air pollutants and these will fall further with Net Zero policies. However, there is no consideration of the impact of climate change.
As reported in 2019, targets and actions are in place to reduce air pollution within the Clean Air Strategy (CAS) and 25 Year Environment Plan. The Environment Bill delivers key parts of the Strategy and introduces a duty to set a legally binding target for fine particulate matter concentrations, and a duty to set a long-term air quality target. If met, future air pollution levels will be lower than now, and the marginal effect of climate change will act on a much lower baseline.[124]

Future levels of air pollution for will fall even further with the implementation of virtually all changes proposed in the CCC's Net Zero pathways.* There are several areas where the options adopted to meet Net Zero need to be carefully assessed to ensure the pathway is as beneficial as possible. For example, tree planting of certain species of tree and bioenergy crop may lead to increased production of ground level ozone and pollen that can aggravate asthma, hay-fever and other respiratory problems.[125] [126]

The benefits of additional adaptation to target climate induced changes in outdoor air quality are likely to be low.
The most effective actions would be through the existing air quality policies and identified air quality improvement measures. These must ensure that climate risks are integrated into air quality policy and plans, taking account of both 2˚C and 4˚C warming scenarios. Further action might also be beneficial around improved early warning and response plans for extreme events, notably where there is an interaction between heat and air quality.

There is also a need for further research on pollution and health monitoring and modelling in different weather events.

Cleaner Air is one of Public Health England's (PHE's) top ten strategic priorities, as set out in PHE's Strategy 2020-2025. They are considering physical and mental health co-benefits from reduced exposure to air pollution, including climate change.
PHE is developing a five-year programme of work which aims to reduce the sources of air pollution and people's exposure to it, particularly for the most vulnerable groups. One priority is to understand opportunities and threats associated with air pollution and health, including climate change.[127]

Fewer options are available to control pollen sources.
The benefits of further action are mostly in further research and analysis of the linkages, and enhanced health advice and public warning systems. These are low-regret options.

The Government has proposed changes to Part F (ventilation) of Building Regulations.
These changes propose to simplify and clarify guidance on ventilation in new build homes to ensure good indoor air quality and comfort to occupants. Indoor air quality is determined by many factors including outdoor pollution, indoor pollutants and ventilation in buildings. Interventions to warm homes by reducing uncontrolled air leakage and prevent heat loss (e.g. through increased drought proofing and insultation) need to include adequate ventilation, otherwise they can worsen indoor air quality by concentrating pollutants generated indoors. This is an unintended consequence of high-performance retrofits, along with overheating, which can have negative impacts on respiratory conditions (including lung cancer), cardiovascular disease and allergic symptoms (e.g. atopic dermatitis, rhinitis, conjunctivitis and hay fever). These effects have major implications for building standards with respect to health.[128]

* Major benefits to air quality are predicted from, for example, widespread electrification of transport and industry, where electricity supply is from 'clean' sources, and from reduced livestock in agriculture which reduces the emissions of ammonia that contribute to an important fraction of PM2.5. There are some actions where care is needed with respect to potential disbenefit on air quality; for example, the avoidance of high VOC (Volatile organic compounds) emitting species in increased forest and bioenergy cropland cover, which may lead to increased production of ozone. Biogenic VOCs from trees and shrubs contribute to formation of both ozone and particulate matter. Their emission is highly temperature-sensitive and hence climate change is liable to have adverse effects. Such effects would be exacerbated by tree planting programmes unless low-emitting species were selected.

In 2020, guidance from Public Health England on selected volatile organic compounds (VOCs) indoors and World Health Organisation (WHO) recommendations for indoor pollutant levels have allowed further flexibility to be introduced into Approved Document F by allowing designers to asses individual VOCs. In 2019 MHCLG reviewed Part F of Building Regulations (for ventilation) alongside Part L (for energy) in new homes to ensure the right level of ventilation is supplied that provides good indoor air quality. Natural ventilation, continuous extract (MEV systems) or supply and extract (including MVHR systems), are recognised as effective means of ventilating a modern property if designed, installed, used and maintained correctly. The revised Building Regulations guidance in Approved Document F is expected to improve compliance with the standards and therefore improve indoor air quality.

In 2021, MHCLG consulted on changes to the guidance in Approved Document F for existing homes.[129] These proposed changes recommend that extra ventilation in installed when installing common energy efficiency measures in existing properties, as well as when replacing windows, adding rooms, refurbishing kitchens or bathrooms (as is currently). The proposed changes aim to prevent homes becoming under-ventilated and less compliant with Part F as homes become more energy efficient.

A large proportion of homes simply do not comply with the current building regulations' requirements.

Despite positive changes proposed to regulations, the UK Government's 'Ventilation and indoor air quality in new homes' paper, has shown a large proportion of homes simply do not comply with the current building regulations' requirements, and poor indoor air quality has been observed in several sample homes tested.[130] There is a need for more accurate performance testing of new homes, committing developers to the standards they advertise.

The Health Protection Research Unit on Environmental Change (2016-20) has led to the development of a policy brief on the issue of housing energy efficiency and indoor air quality (specifically with regards to radon).

Has the risk management score changed?

No. The evidence available on managing risk remains the same as in 2019.

Poor air quality causes significant harm to health.
Poor air quality is associated with heart disease and stroke, as well as exacerbating respiratory conditions such as asthma, chronic obstructive pulmonary disease, lower respiratory tract infections and carcinomas of the respiratory tract. Particulates are estimated to contribute to around 29,000 deaths in the UK each year and up to 40,000 deaths when nitrogen dioxide exposure is also included.[131]

Long-term exposure to air pollution is associated with increased morbidity and mortality from chronic diseases, some of which have also been identified as increasing the risk of severe COVID-19 symptoms.

One study has estimated around 10-20 additional ozone related deaths per year in the UK due to climate change, although a reduced number of deaths from particulate matter.

In terms of future deaths from air quality that are attributable to climate change, there have been studies that model climate change impacts on air quality for Europe. One study estimated around 10-20 additional ozone related deaths per year in the UK, although a reduced number of deaths from particulate matter.[132]

Vulnerability to air pollution, measured by the total number of people living with chronic respiratory conditions (COPD and asthma), has continued to increase.
Vulnerability to risks from air pollution can be monitored through assessing changes in the vulnerable population over time for air pollution related health impacts and deaths.

Although asthma and COPD cases can be viewed as an impact indicator (along with related deaths), in this context the Committee are treating them as vulnerability indicators; people with chronic respiratory conditions are more susceptible to periods of high air pollution:

- There has been a 20% increase in the number of patients receiving treatment for asthma in England, from 3.3 million patients in 2010-11 to 3.9 million patients in 2019-20.[133]

- The number of patients receiving treatment for COPD increased by 30% from 900,000 in 2010-11 to 1.2 million in 2019-20. Over this same period, the percentage of the total population receiving treatment for COPD increased from 1.6% to 1.9%.[134]

- London has the lowest percentage prevalence of both COPD and asthma, with the North of England having the highest percentage for COPD and the south west for asthma.

- Since 2001, deaths from asthma and COPD have increased by 24%.[135]

- Over 85s account for nearly 50% of deaths where asthma was the underlying cause compared to 23% in 2001.[136]

There is little evidence of monitoring of indoor air quality occurring in existing homes.

Apart from the MHCLG research mentioned above there is little evidence of monitoring of indoor air quality occurring in existing homes.

3.6 Effectiveness of the emergency planning system

Progress summary – Effectiveness of the emergency planning system		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • The plan score remains the same. Climate change has now been recognised in the National Risk Register and is being included by some Local Resilience Forum in local resilience plans and risk registers. However, climate change is already altering the risk profile of some hazards and extreme events are possible in the current climate. It is unclear how this change in risk is being factored into current national risk assessments and legislation. Local Resilience Forum report being less prepared to respond to surface water flooding, drought and heatwaves, compared to river or coastal flooding. **Risk management score - medium** • The risk management score remains the same. Resilience Direct provides a platform for live multi-agency responses, resilience planning, exercising and recovery and has over 83,000 users. There are warnings in place for most climate hazards. However, climate risk is increasing, while the capacity to respond to incidents appears to be decreasing. This may lead to the available response capacity of some local areas becoming overwhelmed by future unprecedented events or series of events in parallel or quick succession. Improvements in resilience should be geographically targeted, with service vulnerability hotspots identified.	5
Notes: See annex for full datasets Key Indicators: Environment Agency staff trained to respond to flood incidents, Number of emergency responders, Number of emergency planners and responders using Resilience Direct (not yet available), Time to coordinate responses to events (not yet available).		

Summary of 2019 report score

In our last report, effectiveness of the emergency planning system scored a 5 (medium plan score, medium risk management score).
Our 2019 report found that there are plans in place for the major climate-related emergencies today, but these do not include a consideration of the present-day change in risk from climate change. Weather and climate models have been increasing in the level of skill and granularity and can provide an improved baseline understanding of the current likelihood of extreme weather events. On progress in managing risk, our previous report highlighted that recent events have shown that the response system can be stretch and that capacity to respond in some areas is decreasing. These factors need to be properly assessed to ensure emergency planning is fit for the future climate.

Crisis response in the UK involves a diverse range of national and local organisations. National organisations and guidance clearly have a vital role to play in setting strategic direction. However, the responsibility for crisis planning and response at a local level in England lies with local resilience forums.

Has the plan score changed?

No, the score remains the same.

Climate change has now been recognised in the National Risk Register.
In 2019 the Committee reported that the National Risk Register (NRR) (the public facing document of the National Security Risk Assessment, NSRA) did not acknowledge the projected changes in climate extremes that drive environmental hazards. The 2020 NRR now includes up front a section on climate change and recognises it as a significant crisis that the UK will need to face. There is a mismatch in the timescales considered by the NRR and CCRA which means that the NRR does not assess the impact and likelihood of climate trends, though it does now provide a link to the Climate Change Risk Assessment.

It is important that changing climate risk is also factored into the NSRA.

Climate change is already altering the risk profile of some hazards and extreme events are possible in the current climate.
The CCRA3 Technical report reported that significant progress has been made in the attribution of extreme weather events since CCRA2, but this remains challenging because of the UK's highly variable weather and the fact that these events are, by definition, rare.[137] Recent extremes can be largely explained by the prevailing atmospheric circulation anomalies; however, these factors alone are not necessarily sufficient to explain the intensity of events, which may also have an underlying contribution from the warming UK climate.

A new methodology, known as UNSEEN (UNprecedented Simulation of Extremes with Ensembles) is providing a valuable tool for assessing current and near-term climate risks by providing better estimates of the tails of the observed distribution for the current climate and providing bounds on what is meteorologically plausible in terms of extreme events.

There is an 11% likelihood of any current year of summer temperatures exceeding those in 2018.

For example, it suggests that the severity of flooding of the Thames in 2014 should not be unexpected, even under present climate conditions, with even more extreme monthly rainfall totals possible. It has also been used to assess that there is an 11% likelihood of any current year of summer temperatures exceeding those in 2018 (where summer average temperatures were close to +2°C above the 1981–2010 average for a large swathe of southern and central England and Wales).

It is unclear how this change in risk is being factored into current national risk assessments and legislation.
A study by the British Red Cross[138] recommended that there is a need for a future-proofed framework including a clearer role for the voluntary and community sector. Current legislation dates from 2004 and while the Government reviewed the Civil Contingencies Act in 2017, finding the legislation was working as intended, this was prior to some significant flood events of 2017. The Red Cross reports that since the legislation was introduced many in the crisis response sector have learnt important lessons from national crisis and are adapting to new threats such as the increased risk of climate related events. The Government should review regulations and guidance under the Civil Contingencies Act to ensure the legislation is fit for the changing nature of crisis response in the UK, including from the impacts of climate change.

Climate change is being included by some LRFs in plans and risk registers.
An assessment of Local Resilience Plans by the British Red Cross[139] found that the emergency plans consistently prioritised short-term needs over longer-term support. Longer-term issues tended to be considered within the remit of other bodies such as local authorities or were featured in other specific plans such as the Recovery Plan, highlighting a potential lack of joining up between difference strategies.

A survey of Local Resilience Forum by the CCC however found that most responders reported that they included climate change in Local Resilience Plans and/or Risk Registers.* Survey responses said that climate change is usually derived from or embedded within assessments of risks in the National Security Risk Assessment (NSRA). All responders of the survey indicated that local risk assessments were updated once a year or more often and can incorporate changes to hazard likelihoods and impact.

LRF's capability to respond varies depending on type of event.
The survey also found that responders felt that their LRF's capability to respond to weather-related emergencies was either good or excellent. Drivers of capability to respond were mixed, although all LRF's surveyed said that one factor was experience of previous weather-related emergencies. Other key factors included the availability of resilience tools (such as Resilience Direct) and resources being made available to fund the LRF.

However, some LRFs felt they were not as prepared to deal with some hazards compared to others, a finding that is reflected in the Committee's earlier analysis of emergency planning from 2014. Whilst, responders of the survey felt that LRFs were prepared for river and coastal flooding, cold, and snow a number said that they were less prepared for heatwaves, drought and surface water flooding.

The Community Resilience Development Framework was published in September 2019 after consultation with representatives from UK Government Departments, statutory responders under the Civil Contingencies Act, the voluntary and community sector and academics.[140] The Framework provides a reference tool for the delivery of strategic approaches to community resilience development. Guidance on planning the coordination of spontaneous volunteers was also released, providing emergency responders with the guidance on how to plan, coordinate and manage spontaneous offers of support from the public during an emergency, including severe weather events.[141]

England has Heatwave and Cold weather plans that provide guidance to health, social care and community practitioners and the public. However, these do not constitute a comprehensive long-term adaptation plan to reduce the risk of heat- and cold-related mortality and illness.
The plans are due to be combined into one extreme weather plan, with an aim to move away from focusing on emergency response to longer-term resilience (see Section 3.5.1)

The 2021 Heatwave Plan has no significant changes but does include recognition that concurrent risk of heatwaves and COVID-19 pandemic could amplify risks to health.

Has the risk management score changed?

No, the evidence available on managing risk remains the same as in 2019.

* There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England.

The Resilience Direct platform is a tool for live multi-agency responses, resilience planning, exercising and recovery.
The Resilience Direct (RD) service currently has over 83,500 users. Resilience Direct capability is assessed by the resilience community and enhanced accordingly.* New RD mapping capability was launched in June 2020 which included new features to support RD users, such as Nowcasting.† Nowcasting allows responders to understand which access routes may be affected by surface water during high rainfall events and allows the emergency services to gain greater insight into the best routes during flooding, saving time in response.

There are weather warnings in place for most climate hazards.
There are well developed warning systems in place to alert the public and emergency responders to imminent threats of flooding, heavy rainfall, strong winds and heatwaves. The commissioning of year-round altering system for heat and cold is complete.[142] The Met Office will issue a new Extreme Heat Warning service in June 2021, designed for extreme heat episodes and to work alongside PHE heat-Health Alert system. The warnings will focus on impacts to the general public.

The Cabinet Office continues to support the Met Office's year-round WeatherReady campaign.[143] The WeatherReady campaign encourages individuals, families and communities to think about preparations they can make to prepare for and cope with severe weather. It also provides resilience practitioners in local authorities, local emergency responders, and voluntary sector partners, with up-to-date expert guidance that can be used to communicate severe weather advice to individuals and communities.

The capacity to respond to incidents appears to be decreasing, while risk is increasing.
The effectiveness of the emergency response system is particularly sensitive to the expected impacts of future increases in extreme rainfall and flood risk. The numbers of Civil Category 1 responders, the response times of responders, the number of other responders (such as volunteers and charities) and the funding available for local authorities can impact how much capacity and ability an area has to be able to respond to extreme weather events.[144]

Category 1 responders are decreasing in number from the high point in 2009/10 which could impact the emergency services' ability to respond to any major situation, including floods or heatwaves:

- Fire service personnel have decreased by 23% since 2009.[145]
- Police service personnel have decreased by 8% since a peak in 2010, although numbers have risen since our 2019 report.[146]

Whilst the number of staff working for the Ambulance Service (full-time equivalent) increased by 24% between 2010 and 2019, this is mostly due to an increase in clinical support staff rather than ambulance staff which has remained constant.[147]

This decline may lead to the available response capacity of local areas becoming overwhelmed by future unprecedented events or series of events in parallel or quick succession.

* Discussion with Cabinet Office (2021).

† The service is currently experimental and covers London, Birmingham, Manchester, Worcester and Leicester.

Other bodies are also available during emergencies. The armed forces have been used to support the response to natural disasters, for example during the response to Storm Dennis in 2020.[148] The British Red Cross is an auxiliary to Government and helps authorities respond to emergencies. The voluntary and community sector can be used to plan for and respond to emergencies.[149]

The number of Environment Agency staff who are trained and ready to respond to flood and environmental incidents is just above the target of 6,000.

The number of Environment Agency staff who are trained and ready to respond to flood and environmental incidents is just above the target of 6,000 (6,408).[150] Since the floods of winter 2015 to 2016, the Environment Agency has invested in new incident response kit including 40km of temporary flood barriers and 250 high volume pumps.

Improvements in resilience should be geographically targeted, with service vulnerability hotspots identified before major events occur in areas where emergency services are already under strain.
Emergency responders are required to reach urgent cases within mandatory timeframes, regardless of weather conditions. However, flooding of transport networks can add critical minutes to travel times between dispatch and arrival. A 2020 study found that vulnerable facilities with concentrations of elderly people, children and people with poor health, fall outside emergency service areas during flood events (even relatively low-magnitude coastal/fluvial (< 1-in-30 years) and surface water (1-in-30 years). This indicates that for those populations who may need help during a flood (for example, evacuation), it is also much harder for emergency responders to gain access to those affected in good time.[151]

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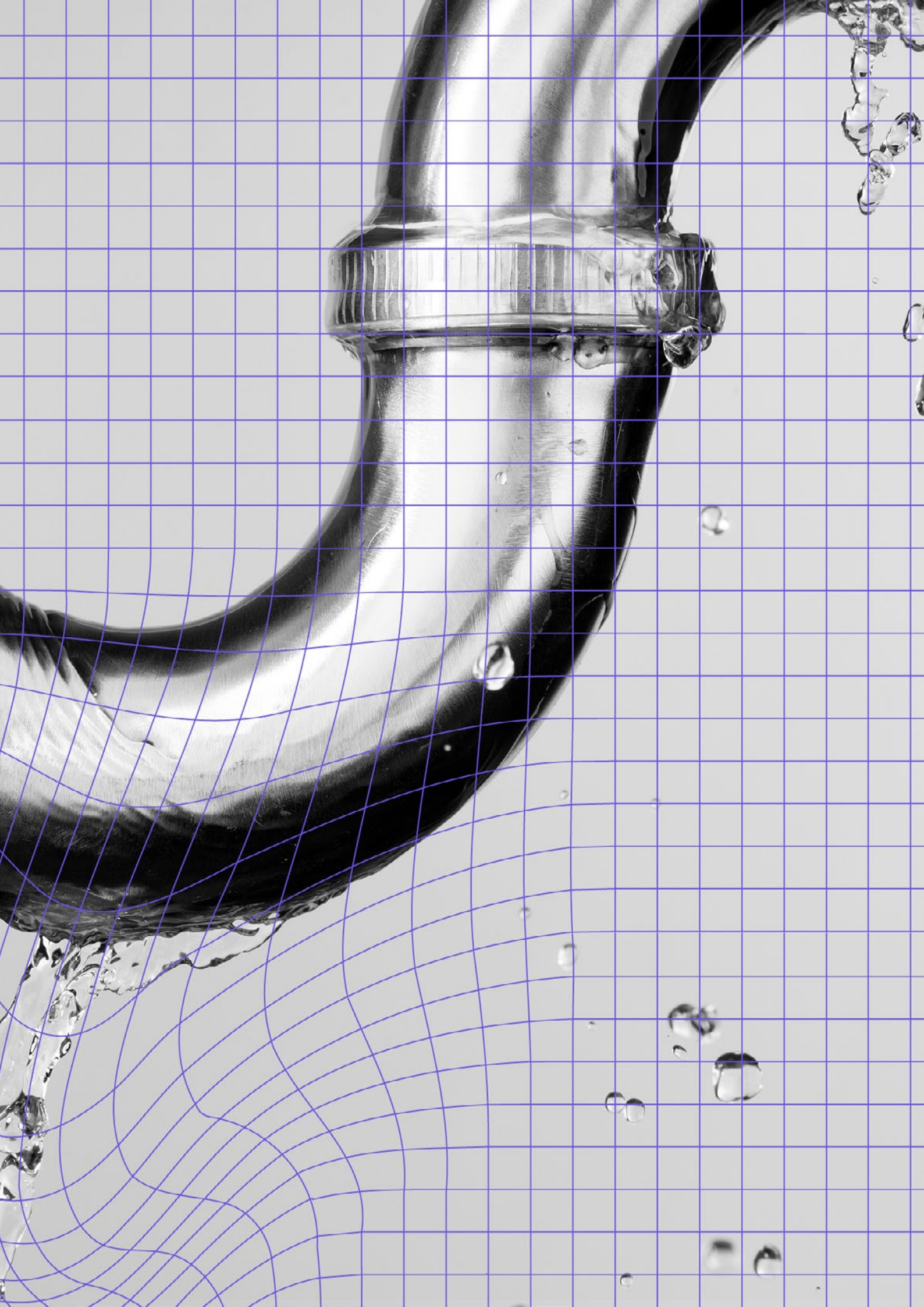
Chapter 4

Infrastructure



4.1 Introduction

There have been a number of high-profile weather events causing damage to infrastructure in England since our last assessment.

The functioning of our society and economies is heavily reliant on the services that infrastructure provides. Infrastructure systems in England are vulnerable to disruption and failure from extreme weather and a changing climate.
Disruption to infrastructure networks from extreme weather can have significant implications not just for economic activity, but societal equity, health and well-being more generally. Networks are also vulnerable to increased degradation and reduced performance over time as a result of long-term changes in climate. There have been a number of high-profile weather events causing damage to infrastructure in England since our last assessment. 2019 was a particularly significant year with intense summer and autumn rainfall producing flash floods, notably impacting several stations on the London Underground. In the summer of 2019, temperatures exceeded 38°C (the hottest day ever recorded in the UK) which led to rail buckling and subsequent widespread damage and disruption on the rail network in England. A lightning strike in August that year caused a loss of power to one million customers including homes, businesses, one hospital and Newcastle Airport, and triggered disruption on the rail network. Winter flooding led to widespread disruption in South Yorkshire, quickly followed by the impacts of Storm Ciara and Dennis in early 2020.

The UK Climate Risk Independent Assessment (CCRA3)[1] identifies increasing risks to infrastructure in England from high temperatures, flooding, drought, coastal erosion, and potentially wildfire in the coming decades.
The CCRA3 Technical Report sets out the changes in climate that are expected over the coming decades; increasing average and extreme temperatures, changing rainfall patterns leading to flooding at certain times and water scarcity at others, and rising sea levels (see Chapter 1). An increasing frequency and severity of flooding from a range of sources represents the most significant climate change risk to UK infrastructure, including energy, transport, water, waste and digital communication. Assets and networks across all infrastructure sectors are already exposed to multiple sources of flooding, and the number of assets exposed could double under projected changes in climate by the 2080s. Projected extended periods of rainfall will increase the risk of slope and embankment failure - approximately 8% of the UK's transport and road network is at medium to high risk of landslide disruption.[2] Changes in rainfall, coupled with population growth, are projected to lead to supply-demand deficits in water resource zones across England and in some other parts of the UK by the 2050s, with widespread deficits projected by the 2080s. High temperatures can cause railway tracks to buckle, electricity cables to sag, signalling equipment to overheat and fail and road tarmac to soften and rut. Data centres are vulnerable to flood, high winds, wildfire and droughts as well as a loss of supporting power supply. While future projections remain uncertain, increases in maximum wind speeds experienced during storms would have significant implications for overhead power lines, data network cabling and the rail network, as well as for offshore infrastructure and wind turbines.

Infrastructure assets can have very long lifetimes, in excess of 100 years, during which the English climate is expected to change considerably.
Adaptation planning that considers long-term changes in the context of 2°C and 4°C global temperature scenarios is therefore particularly important for infrastructure.

Infrastructure can be built from the outset to be resilient to the anticipated range of future climatic conditions or designed to allow it to be upgraded cost-effectively as the climate changes, i.e. a managed adaptive approach.

Whilst understanding of sectoral risks has improved over the last few years, the impacts of climate change could be amplified by interdependencies between infrastructure sectors, and these interactions are not well understood.

All of the major climate hazards considered in CCRA3 could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms.

No infrastructure network operates in isolation and a failure on one system can interact, and rapidly cascade into other sectors. System resilience to climate change goes beyond just the individual infrastructure network and can have far reaching consequences. All of the major climate hazards considered in CCRA3 could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms. Interaction between climate hazards adds further complexity, for example combinations of drought followed by periods of intense rainfall can exacerbate bank stability issues.

There have been a number of recent policy developments for national infrastructure and an increased focus on climate change adaptation is emerging.

The UK Government has produced National Policy Statements which comprise the government's objectives for the development of nationally significant infrastructure and require climate change projections to be considered when developing new major infrastructure assets and projects. The first National Infrastructure Assessment was published in 2018, which included a number of climate change related recommendations such as national flood resilience standards and a plan to enable the water sector to meet changing supply and demand in 2050. A new National Infrastructure Strategy was published in 2020. The 2020 Spending Review committed £640 billion of gross capital investment in infrastructure before 2024-25.[3]

Broader societal drivers will influence the need for resilient infrastructure.

There will be significant implications for infrastructure resilience as a result of the transition to a Net Zero economy, for example a marked increase in reliance on electricity and the development of new energy infrastructure. This is explained further in Box 4.1.

Box 4.1
Net Zero implications for infrastructure

The UK Government has adopted a Net Zero target through a revision to the 2008 Climate Act (such that the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline). This will impact upon the type of infrastructure the UK will be reliant upon in 2050 as well its role within the wider economy and society. Changes in the energy, water supply and transport sectors will include:

- Increased reliance on electricity and ICT through extensive electrification, which amplifies the consequences of power outages and makes cascade failures to other networks more probable.
- Increased significance of offshore infrastructure to electricity supply.
- New infrastructure (e.g. hydrogen production, distribution and storage, electric vehicle charging points) with implications for scaling up investment in flood risk management.
- Increased requirements for water for CCS and Hydrogen production increases vulnerability to water shortages and, if facilities are sited on the coast, coastal erosion and sea level rise.

All proposed infrastructure investments will need to be critically evaluated through a Net Zero lens.

Energy supplies in particular will need to become increasingly resilient to climate change and interdependencies will need to be better understood and managed. Work is needed to understand the implications of water availability projections for the energy sector, in the context of Net Zero. The Government's new National Infrastructure Bank, announced as part of the National Infrastructure Strategy in 2020, will have a major role to play in supporting the transition of the UK's economy to Net Zero emissions by 2050.

Source: CCC (2021) *The Third UK Climate Change Risk Assessment (CCRA3) - Advice to Government.*

In a recent White Paper, the Institution of Civil Engineers found that while the UK's long-term infrastructure drivers and challenges have not changed because of Covid-19, in the short to medium term the pandemic highlights the need to prioritise investments around digitalisation of new and existing infrastructure assets.[4]

In the sections below the Committee assess progress being made in accounting for and adapting to climate change for new infrastructure, existing infrastructure (broken down by sector) and with regard to infrastructure interdependencies.

4.2 Infrastructure interdependencies

Progress summary – Infrastructure interdependencies		
2019 score:	**What has changed since 2019:**	**2021 score:**
1	**Plan score – low** • The plan score has not improved, however there are promising developments through the new National Infrastructure Strategy (NIS) and the National Infrastructure Commission's Resilience Study, which could lead to an improved plan score over the next two years. The new NIS is welcome and does acknowledge the increasingly important need to identify and limit cascading risks across infrastructure networks. However, there remains no systematic assessment of interdependency risk, or plan to improve resilience or address risks and opportunities from climate change. The Resilience Study develops a framework for the next National Infrastructure Assessment in 2023 and identifies climate change as one of three key challenges for resilient infrastructure. **Risk management score – low** • The risk management score has not improved. Impacts caused by cascading failures from weather and climate related disruptions are still not recorded and monitored at a national scale. There remains a lack of data to assess whether actions by individual operators are reducing risk, and opportunities for data sharing across networks and Local Resilience Forums could be improved. Defra is promoting use of the UKCP18 climate projections through the Infrastructure Operators Adaptation Forum and the Adaptation Reporting Power. Defra has also been engaging reporting organisations to include better coverage of interdependent risks in ARP3 reports. However, the ARP3 reporting deadline exceeds the timeframe for this report therefore the Committee have been unable to assess the extent to which interdependent risks are being identified and managed. The transition to Net Zero and increased reliance on electricity for heating, transport and industrial processes will increase the potential impact of interacting risks.	1
Notes: See annex for full datasets Key Indicators: There remains a lack of data on interdependent risks and resilience actions by infrastructure providers.		

Summary of 2019 report score

In our last report, infrastructure interdependencies scored a 1 (low plan score, low risk management score).
In our last assessment the Committee found that there was no systematic national assessment of interdependency risk or plan to improve resilience, including addressing risks and opportunities from climate change. The report also highlighted issues around sharing of resilience data.

Strategic actions to reduce risk did not appear to be happening - there are NAP actions to share data, but these were not on track. Some research was underway and the Committee acknowledged the role of the NIA in beginning to address vulnerabilities. While many assets were being protected to the standard set out in the National Flood Resilience Review, it was not known whether risks were being fully managed.

Has the plan score changed?

No, but there are promising developments. The new National Infrastructure Strategy acknowledges the increasing importance of managing cascading risks from climate change. However, there remains no systematic national assessment of interdependency risk or plan to improve resilience.

The new National Infrastructure Strategy acknowledges that the increasingly interdependent nature of the UK's critical infrastructure means the need to identify and limit cascading risks is only becoming more important.[5] The Strategy is the Government's response to the National Infrastructure Commission (NIC) National Infrastructure Assessment (NIA) published in 2018. In its 2019 Resilience Study, the NIC sought feedback on cross-cutting resilience challenges facing the UK, especially those related to its economic infrastructure. In particular, the NIC focussed on the interconnected areas of digital, power, transport and water. The study identifies climate change, population growth and an increasing reliance on, and integration of, digital technologies as the top three challenges for resilient infrastructure in the UK.

In its final report on the Resilience Study, the NIC concludes that there is a need for a new framework for resilience which anticipates future shocks and stresses; improves actions to resist, absorb and recover from them by testing for vulnerabilities; values resilience properly; and drives adaptation. The Commission has made three recommendations to Government, which will help to deliver the framework for resilience:

- Government should publish a full set of resilience standards every five years, following advice from regulators, alongside an assessment of any changes needed to deliver them.

- Infrastructure operators should carry out regular and proportionate stress tests that consider vulnerabilities from interdependencies, overseen by regulators, to ensure their systems and services can meet government's resilience standards, and take actions to address any vulnerabilities.

- Infrastructure operators should develop and maintain long term resilience strategies, and regulators should ensure their determinations in future price reviews are consistent with meeting resilience standards in the short and long term.[6]

This framework will be applied to the next NIA in 2023. It is noted that the recommendations do not specifically include climate change considerations, and the report tends to focus more on resilience to one-off disruptions rather than resilience to a changing climate.

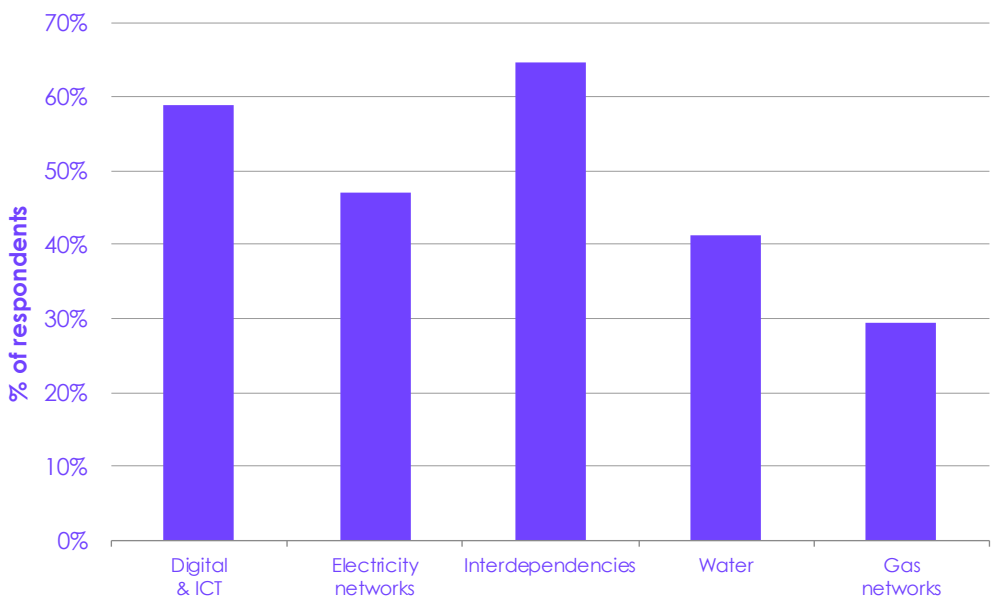
Some NAP actions on cross-sectoral interdependencies are off-track and information sharing on interdependencies between Local Resilience Forums must be improved.
In our last assessment, the Committee highlighted concerns in the extent of actions to manage interdependent risks and data sharing arrangements:

"It remains unclear what action is being taken to reduce the climate risks related to infrastructure interdependencies. Cabinet Office should ensure that data sharing arrangements are in place between infrastructure providers and Local Resilience Forums and provide evidence to the CCC that this is happening".

Two thirds of Local Resilience Forums surveyed by the CCC stated that information on interdependencies between sectors could be improved in their area.

Local Resilience Forums (LRFs) play a key role in responding to and managing the impacts from extreme weather (see also Chapter 3, section 3.2.6 and 3.6). As in our last assessment, a biennial survey by the Cabinet Office of all local responders and LRFs in England has not been completed. In a survey of LRFs completed by the CCC for this report, when asked about the level of knowledge and information about the key risks to infrastructure in their area, two thirds of respondents stated that information on interdependencies between sectors could be improved (Figure 4.1). The majority of respondents also highlighted that better local information was needed on risks to Digital & ICT (59% of respondents) and electricity networks were also an area of concern (47% of respondents). LRFs typically felt that information on transport was sufficient*; this may be because the location and key attributes of transport infrastructure assets are readily available.

Figure 4.1 LRF survey: Types of infrastructure for which local information could be improved



Source: CCC survey of Local Resilience Forums, conducted in March 2021.
Notes: There are 38 LRFs in England. 17 LRFs responded to the survey, representing 45% of all LRFs in England. Results for transport sectors are not shown in the chart – the % of respondents who said information could be improved for transport sectors is as follows: Railways 24%, Roads 18%, Airports 12% and Ports 12%.

To support the assessment of interdependent risks in the CCRA3 Technical Report, a project was commissioned to assess how climate change affects the interaction of risks across the infrastructure, built environment and natural environment sectors. Interruptions to power supply and disruptions to IT and communication services were identified as having the highest number of knock-on impacts across sectors. [7] It is particularly concerning that these are also the sectors which most LRFs identified in the survey as needing better information at a local level.

* Transport includes railways, roads, airports and ports.

Recommendation

Improve information sharing on climate risks to infrastructure interdependencies at a local level, especially for electricity, digital and ICT networks.

As reported in our previous assessment in 2019, NAP actions to enhance arrangements for information sharing between local infrastructure operators and improve understanding of critical risks arising from interdependencies have not been completed. Defra's link with Local Resilience Forums is key, and BEIS and DCMS should engage with utility companies to encourage standardised benchmarking and data sharing on climate risks to electricity networks, digital & ICT.

Department: Defra, BEIS and DCMS. Timing: Now and ongoing.

The Cabinet Office Civil Contingencies Secretariat is developing a standardised approach to support infrastructure owners and operators to understand the vulnerabilities across different critical sectors, with the goal of enhancing the information sharing of risks to infrastructure between Government departments and operators. The Cabinet Office reports that the scale of the response to the Covid-19 pandemic has led to some delays in delivery of this work. The Critical National Infrastructure Knowledge Base platform has been developed to better understand and manage the UK's critical national infrastructure and its supply chains. While this is a promising development, the extent to which climate risks will be included is not yet clear.

A sector-led forum of water companies and local authorities is being developed to define and develop a standardised methodology for benchmarking. The NAP references a National Infrastructure Resilience Council (NIRC) which was established to take a coordinated approach to flood resilience by utilities companies, however it is unclear whether any actions have yet been delivered under this body. These are positive developments for water and utilities sectors – the Department for Transport (DfT) and the Department for Digital, Culture, Media and Sport (DCMS) should seek to identify similar opportunities for better collaboration and data sharing with transport and digital sectors.

Has the risk management score changed?

No. There is a continuing lack of data on the vulnerability of infrastructure to extreme weather and the progress that has been made in improving resilience.

Impacts caused by cascading failures from weather and climate-related disruptions are still not systematically recorded and monitored. Whilst there is a lot of good research underway, there remains a lack of data on resilience actions by infrastructure providers, and especially on the fragility of infrastructure networks, including roads, rail, energy systems and ICT. The Infrastructure Operators Adaptation Forum is a cross-sector group which facilitates information sharing on interdependencies. Defra continues to engage with this group and to promote use of the latest climate projections by operators in their adaptation planning and reporting.

Adaptation Reporting Power reports can go a long way towards providing this crucial information, however, ARP3 reports have not been available for this assessment.

Awareness of, and planning for, interdependent climate risks and cascade failures by infrastructure operators seems to be increasing and Defra is encouraging increased focus on interdependencies under the Adaptation Reporting Power. There are two key objectives in Defra's strategy for the third round of reporting under the Adaptation Reporting power (ARP3):

- Support the ongoing integration of climate change risk management into the work of reporting organisations.

- Reports contribute to Government understanding of the level of preparedness of key sectors to climate change, at a sectoral and national level, and feed into the Adaptation Committee's reports to Parliament.[8]

When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies.

When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies.

In the CCC's review of ARP2[9] and our response to Defra's consultation on ARP3, the Committee recommended that reporting under the ARP should be mandatory and reports should be completed in time to inform CCRA3 and this Progress Report. Defra consulted on proposals for the third round of adaptation reporting in 2018 and concluded that the majority of respondents supported the continuation of voluntary reporting and there was support for the proposed timing and other circumstances in which the reporting power should be used.[10]

With a deadline of December 2021 however, only four* ARP3 reports have been available for this assessment and based on the list of organisations who have confirmed they will report, there are expected to be gaps in coverage, particularly related to the resilience of canals and ports (see section 4.6 on ports).†[11] These reports are intended to be a key feed-in to the development of the NAP and the CCRA. A recent policy paper by the Chartered Institute of Water and Environmental Management (CIWEM) also recommended the Government consider mandatory reporting and that the sequencing of reporting rounds should be modified so that reports can inform the CCRA.[12]

In 2020, the UK Government set out a roadmap towards mandatory climate risk reporting for large companies and financial institutions in the UK by 2025, aligned to the reporting requirements set out by the Financial Stability Board's Taskforce on Climate-related Financial Disclosures (TCFD). Using the Adaptation Reporting Power to the full extent set out in the Climate Change Act (2008) would send a very strong message on the UK's commitment to tackling climate risks across the economy.

Recommendation

Make changes ahead of the next round of reporting under the Adaptation Reporting Power (ARP). When used effectively, the ARP can present updated risks and adaptation actions that allows for an assessment of preparedness of all infrastructure sectors and their interdependencies. In particular:

- The next round of reporting must be mandatory.
- The deadline for reporting must allow sufficient time for consideration of all the reports in the fourth UK Climate Change Risk Assessment, and the CCC's statutory assessment of progress on adaptation.
- The list of organisations reporting should be expanded to ensure comprehensive coverage of critical infrastructure and services, such as canals and food supply chains, as recommended by the ARP3 consultation.

Department: Defra, Timing: 2023

* Anglian Water, Energy Networks Association, Energy UK (due to be published 2021) and Port of London Authority

† The Committee notes that the Covid-19 pandemic may have been a contributing factor in fewer organisations submitting their ARP3 reports early.

4.3 Design and location of new infrastructure

Progress summary – Design and location of new infrastructure		
2019 score:	**What has changed since 2019:**	**2021 score:**
6	**Plan score – high** • The plan score remains high. The new National Infrastructure Strategy (2020) states that national infrastructure will be made resilient to future climate change, by ensuring that its expected effects are fully considered at the design stage and building in cost-effective mitigations over the whole life cycle of the asset. However, there is no explicit consideration of 2°C and 4°C warming scenarios. National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects - they include broad consideration of 2°C and 4°C scenarios. New Green Book supplementary guidance on climate change recommends that projects with lifetimes beyond 2035 be assessed under a minimum of 2°C and 4°C scenarios. The Infrastructure and Projects Authority is working to build tests for climate resilience into assurance processes for all infrastructure projects on the Government's Major Project Portfolio. **Risk management score – low** • The risk management score remains low. Developments suggest it could improve in the next two years, though better data is required. The progress above, in relation to planning and assurance requirements for new major infrastructure projects, should lead to slower rates of increase in risk. However, there are no actions in the second National Adaptation Programme and no data to assess how the risk is being managed.	6
Notes: See annex for full datasets Key Indicators: There remains a lack of data on the extent to which climate risks are being considered in the design and location of new infrastructure.		

This section assesses the extent to which climate change is being considered in new major infrastructure in England.

Summary of 2019 report score

In our last report, design and location of new infrastructure scored a 6 (high plan score, low risk management score).
In our last report, the Committee highlighted the role of The National Infrastructure Assessment (NIA) 2018 in setting out the new flood and water supply infrastructure needs by 2050, considering both 2°C and 4°C scenarios. The National Policy Statements require climate change projections to be taken into account when developing new major infrastructure assets and projects and include broad consideration of 2°C and 4°C scenarios. Nationally Significant Infrastructure Projects were continuing to take account of flooding, however it was more difficult to establish if other climate hazards were also being considered.

On progress in managing risk, there were no new actions in the second National Adaptation Programme (NAP2) for this priority and based on the evidence available, it was not possible to assess how well the risk was being managed.

Has the plan score changed?

No, the plan score remains high.

All new infrastructure is subject to a complex arrangement of planning and environmental regulations.
The Planning Act 2008 sets out the development consent regime for nationally significant infrastructure projects in the fields of energy, transport, water, waste water, and waste. These projects are commonly referred to as major infrastructure projects. Climate change considerations are not fully integrated into planning legislation, though authorities are working to set out powers and duties related to adaptation.

National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects.
They include broad consideration of 2°C and 4°C scenarios. Nationally Significant Infrastructure Projects are continuing to take account of flooding, though it is more difficult to establish if other climate hazards are being considered. The Infrastructure and Projects Authority (IPA) is working to build tests for climate resilience into assurance processes for all projects on the Government's Major Project Portfolio (GMPP), which will ensure that climate risks are assessed from the earliest stage of project development and require new projects to demonstrate how adaptation has been considered in project design.

National Policy Statements require climate change projections to be considered when developing new major infrastructure assets and projects and include broad consideration of 2°C and 4°C scenarios.

New supplementary Green Book guidance covers the consideration of climate change impacts in policy appraisal.
The IPA work aligns closely with the new HM Treasury Green Book supplementary guidance on climate change, which supports analysts and policymakers to identify if and how their proposals could be affected by climate risks and challenges and to design adaptation measures in response.[13] The guidance recommends that projects with a lifetime to 2035 be appraised against a minimum of one scenario, consistent with a global temperature rise of 2°C, but for projects with longer time horizons, a minimum of at least two climate scenarios should be considered, consistent with 2°C and 4°C warming scenarios.

The new National Infrastructure Strategy (2020) states that national infrastructure will be made resilient to future climate change.
The strategy requires that expected effects of climate change are fully considered at the design stage for major projects, including impacts from higher temperatures, more extreme weather, and increased incidence of droughts, floods, and disease, and building in cost-effective climate risk reduction over the whole life cycle of the asset. In doing so, reference is made to the risks identified in the 2017 Climate Change Risk Assessment and the guidance for policy and programme makers set out in the Green Book supplementary guidance on climate change. The Government has committed to embedding environmental net gain* in infrastructure in its 25 Year Environment Plan and is currently legislating for biodiversity net gain though the Environment Bill. This is discussed further in Chapter 2 (Natural Environment), though recent work of the NIC on natural capital and environmental net gain for infrastructure projects is discussed further in Box 4.2.

Box 4.2
Infrastructure, Natural Capital and Environmental Net Gain

The National Infrastructure Commission (NIC) provides the Government with impartial, expert advice on major long-term infrastructure challenges. In February 2021, the NIC released a discussion paper setting out its strategic position on Natural Capital and Environmental Net Gain.

* An approach to development that leaves both biodiversity and the environment in a measurably better state than prior to development.

The paper states that infrastructure developers should consider the impact of infrastructure development on natural capital assets and take the opportunities to contribute to the environment and biodiversity as part of development. Infrastructure projects should target environmental net gain, ensuring that infrastructure developers leave the environment in a measurably better state than they found it.

The Commission supports an environmental net gain approach across all infrastructure projects, including major infrastructure projects. This means that:

- infrastructure developers on all infrastructure projects should leave the environment in a measurably better state compared to the pre-development baseline;
- natural capital frameworks and analysis should be used in decision making for infrastructure; and
- infrastructure investors, developers, providers and operators should follow the mitigation hierarchy when delivering environmental net gain by:
  - avoiding impacts as far as possible;
  - minimising unavoidable impacts; and
  - as a last resort, compensating for unavoidable losses wherever the greatest benefits can be delivered, either locally or nationally, first considering compensating for losses within the development footprint.

However, the Commission recognises that there is further work that needs to be done and there are challenges that need to be addressed in order to support infrastructure projects to achieve this.

Source: National Infrastructure Commission (2021). Natural Capital and Environmental Net Gain – A discussion paper.

Has the risk management score changed?

No, the risk management score remains low, though developments suggest it is improving and the score could increase in the next two years.
There are no relevant actions in the second National Adaptation Programme. However, the developments above in relation to planning and assurance requirements for new major infrastructure projects should limit the increase in risk from new infrastructure.

There remains a lack of data on the extent to which climate risks are being considered in the design and location of new infrastructure.
Potential sources of this information could be data from the IPA on project approvals for GMPPs, or possibly the Nationally Significant Infrastructure Projects dataset, though it is not currently collected.

4.4 Energy generation, transmission and distribution

Progress summary – Energy generation, transmission and distribution		
2019 score:	**What has changed since 2019:**	**2021 score:**
8	**Plan score – high** • The plan score remains high. National Policy Statements for the energy industry, and new rules under the planning system and the Environmental Permitting Regime, require consideration of climate change impacts in the early stages of development for large installations or major upgrades of existing assets. The electricity transmission and distribution sector has cross-industry technical standards for managing current and future flood risk and a consistent approach to identifying critical assets at high levels of risk. The Energy Emergencies Executive (E3) and its Committee (E3C) monitors key risks to the sector and measures in place to ensure resilience of the system. Wind turbines and offshore energy infrastructure are heavily regulated. **Risk management score – medium** • The risk management score remains medium. The energy generation and network sectors have published their ARP3 reports, collated by Energy UK and the Energy Networks Association. There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather in that time. New analysis for CCRA3 shows an increased exposure to surface water flooding for power stations and electricity substations, even with additional adaptation, though substations serving one million customers were assessed as benefitting from flood protection measures from £172 million planned investment to 2023. The future planned increased reliance on electricity to power, transport, industry and heating increases the potential impact of any risk to the electricity system and work is needed to understand the implications of water availability projections for the energy sector, in the context of Net Zero.	8
Notes: See annex for full datasets Key Indicators: Future flood projections from Sayers (2020) and limited data on assets benefitting from flood protection measures (substations only) have been used to assess the risk management score.		

Summary of 2019 report score

In our 2019 report, energy generation, transmission and distribution scored an 8 (high plan score, medium risk management score).
Plans were assessed as high, as the electricity sector has a well-developed understanding of risks faced by flooding which is supported by design guidelines for energy companies which include climate change and require companies to protect primary substations against flooding. Plans to manage risks to nuclear infrastructure include consideration of all relevant hazards.

On progress in managing risk, the Committee concluded that flood protection measures were being implemented by electricity supply, transmission and distribution companies and over 90% of sub-stations (550/589) deemed at risk of flooding should be resilient to a 1/1000 year flood event by 2021, reducing the exposure of customers at risk of interrupted supply. For other hazards and non-primary substations, it was less clear what steps were being taken. NAP2 and the ARP2 reports had highlighted actions and research needed to address CCRA2 gaps such as potential changes to wind speeds and the risk to gas networks crossing bridges.

Has the plan score changed?

No, the plan score remains high.

National Policy Statements for the energy industry and new rules under the planning system and the Environmental Permitting Regime require consideration of climate change impacts in the early stages of development for large installations or major upgrades of existing assets.
National Policy Statements for energy infrastructure set out how applicants and the Planning Inspectorate should take the effects of climate change into account when developing and consenting infrastructure. The Inspectorate should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections available at the time the Environmental Statement was prepared. This should cover the estimated lifetime of the new infrastructure. The Environmental Impact Assessment (EIA) Regulations were updated in 2019, requiring energy infrastructure above a certain capacity to provide climate change risk assessments to the Planning Inspectorate as part of their planning application.

The electricity transmission and distribution sector has cross-industry technical standards for managing current and future flood risk and a consistent approach to identifying critical assets at high levels of risk.
Engineering Standard ETR138, updated in 2018, remains the industry standard for assessing and addressing asset risk from flooding. Planned actions by electricity supply, transmission and distribution companies are expected to see over 90% of substations deemed at risk of flooding become resilient to 1 in 1000-year flood events by 2021. This is in line with standard ETR138, which applies this requirement to primary substations with over 10,000 connections. This standard includes an assessment of the risks from flooding to all new and existing sites. It is not clear what actions are being taken for non-primary substations.

Planned actions by electricity supply, transmission and distribution companies are expected to see over 90% of substations deemed at risk of flooding become resilient to 1 in 1000-year flood events by 2021.

The Energy Emergencies Executive (E3) and its Committee (E3C) monitors key risks to the sector and measures in place to ensure resilience of the system. Energy distribution companies are including flood protection proposals in their ED2 stakeholder plans with the intention of continuing the retrospective protection of key sites vulnerable to flood risk. Engineering Standard ETR 132 requires Network Operators to fell a proportion of trees within falling distance of overhead lines. The ENA has commissioned a research report to understand impacts of changes in climate projected in UKCP18 on energy assets.

Wind turbines and offshore energy infrastructure are heavily regulated in design and operation.
Wind turbines are designed for specific climatic conditions in accordance with IEC 61400, an International Standard published by the International Electrotechnical Commission. The standard prescribes a set of design requirements to ensure that wind turbines are appropriately engineered to provide sufficient structural integrity against damage from all hazards within the planned lifetime of the asset. Design codes are evolving to include requirements to allow for future effects of climate change in the selection of environmental loads and other actions on offshore infrastructure. Any new offshore windfarms and transmission assets connected to the National Grid Transmission system will be subject to Ofgem connection requirements, including resilience to extreme disruptive weather.

Has the risk management score changed?

No, the risk management score remains medium.

The energy generation and network sectors have published their ARP3 reports, collated by Energy UK and the Energy Networks Association (ENA).
The scope of the Energy UK ARP3 report has been broadened compared to earlier ARP reports, from large (>100 MWe) thermal and hydroelectric power stations to include smaller (50 MWe to 100 MWe), distributed thermal plant and large (>100 MWe) wind turbine assets. The report is based on an assessment of risk under UKCP09 climate projections, however a review by the Joint Environmental Programme for the ARP3 report found that the conclusions of the previous assessment do not change under UKCP18 projections. All adaptation actions identified in the first adaptation report have been progressed and 73 of the 88 agreed actions have now been completed. All of the reporting companies assess climate risks as part of their corporate risk management processes and a number of Energy UK member companies are signed up to the Task Force for Climate-related Financial Disclosures.* The report states that the sector is continuing to understand and address interdependencies through:

- Engagement with other infrastructure sectors, for example the Infrastructure Operators Adaptation Forum;
- Engagement with research, for example the interacting risks project commissioned for CCRA3;
- Responding to and learning from outages with widespread impacts, such as the 2019 lightning strike outage; and
- Working to support Black Start permit conditions†.

The ENA report[14] consolidates progress by gas and electricity network operators and highlights that interconnections between different industry sectors is a major source of risk for the energy network, with telecommunications and road transport thought to be the most important sources of risk. The report includes an updated risk assessment for energy networks and sets out the actions being taken to address those risks. Risk scores for 2050 have not been allocated in the report, which states there are too many variables that could affect the magnitude of climate change impacts, including Net Zero strategy.

There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather in that time. However, cascading impacts from a power outage across sectors can be significant.

There has been only one significant loss of generating capacity due to weather since 2015, despite several episodes of extreme weather since 2015. However, cascading impacts from a power outage across sectors can be significant.

In February 2018, the 'Beast from the East' and Storm Emma weather events brought freezing temperatures, blizzards and high winds, prompting a Red alert from the Met Office. The summer of 2018 was exceptionally dry and warm weather – the second warmest June on record for the UK - and in February 2020 Storms Ciara and Dennis brought very strong winds and heavy rain in one of the wettest months ever recorded. Energy UK reports that electricity generation was not significantly affected in any of these instances.[15] A lightning strike in August 2019 caused a loss of power to one million customers including homes, businesses, one hospital and Newcastle Airport, and triggered disruption on the rail network (Box 4.3). In response to that event, the Energy Emergencies Executive Committee (E3C) (in which Energy UK participates) put forward a list of recommendations to enhance the security of the network, and to prevent and manage further power disruption events.

* Including Centrica, Drax Power, EDF Energy UK, SSE and Uniper

† A Black Start Event is a significant partial or total failure of the electricity supply system across Great Britain.

The resulting actions, in alignment with those from Ofgem's independent investigation, are being taken forward through the E3C and its various Task Groups.[16]

Box 4.3
Cascading impacts from 2019 power outages in England and Wales

All of the major climate hazards considered in the CCRA could trigger a cascade effect from the power sector to other sectors; flooding, reduced water availability, increased temperatures and wildfire, as well as potential increases in storms.

Power outages in England and Wales on the 9th of August 2019 demonstrate the potential for cascading infrastructure failure (Ofgem, 2020). The event was triggered by a lightning strike on the Eaton Socon-Wymondley circuit between Cambridgeshire and Hertfordshire, causing a routine fault on the national electricity transmission system and the disconnection of a number of small generators connected to the local distribution network. Simultaneously, two larger generators (Hornsea 1 Limited and Little Barford) experienced technical issues and were unable to provide power. The combined power losses exceeded the back-up power generation capacity of the Electricity System Operator (ESO), triggering a power outage.

A total of 892 megawatts (MW) of net demand was disconnected from local distribution networks. The electricity supply of over one million consumers was interrupted. The outage had significant knock-on impacts for the rail sector, with the Train Operating Company (TOC) Govia Thameslink Railway experiencing stranded trains, triggered by on-board automatic safety systems. This in turn caused knock-on delays across the rail network (Ofgem, 2020). Hornsea 1 Limited and RWE Generation UK plc (operators of Little Barford) each agreed to make voluntary payments of £4.5m to the Energy Industry Voluntary Redress Scheme.

Source: *The Third UK Climate Change Risk Assessment Technical Report,* Chapter 4: Infrastructure.

New future flood projections show an increased risk of surface water flooding for power stations and electricity substations, even with additional adaptation.

170 power stations and 463 electricity substations are currently exposed to significant risk of surface water flooding (1:30 or greater) in England. 53 power stations and 143 substations are currently exposed to significant risk of river flooding (1:75 or greater).

New analysis for CCRA3 (Sayers et al., 2020) found that 170 power stations and 463 electricity substations are currently exposed to significant risk of surface water flooding (1:30 or greater) in England. 53 power stations and 143 substations are currently exposed to significant risk of river flooding (1:75 or greater). With current levels of adaptation, updated flood projections show that the risk of surface water flooding for power stations and electricity substations still increases compared to present day (Figure 4.2). The adaptation shortfall remains even under an enhanced adaptation scenario that goes over and above current planned adaptation action. By the 2080s in a 4°C world, the increase in risk is as high as 101% for electricity substations.[17]

Under current and announced adaptation measures, energy assets in England will be well protected from river flooding - the number of power stations and electricity substations at risk are projected to decrease by at least 56% in a 4°C world by the 2080s.

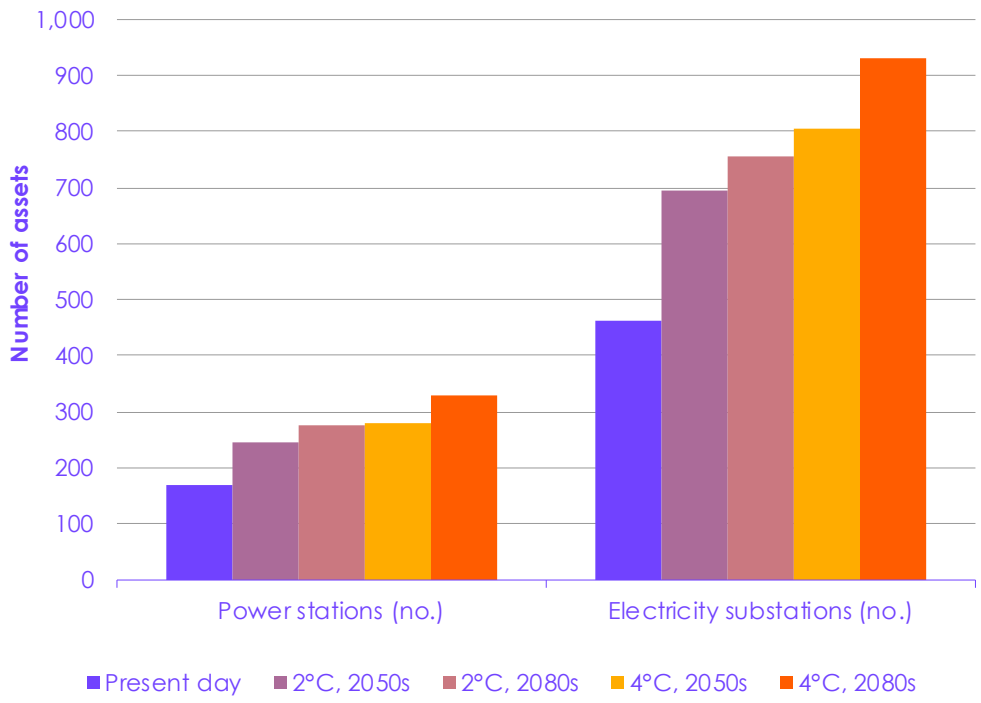
Conversely, Sayers et al (2020) project that under current and announced adaptation measures, energy assets in England will be well protected from river flooding. Under a low population and no additional adaptation scenario, the number of power stations and electricity substations at risk are projected to decrease by at least 56% in a 4°C world by the 2080s.

There is evidence of continued investment from flood protection measures.

Substations serving one million customers were assessed to benefit from flood protection measures from £172 million planned investment between 2011 and 2023.

There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy.

Figure 4.2 Number of electricity assets at significant risk of surface water flooding under a range of climate change scenarios



Source: Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA) Future flood risk.*
Notes: Data extracted for the CCRA3 technical chapters from the results database available at www.ukclimaterisk.org. The climate scenarios presented above assume current levels of adaptation and low population growth in the mid and late century.

Research is underway to better understand the implications of UKCP18 projections on energy networks.
The Energy Networks Association (ENA) has engaged the Met Office to undertake research and provide a report on the impact of climate change factors on energy industry assets and operation using the revised UKCP18 data, including identifying regional differences. The report from this research has been used to assess the current risks to the energy network in the ARP3 report. Work is needed to understand the implications of CCRA3 water availability projections for the energy sector, in the context of Net Zero.

There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy.
There will be significant implications for energy infrastructure resilience and water abstraction as a result of the transition to a Net Zero economy. The UK will become heavily dependent on electricity as our dominant energy source as we reduce our greenhouse gas emissions to Net Zero. While electricity provides about 15-20% of our energy today, by 2050 it could account for 55-65%, used for light, heat, communications, transport, industry and delivery of other critical services such as water. [18] This is alongside a potential increased reliance on renewables for electricity generation to 80% by 2050.* [19] This will necessitate the development of new energy infrastructure, energy supplies will need to become increasingly resilient to climate change and interdependencies will need to be better understood and managed.

* Under the CCC's Balanced Pathway to Net Zero from the Sixth Carbon Budget Report.

In their ARP3 report, Energy UK notes that future access to sufficient and reliable freshwater supplies will remain a priority issue for the energy sector for the foreseeable future, given uncertainties around the future energy mix and the water-dependent nature of Carbon Capture Usage and Storage, Bioenergy with Carbon Capture and Storage, and hydrogen production.

4.5 Public water supply infrastructure

Progress summary – Public water supply infrastructure		
2019 score:	**What has changed since 2019:**	**2021 score:**
8	**Plan score – high** • The plan score remains high. The Draft National Policy Statement for Water Resources Infrastructure sets out how the applicant and the Secretary of State will consider the effects of climate change when developing and considering water resource NSIP applications, using the latest UK Climate Projections. Ofwat set out a £51 billion five-year investment package in its 2019 Price Review for the 2020-25 period, including requirements for water companies to cut leaks by 16% and reduce mains bursts by 12%. The water industry has committed to a 50% reduction in leakage by 2050. **Risk management score – medium** • The risk management score remains medium. Total leakage for 2019/20 was 2950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels. All but one water company in England met their leakage targets in 2019-20. Though there has been some progress in reducing leakage since our last assessment, the long-term trend is unclear and continued progress is required before the risk management score can be improved. The Consumer Council for Water reported in 2020 that though there has been a reduction in interruptions to supply (11% less than the previous year), performance over the last 5 years has remained static and consumers are still experiencing more interruptions than they should. In its initial assessment of water company plans for 2020-25, Ofwat stated that while all companies plan to improve the resilience of their services and systems, resilience in the round needs to be more firmly embedded across the whole of each water company's business.	8
Notes: See annex for full datasets Key Indicators: Total actual and forecast leakage for all water companies. Interruptions to supply.		

This section considers progress in preparing for climate change in public water supply infrastructure, such as supply-side measures and structural improvements to water company networks, to reduce leakage and make water supply infrastructure resilient to extreme weather. Demand-side measures are typically lower regret and should be pursued first in balancing the supply and demand for water. Chapter 3 considers demand-side measures to reduce household water consumption and the use of water by businesses and industry is discussed in Chapter 5. Water in the natural environment is considered in Chapter 2.

Summary of 2019 report score

In our last report, public water supply infrastructure scored an 8 (high plan score, medium risk management score).
The Water Resource Management Plans (WRMPs) set out how water companies have committed to more ambitious targets to reduce leakage and many had considered possible options for new water supply infrastructure and improving resilience to extreme weather.

On managing risk, progress in reducing leakage had slowed compared with during the 1990s. It was apparent that water companies were investing to improve resilience, but it was not clear if this investment would be adequate to address future risks from climate change.

Has the plan score changed?

No, the plan score remains high. The National Policy Statement for water infrastructure will incorporate the latest climate projections and evidence from the third UK Climate Change Risk Assessment.
The Planning Act requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change in designating a National Policy Statement (NPS). The Draft NPS for Water Resources Infrastructure sets out how the applicant and the Secretary of State will consider the effects of climate change when developing and considering water resource Nationally Significant Infrastructure Projects applications, using the latest UK Climate Projections. The draft NPS for water identifies areas where climate change adaptation should be incorporated into detailed design, such as flood risk and coastal change, biodiversity and nature conservation and water quality. Detailed consideration must be given to the range of potential impacts of climate change (for example, the 10th, 50th and 90th percentiles) using the latest UK Climate Projections available at the time, and to identify appropriate adaptation measures. This should cover the estimated lifetime of the new infrastructure.

Under the draft NPS, any adaptation measures should be based on the latest set of UK Climate Projections, the most recent UK Climate Change Risk Assessment, consultation with statutory consultation bodies, and any other appropriate climate projection data. The government consulted on the draft NPS for water resources in 2018/19. The final NPS was due to be laid in 2019 but has been delayed.

Water companies continue to set targets to increase the resilience of water supplies.
Ofwat set out a £51 billion five-year investment package in its 2019 Price Review for the 2020-25 period, including requirements for water companies to cut leaks by 16% and reduce mains bursts by 12% (both relative to 2017-18 levels by 2025).[20] In 2019 the water industry announced a new Public Interest Commitment[21] with a goal to triple the rate of leakage reduction by 2030 and the industry has committed to reducing leakage by 50% (on 2017-18 levels) by 2050 at the latest.[22] The 50% reduction was a recommendation from the National Infrastructure Commission.[23]

The next round of water company plans will incorporate the latest UK climate projections and set stricter leakage targets.
Current water company plans (WRMP19) use climate change data from UKCP09. WRMP24 is making use of UKCP18 and will include options to further reduce leakage. In 2019 the water industry announced a new Public Interest Commitment, which was created in response to dialogue with customers which revealed that they would like the water industry to do more, not just to improve services, but also to tackle wider social and environmental challenges. As part of the Public Interest Commitment, water companies have agreed to work together towards five challenging goals, one of which is to triple the rate of leakage reduction across the sector by 2030. A programme of work to help achieve each of the above goals will be led by a member of the Water UK board and an independent panel will be established to report annually on how well the sector is performing collectively.

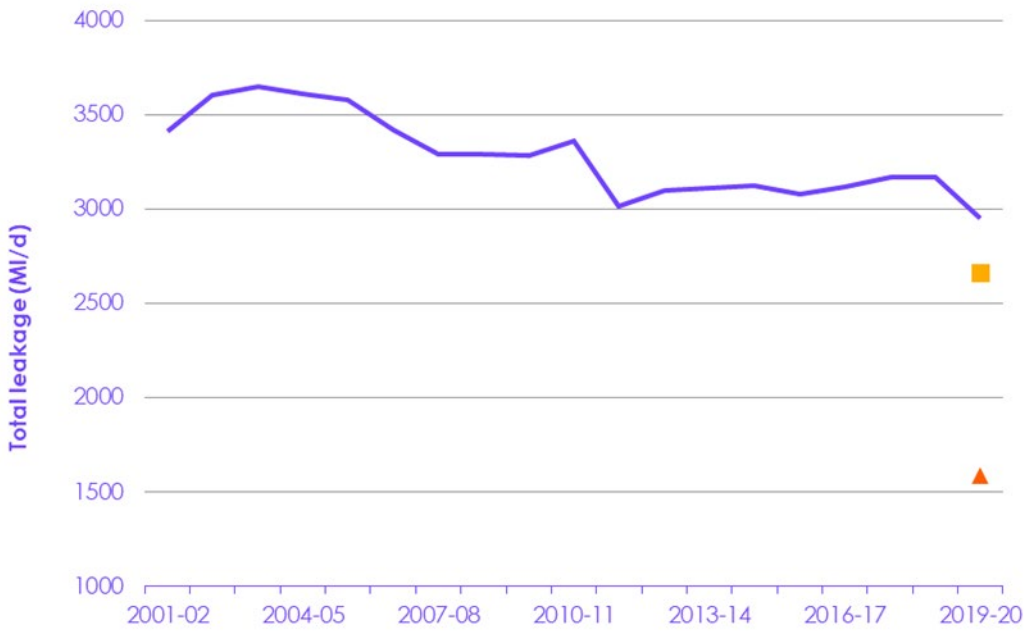
Has the risk management score changed?

No, the risk management score remains medium. There has been some progress in reducing leakage since our last assessment, though continued progress is required before the risk management score can be improved.

Total leakage for 2019/20 was 2,950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels.

Total leakage for 2019/20 was 2,950 ml/d - this represents a 7% reduction in leakage on 2017/18 levels (Figure 4.3). Leakage has remained at a similar level since 2011/12 but is beginning to fall. All but one water company in England met their leakage targets in 2019-20.

Figure 4.3 Total leakage for all water companies from 2000-01 to 2019-20 against future commitments



Source: Total leakage data from consumer Council for Water, Water & Wastewater Resilience Report 2019/20, Data Appendices. Ofwat 2025 commitment from 2019 Price Review for the 2020-25 period. Industry 2025 commitment from a letter from Water UK to the Secretary of State on 17/10/2018.
Notes: Purple line shows actual leakage for all water companies in England for the period 2001-02 to 2019-20. Yellow square shows the Ofwat performance commitment to reduce leakage by 16% (on 2017-18 levels) by 2025. Orange triangle shows industry commitment to reduce leakage by 50% (on 2017-18 levels) by 2050.

Ofwat have set performance commitments to cut leakage by 16% by 2025 (on 2017-18 levels) and the industry has committed to reducing leakage by 50% (on 2017-18 levels) by 2050 at the latest. The 50% reduction was a recommendation from the National Infrastructure Commission.

Interruptions to water supply are reducing, though these are still considered to be higher than they should be.

The Consumer Council for Water reported in 2020 that though there has been a reduction in interruptions to supply (11% less than the previous year), performance over the last 5 years has remained static and consumers are still experiencing more interruptions than they should.[24] Interruptions are not exclusively from extreme weather, though extreme weather is the predominant cause and the industry focus is on reducing weather-related interruptions.

In its initial assessment of water company plans for 2020-25, Ofwat stated that while all companies plan to improve the resilience of their services and systems, 'resilience in the round' needs to be more firmly embedded across the whole of each water company's business. Our assessment of progress in demand-side measures to improve the resilience of the public water supply, including analysis of trends in per capita consumption and the uptake of water metering, is set out in Chapter 3.

4.6 Ports and airports

In previous assessments, ports and airports have been combined into one adaptation priority. In this report, they have been given separate scores to reflect emerging differences in the publicly available information on the extent of planning for climate change across these two sectors, as well as the different climate hazards to which these sectors are vulnerable.

Summary of 2019 report score

In our last report, ports and airports scored a combined score of 5 (medium plan score, medium risk management score).
Resilience standards and performance are, in general, left to individual port and airport operators to determine. Gatwick and Heathrow are required to produce resilience plans and incorporate resilience into businesses planning. Our last report reiterated that the Adaptation Reporting Power could present sector-wide reporting for ports and airports, however without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed completely in these sectors as not all operators had submitted a report in ARP2.

On progress in managing risk, the report highlighted that NAP2 actions are focused on developing a better understanding of risk, rather than reporting on changes in vulnerability. There had been progress at some ports in raising quay heights and assessing interdependencies, however actions at airports to improve flood resilience had been more reactive. There was limited data available to assess the frequency of disruptions to port and airport operations from extreme weather events, and how this might change in the future.

Progress summary – Ports

2019 score:	What has changed since 2019:	2021 score:
5 (Ports and airports combined)	**Plan score – low** • Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts. The Department for Transport report that they continue to liaise with ports and disseminate relevant climate risk information. Several port operators declined to participate in the second round of the Adaptation Reporting Power (ARP2) and expected participation in ARP3 is unclear. The Port of London Authority (PLA) has, however, submitted a third-round report ahead of the deadline. **Risk management score – medium** • There is no new data available to assess the frequency of disruptions to port operations from extreme weather events, and how this might change in the future. The PLA ARP3 report acknowledges the benefits of adaptation reporting and identifies new risks from climate change. ARP3 reports may provide detail on adaptation actions to manage risk across the sector, however only the PLA report was available the time of assessment. There are limited actions in the NAP related to ports.	2 (Ports)

Notes: See annex for full datasets
Key Indicators: There are no data available to assess the extent to which ports in England are resilient to climate change.

What is the plan score?*

The plan score is low.

There is limited information available on the extent of planning for climate change impacts by port operators.
Ports are not subject to economic regulation and as a result there is a general lack of data regarding the overall resilience of ports compared to most other regulated sectors. Resilience standards for ports are left to individual operators and due to their commercial nature, there is limited information available on the extent of planning for climate change impacts. Since our last assessment, the implications of Brexit have been a key focus for the sector.

Internationally, there is non-mandatory guidance from the World Association for Waterborne Transport Infrastructure (PIANC, Working Group 178) regarding climate change adaptation for ports and inland waterways. It is not clear how many ports in England have implemented this guidance. The growing importance of and increased investment in freeports† presents an opportunity for early adaptation.

What is the risk management score?

The risk management score is medium.

There is no new data available to assess the frequency of disruptions to port operations from extreme weather events, and how this might change in the future.
ARP3 reports may provide detail on adaptation actions to manage risk, however only one ARP3 report from the ports sector, the Port of London Authority, was available at the time of assessment. Half of the UK's port capacity is located on the east coast, where the risk of damage from a tidal surge is greatest. Sea-level rise of around or beyond 50cm by 2080 is a particular concern, especially for some ageing port infrastructure, but flooding and physical damage to harbour infrastructure will also become an increasing threat. [25] It is also important to manage interdependencies with other infrastructure, particularly energy and the preparedness of the road and rail networks for climate change.

The Port of London Authority ARP3 report acknowledges the benefits of adaptation reporting and identifies new risks from climate change.
Following submission of the first ARP report in 2011, the Port of London Authority (PLA) has been reviewing climate risks regularly, undertaking adaptation measures, and collecting monitoring data the changes. PLA states that these actions have helped the PLA better understand the extent of the impacts and enable the evaluation of the action's effectiveness.

The report sets out new adaptation measures to address the following previously unidentified risks:

- Risks on the delivery of the Net Zero commitments of the organisation;
- An increased risk on port trade by climate change-induced disruption in the international supply chain; and

* As the ports and airports adaptation priorities have been split out for the first time in this report, the assessment questions are slightly different. For all other adaptation priorities in this report the assessment questions are 'Has the plan score changed?' and 'Has the risk management score changed?'.

† An area that is exempt from customs duties and tariffs to enable added-value processes to take place.

- The increased chance of pandemics which affect port trade, inland freight and passenger transport;

PLA has been collaborating with the Environment Agency, including data sharing with regard to river flow level, monitoring the changes and managing the foreshores, liaising on the operation and maintenance of flood defences, engaging with the 10-year full review of the TE2100 plan, and the River Basin Management Plan for the Thames catchment.

ARP reports could provide key information about the actions port operators are taking to identify and manage climate risks, but a sector-wide picture is not available.

Without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed in this sector.

Six port operators submitted a report in round 2, while a number of operators invited to report declined to do so.[26] Only seven operators have indicated they will submit a report for round 3 in 2021.[27] Without making the Adaptation Reporting Power mandatory, the Government has no assurance that risk is being effectively managed in this sector. A more tailored approach for the ports sector may be appropriate, to ensure key information on climate risks and adaptation actions is being captured. Information that would enable an evidence-based assessment of the vulnerability could include time-series data on the number of disruptions caused by extreme weather events and the level of investment being made in improving standards of resilience.

Recommendation
Work with Port Operators and the British Ports Association to ensure the format of reporting under the Adaptation Reporting Power is appropriate for port operators and that the right operators are being asked to report. Defra should work with these organisations to identify what further support could be offered to enable more comprehensive reporting on adaptation by the ports sector. Department: Defra, Timing: 2023

There are limited actions in the NAP related to ports.

The Department for Transport (DfT) continue to liaise with ports and disseminate relevant climate risk information. It is understood that there are individual projects to look at interruptions from extreme weather, but these are not industry wide. Shoreline Management Plans are in place for the full length of the English coastline and while they provide long-term considerations for all parts of the English coast, they cannot be relied upon as committed adaptation plans as they are non-statutory and unfunded.

Progress summary – Airports		
2019 score:	**What has changed since 2019:**	**2021 score:**
5 (Ports and airports combined)	**Plan score – medium.** • Resilience standards for most airports are left to individual operators, though Gatwick and Heathrow are required to produce resilience plans and incorporate resilience into business planning. Flood risk is assessed by airports with over five million passengers per year through their annual resilience plans. A new Aviation 2050 Strategy is expected - the draft strategy proposes that Government works with the aviation industry to improve resilience to weather but does not mention adapting to specific levels of future climate change such as 2°C or 4°C warming scenarios. **Risk management score – medium.** • There are limited data available to assess the frequency of disruptions to airport operations from extreme weather events, and how this might change in the future, though actions being taken by individual airport operators should be lowering risk, in particular in relation to flooding. Defra expects all airports to submit an ARP3 report, however these were not available at the time of this assessment. Though the impacts of climate change on airports are expected to be lower than other transport modes (CCRA2), it is important to manage interdependencies with other infrastructure, particularly energy and the preparedness of the road and rail networks for climate change.	5 (Airports)
Notes: See annex for full datasets Key Indicators: There are no data available to assess the extent to which airports in England are resilient to climate change.		

What is the plan score?*

The plan score is medium.

The two major airport operators in England must produce resilience plans under economic licence conditions and larger airports assess flood risk annually.
The mandatory preparation of resilience plans for Gatwick and Heathrow airports continues to be governed by economic licence conditions. These require resilience plans to be incorporated into business plans. Other airport operators continue to responsible for their own resilience planning and flood risk is assessed by airports with over five million passengers per year through their annual resilience plans. Heathrow airport has begun the planning process for the next regulatory period (2019-2023) which includes a climate change adaptation risk register and incorporating climate change adaptation into business planning processes.

A new Aviation 2050 Strategy is expected.
The draft strategy proposes Government works with the aviation industry to improve resilience to weather but does not mention 2°C or 4°C warming scenarios. The strategy was consulted on in 2019 but has not yet been published.

* As the ports and airports adaptation priorities have been split out for the first time in this report, the assessment questions are slightly different. For all other adaptation priorities in this report the assessment questions are 'Has the plan score changed?' and 'Has the risk management score changed?'.

As an industry, airport operators appear to be actively collaborating to improve resilience across the sector.
The Industry Resilience Group - a collaboration between airports, airlines, air traffic control and regulators – was created in 2018 to ensure the activities and changes identified by the Voluntary Industry Resilience Group in its report to industry are delivered. The output will support a systemised approach to the way in which the UK's aviation network is planned and operated to enhance its day to day operating resilience. The Airport Operators Association convenes an adaptation working group with UK airports quarterly.

What is the risk management score?

The risk management score is medium.

There are limited data available to assess the frequency of disruptions to airport operations from extreme weather events.

While the impacts of climate change on UK aviation are expected to be the least significant of all transport modes, interdependencies with other infrastructure networks can be problematic, in particular power and ICT.

While the impacts of climate change on UK aviation are expected to be the least significant of all transport modes, interdependencies with other infrastructure networks can be problematic, in particular power and ICT. The safety critical nature of airport operations means that even a small flood or power outage due to extreme weather can cause major disruption. Flooding of road and rail infrastructure can also affect passenger travel to and from airports. A widespread power cut due to extreme weather in 2019 affected two airports in England, and extreme weather caused widespread disruption at Gatwick airport on Christmas Eve 2013: unprecedented levels of river flooding led to the loss of three airfield electrical sub stations that serve the runway's lighting system; heavy rainfall caused the North Terminal basement to be flooded leading to the loss of electrical power and of some key systems; and local transport networks – both road and rail – were also severely impacted by the weather.

There is only one action in the NAP for adaptation actions by airports.
This is focused on improving the understanding of risk rather than reporting on reducing vulnerability or exposure. Birmingham, Gatwick, Glasgow, Heathrow, Manchester Group (including East Midlands), and Stansted Airports all reported for ARP2 and Defra states that all airports are expected to report in ARP3, however, participation is voluntary. The ARP3 reports will include climate risk assessments and steps to increasing resilience, however these were not available on time for this assessment.

While there is a lack of data to assess the risk for this report, the actions being taken by the industry set out above are promising. In particular, the Committee will be interested to see the new Aviation 2050 strategy and the outputs of the Industry Resilience Group.

4.7 Rail network

Progress summary – Rail network		
2019 score:	**What has changed since 2019:**	**2021 score:**
8	**Plan score - high** • The plan score remains high. The rail sector continues to prepare for climate risks across a range of warming levels - Network Rail has now published Weather and Route Climate Change Adaptation plans for all routes, which includes consideration of warming scenarios exceeding 4°C. Network Rail has published its Environmental Sustainability Strategy to 2050 and Adaptation Roadmap, with defined outcomes to incorporate long-term adaptation planning and investment into business as usual by 2034. **Risk management score - medium** • The risk management score remains medium. There are limited data on trends in vulnerability to climate risks, though weather-related delay data is relevant. Monitoring data from Network Rail's climate risk assessment is expected to provide better trend data in future. The rail sector remains at increasing risk of river and surface water flooding under a continuation of planned adaptation action, and increased heat risk causing rails to buckle, overhead cables to sag and signals to fail.	8
Notes: See annex for full datasets Key Indicators: The total number of minutes delay per type of weather-related incident in England recorded by Network Rail between 2006-07 and 2020-21. Updated number of bridge sites at intolerable risk of bridge scour.		

Summary of 2019 report score

In our last report, the rail network scored an 8 (high plan score, medium risk management score).
Weather resilience and climate change adaptation plans were in place for each Network Rail route. The plans set out actions, timeframes, accountability and responsibilities in relation to implementing resilience measures under a medium emissions scenario. A climate change and weather resilience strategy was also in place, which is a good starting point for a framework to embed adaptation and resilience into policies, standards, decisions and investment.

The risk management score was assessed as medium. Though actions relating to rail infrastructure were associated with risk reduction and likely reducing vulnerability in some areas, the Committee did not have the evidence required to show this. The main indicators available for rail reliability were delay data and although of interest, they did not give a sense of how vulnerability to climate risk was changing.

Has the plan score changed?

No, the plan score remains high. The rail sector continues to prepare for climate risks in a range of future warming scenarios, exceeding 4°C.

The rail sector continues to prepare for climate risks in a range of future warming scenarios, exceeding 4°C.

Network Rail has now published updated Route Weather Resilience and Climate Change Adaptation (WRCCA) plans for all routes, which contain actions which prepare for warming scenarios exceeding 4°C.[28] According to the Control Period 6 WRCCA Plan Progress Report for 2019 – March 2021, the target of 80% of milestones completed has been met or exceeded for six of the eight plans.*[29]

Network Rail also has a new Adaptation Roadmap with defined outcomes to incorporate long term adaptation planning and investment into business as usual by 2034 (Box 4.4).

Box 4.4
Network Rail Climate Change Adaptation Roadmap

Network Rail has set out an Adaptation Roadmap with defined outcomes to incorporate long term adaptation planning and investment into 'business as usual' operations by 2034.

Key milestones:

- Asset policies and standards updated to reflect long-term climate change projections by 2024.
- Review criticality and vulnerability mapping of all assets for climate change across the network by 2024.
- Agree level of service in extreme weather conditions with Government and regulators by 2027.
- Regions develop long-term adaptation pathway strategies and identify level of investment required for different scenarios by 2029.

Source: Network Rail Environmental Strategy (2020)

Regions are developing adaptation pathways strategies by the end of Control Period 7 (2029), which will include detailed adaptation pathway strategies for the entire network, and detail for areas with the highest level of risk or a need for transformational change.

Has the risk management score changed?

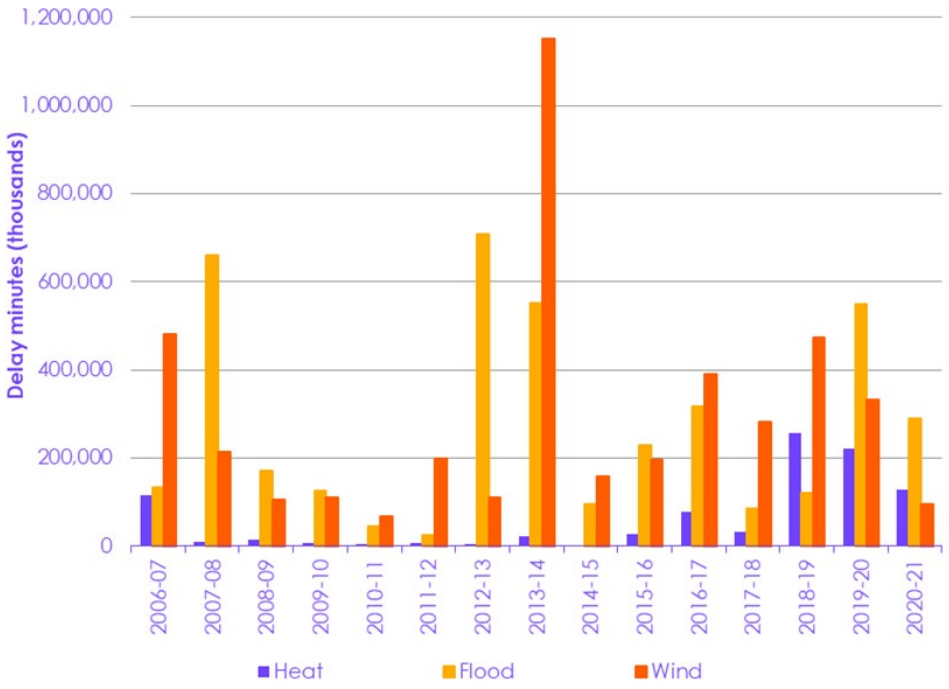
No, however a large programme of work has been undertaken at Network Rail to enable better monitoring of how specific actions are managing climate risks.

Network Rail has developed an Asset Function Risk Assessment which includes a full risk assessment including severity distribution of risks now and projections for the 2050s and 2080s. The risk assessment is supported by an Asset Function Action Plan which maps actions to risks.

Network Rail continues to monitor weather-related delays to the network.
Data on weather-related delays show how the network is being affected by weather, and the Committee is particularly interested in trends in heat, flood and wind impacts which are shown in Figure 4.4. Heat-related delays have been relatively consistent over the past 15 years, though these were significantly higher in 2018-19 and 2019-20 due to the summer heatwaves which are discussed further below. There is no clear trend in flood impacts and wind related delays.

* Network Rail notes that due to some data reporting issues in using the milestones tracker for the first time, actual performance may be higher.

Figure 4.4 The total number of minutes delay per type of weather-related incident in England (2006/07 - 2020/21)



Source: Network Rail (unpublished).
Notes: Data doesn't include long-term closures as a result of extreme weather. While this is recorded, Network Rail report that the data collection is not consistent enough to give reliable data on longer term closures.

Recent hot summer weather in 2018 and 2019 has highlighted the effects that high temperatures can have on rail infrastructure and the potential for widespread impacts across sectors.

There has been increased attention on the impacts of extreme weather on rail infrastructure since our last report.

Recent hot summer weather in 2018 and 2019 has highlighted the effects that high temperatures can have on rail infrastructure and the potential for widespread impacts across sectors. On July 25th 2019, temperatures exceeded 38°C (the hottest day ever recorded in the UK) which led to rail buckling and subsequent widespread damage and disruption on the rail network in England.[30] VA Rail completed an independent review of Network Rail's response to the effects of the hot weather and found that there were good examples of widespread best practice, including lessons learnt from previous hot weather, a long-term asset resilience plan underway and hot weather plans being project-managed and delivered. However, future assets need to be designed and installed for greater resilience at higher temperatures and some standards were being misapplied or not living up to scrutiny. VA Rail made 18 recommendations in the following six categories:

- To ensure that an appropriate level of future resilience is designed into the infrastructure;
- To make the relevant standards & guidance notes fit-for-purpose;
- To reduce the number of unknown risk sites;
- To reduce the number of known risk sites;
- To make more predictable the industry response to hot weather;

- To identify, share and adopt industry best-practice.*

Network Rail has begun work to address some of the recommendations, including updating operational weather management standards and implementing resilience measures on the network. A Seasonal Management Strategy is also under development, with the aim of supporting the transition between seasons and reducing repeat impacts from seasonal weather.

Network Rail continues to manage bridge sites at intolerable risk of scour and there has been no notable change in the total number of sites at risk.
Higher risk scour sites requiring remedial works are identified by Network Rail at the start of each year. While a programme of work is completed throughout the year to rectify those sites, new high- risk sites also emerge during the year. Over the past four years the number of sites rectified has been balanced out by the number of new sites identified, therefore the overall number of high risk sites remains unchanged. In 2019/20, 181 sites were identified as being at high risk at the start of the year, 45 sites were rectified and 43 new sites were identified.†

Following a fatal train derailment in Scotland in August 2020, the Secretary of State requested a wider assessment of the impact of extreme weather on the resilience and safe performance of the rail network.
Though the incident was in Scotland, the subsequent response will consider the resilience of the whole of the network, including England. Network Rail published the findings of two independent task forces - a Weather Advisory Task Force (WATF) and an Earthworks Management Task Force – in March 2021.‡ The key findings from the WATF are summarised in Box 4.5. Neither taskforce was tasked with assessing how Network Rail is responding to the challenge of future climate change, however implementation of the recommendations will address some of the challenges facing the railway.

Box 4.5
Stonehaven derailment – Key findings of the independent Weather Advisory Task Force

The major recommendations for Network Rail from the Weather Advisory Task Force include:

- Formal trial of the latest forecasting capabilities with the Met Office;
- Improvements in assessing the probability of earthwork failures, using forensic analysis of selected events to provide a complete picture of the context surrounding earthwork failures;
- Urgently transform the delivery of weather services, by considering the development of a new hazard and impact-based digital platform;
- A partnership-driven, integrated transport hub to provide 24/7 access to all operational services and expert advice, including flooding, and thus deliver an authoritative set of services across Network Rail routes and regions;
- Build its professional competencies in meteorology, hydrology and climate change so that staff can act as intelligent users of science and services across all its functions.

Source: Network Rail (2021). Weather Advisory Task Force, Final report, February 2021.

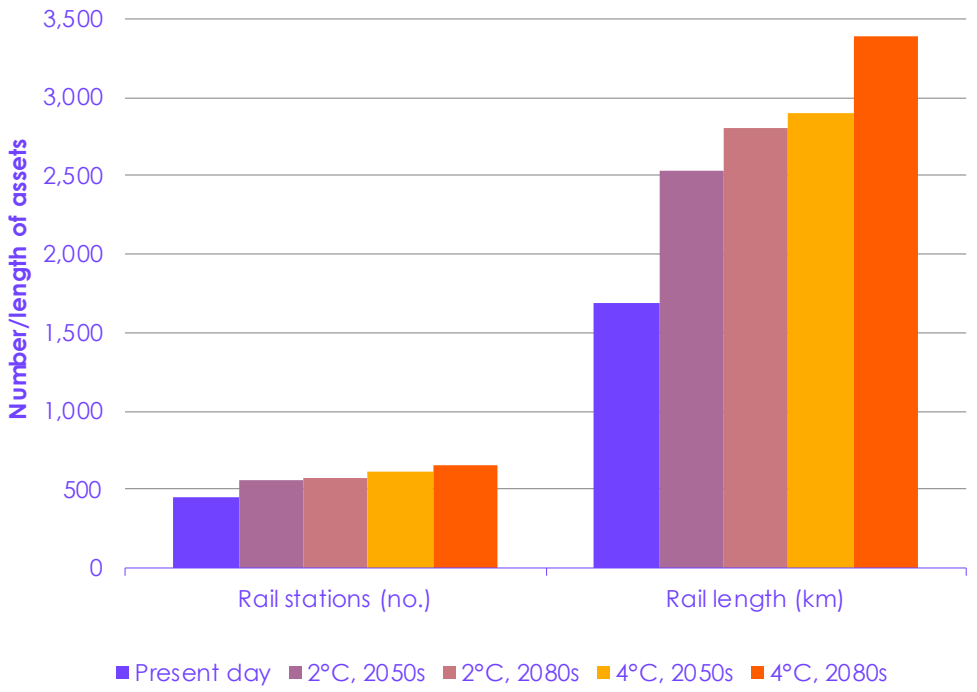
* The report was provided by Network Rail for this assessment. It has been published internally at Network Rail and shared with the National Performance Board.

† Data provided by Network Rail (unpublished).

‡ The two taskforces were overseen by Dame Julia Slingo Lord Robert Mair, both of whom have authored and advised on the CCRA3 Technical Report.

The rail sector remains at increasing risk of surface water and river flooding. New analysis for CCRA3 shows that, under current levels of adaptation, the rail sector remains at increasing risk of river and surface water flooding.[31] Sayers et al (2020) project that in England, under a low population and current levels of adaptation scenario, the risk of surface water flooding increases significantly in both the 2050s and 2080s. In a 4°C world by the 2080s, there is a projected 101% increase in length of railway track at risk and a 46% increase in railway stations at risk (Figure 4.5).

Figure 4.5 Length of railway track and number of railway stations at significant risk of surface water flooding under a range of climate change scenarios



Source: Sayers et al (2020). *Third UK Climate Change Risk Assessment (CCRA) Future flood risk.*
Notes: Data extracted for the CCRA3 technical chapters from the results database available at www.ukclimaterisk.org. The climate scenarios presented above assume current levels of adaptation and low population growth in the mid and late century.

For river flooding, risk also increases for all rail assets in both the 2050s and 2080s. By the 2080s in a 4°C world, there is an increase of up to 21% for length of railway track at risk and a 17% increase in stations at risk (under current levels of adaptation and a low population scenario).

4.8 Strategic road network

Progress summary – Strategic road network		
2019 score:	**What has changed since 2019:**	**2021 score:**
8	**Plan score - high** • The Road Investment Strategy 2 (2020 – 2025) includes a vision that the strategic road network is resilient to climate change and incidents, such as flooding, poor weather conditions and blockages on connecting transport networks. It includes performance indicators on structural, drainage and geotechnical condition. Highways England continues to embed climate change resilience and adaptation into standards. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local road and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards improving strategic road condition or increasing climate resilience more generally. **Risk management score - medium** • Roads in better condition should be better able to withstand extreme weather impacts. In 2019-20, Highways England met its performance target for road condition. However, there has been an increase in the percentage of roads classified as being in poor condition, which is a concern. Targets to address flooding have changed since our last assessment and new metrics on drainage resilience are being developed.	8
Notes: See annex for full datasets Key Indicators: Percentage of Highways England managed roads requiring maintenance in England by type (2007/08-2017/18). Numbers of flooding hotspots mitigated.		

Summary of 2019 report score

In our last report, strategic road networks scored an 8 (high plan score, medium risk management score).
Highways England was embedding resilience and climate change into plans and investments, and taking action to safeguard against flooding on the road network as set out in their climate change risk assessment, which covers all climate hazards. Highways England published a Sustainable Development and Environment Strategy in 2017 which set out the high-level ambitions for the business.

On progress in managing risk, NAP2 actions were found to be relevant, focussed particularly around flood risk, slope stability and bridges. Highways England was meeting performance targets, for example, it met its 2018 target of at least 95% of the network in good condition. However, disruptive events remained a regular occurrence even in the current climate.

Has the plan score changed?

No, it remains high.

Highways England continues to plan for a range of future climate scenarios.
The Highways England Climate Adaptation Risk Assessment considers high emissions scenarios in identifying climate impacts and prioritising actions.

The Road Investment Strategy 2 (2020 – 2025) includes a vision that the strategic road network is resilient to climate change and incidents, such as flooding, poor weather conditions and blockages on connecting transport networks.[32] It includes performance indicators on structural, drainage and geotechnical condition. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local road and motorways (and railway).[33] It is not yet clear what proportion of this additional funding will go towards improving strategic road condition or increasing climate resilience more generally.

The Highways England Strategic Business Plan includes a performance outcome 'delivering better environmental outcomes' which states:

"We will monitor, assess and respond to the impacts of climate change on our network. We will work in partnership with organisations such as the Environment Agency, the Met Office and local authorities to improve the resilience of our network to more severe weather. We will focus on reducing flooding on our roads and minimising risks for local communities, retrofitting our assets to meet new environmental and drainage standards. We will also improve the resilience of our concrete pavements to prolonged high temperatures as part of our concrete maintenance and renewals programme, taking remedial action where necessary".

Highways England is developing a Geotechnical Climate Change Adaptation Plan as well as guidance for geotechnical design, construction and management. This will help to ensure that activities are identified to support the objective of making the network resilient to climate change and extreme weather events in the future.

Highways England continues to embed climate change resilience and adaptation into standards.
The Design Manual for Roads and Bridges sets standards for road design. Standard GG103 includes 12 sustainable development goals that design shall aspire to, including: 'be resilient to climate change'.[34] An accompanying National Application Annex for England includes a requirement that "resilience to future climatic conditions specific to the local and surrounding area shall be identified, assessed and incorporated into the design." Standard LA114 sets out the requirements for assessing and reporting the effects of climate on highways, as well as the effect on climate of greenhouse gas emissions from construction, operation and maintenance projects. It includes requirements for environmental assessments in relation to vulnerability to climate change including: scoping, study area, baseline scenario, data collection, significance criteria, evaluation of significance, and design and mitigation requirements.[35] Standards for drainage require flood risk assessments which apply the latest climate change allowances in accordance with relevant national legislation requirements.[36]

Has the risk management score changed?

No, it remains medium.

Highways England has met performance targets related to road condition.
The Office of Road and Rail completes an annual assessment of Highways England's performance, which includes a key performance indicator that Highways England must maintain the pavement asset such that at least 95% of it does not require further investigation for possible maintenance. At the end of 2019-20, Highways England reported that 95.5% of its pavement (road surface) asset did not require further investigation for possible maintenance (Figure 4.6). This is above the target of 95% and is the same as the score recorded in 2018-19. Highways England has therefore returned the asset in a better condition than it started the road period with, as defined by the metric.

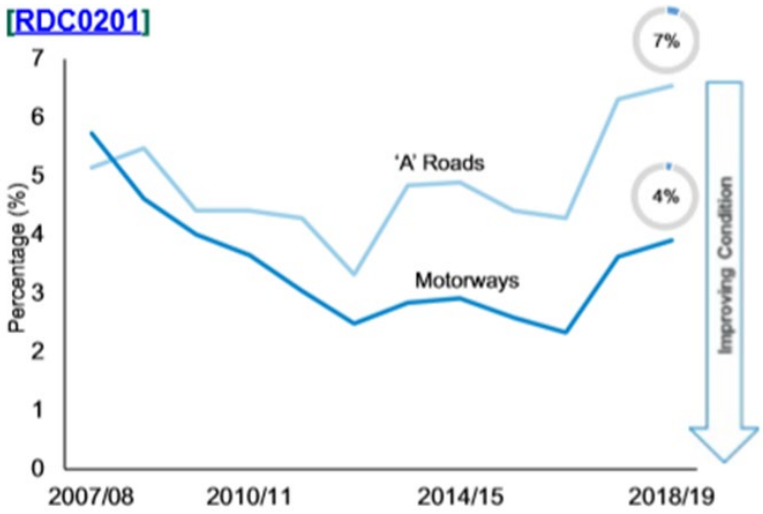
Figure 4.6 Highways England performance against road condition KPI 2015-16 to 2019-20

Source: ORR Annual Assessment of Highways England End of Road Period 1 2015-2020

The condition of strategic roads has worsened since our last assessment.

However, the condition of strategic roads has worsened since our last assessment. Roads in better condition should be better able to withstand extreme weather impacts. For Highways England managed motorways and 'A' roads, 4% and 7% respectively were categorised as red and should have been considered for maintenance in 2018/19 (Figure 4.7).* The proportion broadly fell between 2007/08 and 2012/13 but has fluctuated thereafter with a peak in 2018/19. The relatively small size of the strategic road network could mean these figures are subject to fluctuation, as a change in the proportion denotes a relatively small change in the amount of road. Although the strategic road network is relatively small compared with the local road network, the impact of disruption on individual journeys and nationwide connectivity can be far greater.

Figure 4.7 Proportion of the Highways England managed road network categorised as red*, by road type, 2007/08 to 2018/19



Source: Department for Transport (2019). *Road conditions in England to March 2019.*
Notes: *roads categorised as red should have been considered for maintenance (i.e. further investigation required).

* Current measures of road condition are based on surface condition only and do not reflect the ability of the pavement structure to drain excess water or react to extreme temperatures.

Targets to address flooding have changed since our last assessment.
Highways England report that there were 118 flooding incidents in 2020.* In Road Period 1 (2015–20) Highways England mitigated 248 flooding hotspots and 12 culverts considered to be at risk of flooding. [37] In Road Period 2 (2020-25), the flood resilience metric is 'percentage of carriageway at low risk of flooding', with an aspirational target for mitigation of 30 flooding hot spots per annum.

Flooding of transport networks can affect the provision of critical services, including emergency response. Recent research has found that even low magnitude floods can lead to a reduction in national level compliance with mandatory response times for ambulance and fire and rescue services in England.[38] As highlighted in the indicator wish-list published with this report, better indicators are needed that enable the assessment of impacts from disruption due to extreme weather on key infrastructure, including the impact of flooding events on roads.

* Data provide by Highways England, from National Incident Liaison Officer (NILO) reports. The measure relates to flooding events closing slip roads and affecting 50% or more of carriageway, under the NILO criteria. A change in reporting criteria in 2020 may have affected the number of flooding incidents captured.

4.9 Local road network

Progress summary – Local road network		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score – medium** • The plan score remains medium. There have been no new, or updates to existing, strategies, plans or codes of practice for local roads since our last assessment. In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local roads and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards improving local road condition or increasing climate resilience more generally **Risk management score – medium** • The risk management score remains medium. Road condition has remained the same over the most recent 3 years, following a period of gradual improvement from 2011/12. While it is positive that road condition has not become any worse, there remains a lack of data to assess the vulnerability of local roads to specific climate risks and to assess progress in managing the impact of climate risks on local roads.	5
Notes: See annex for full datasets Key Indicators: Percentage of roads requiring maintenance in England by type (2007/08-2017/18).		

Summary of 2019 report score

In our last report, local road networks scored 5 (medium plan score, medium risk management score).
Our assessment in 2019 noted that local highway authorities have a duty under the Highways Act 1980 to ensure highways, and the assets associated with them such as lighting and bridges, are well maintained. A Highways Code of Practice asks local authorities to take account of climate change when maintaining the local road network. This includes applying the latest UK Climate Projections, ensuring infrastructure is resilient to climate change and determining actions to address risks. However, there was no statutory requirement for them to use this guidance and there had been no systemic assessment of the disruptions caused by flooding or extreme weather on local roads and the actions taken to reduce risk.

On progress in managing risk, the NAP sets out actions related to DfT sharing information with local highway authorities, however, it is the authorities' own responsibility to manage risks to the local road network. The Government allocates funding to local highway authorities to help improve local roads, including to increase resilience to weather, flooding and extreme heat.

Has the plan score changed?

No - there have been no new, or updates to existing, strategies, plans or codes of practice for local roads since our last assessment.

In May 2020, the Government announced a £1.7 billion Transport Infrastructure Investment Fund for local roads and motorways (and railways). It is not yet clear what proportion of this additional funding will go towards reactive repair and what resources will be allocated to adaptation and increasing climate resilience. A

recent survey by the Asphalt Industry Alliance (AIA), found that, despite an increase in highway maintenance budgets, maintaining roads to target conditions is still out of reach for local authorities in England, with a reported shortfall in road carriageway budgets of £522.9m for 2021/21.[39]

A recent survey by the Asphalt Industry Alliance (AIA), found that, despite an increase in highway maintenance budgets, maintaining roads to target conditions is still out of reach for local authorities in England, with a reported shortfall in road carriageway budgets of £522.9m for 2021/21.

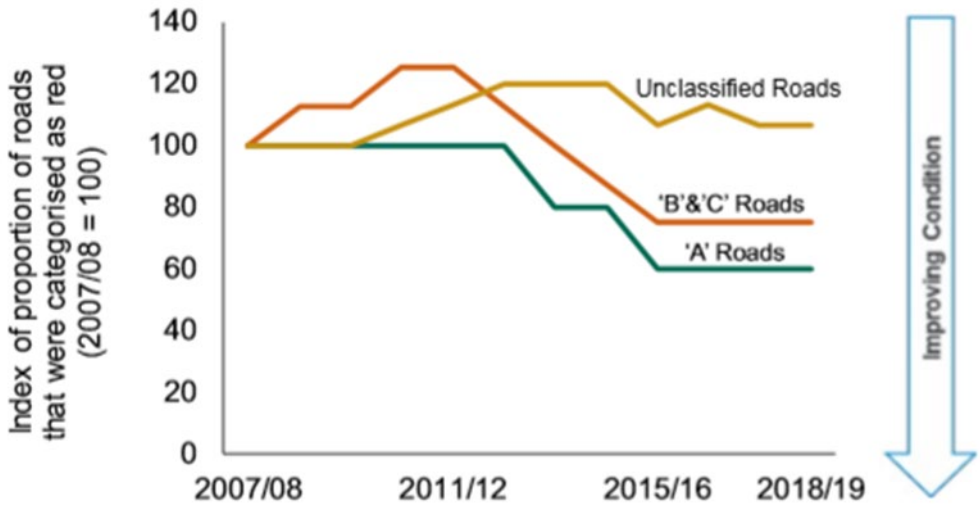
Has the risk management score changed?

No. There remains a lack of data to assess progress in managing the impact of climate risks on local roads.

Data on road condition are a useful indicator of the potential vulnerability of roads to extreme weather, though information is not available on specific actions being taken to manage the impact of climate risks on local roads.

Road condition has remained the same since our last assessment.
The latest figures for local authority surface condition are broadly in line with the previous 3 years (Figure 4.8). Prior to this, 'A' roads, and 'B' and 'C' roads combined, had seen a period of gradual improvement since 2011/12 (i.e. fewer roads categorised as red). Unclassified roads had not seen the same improvement over this period.

Figure 4.8 Trend in the proportion of local authority managed roads categorised as red, by road type, 2007/08 to 2018/19



Source: Department for Transport (2019) *Road conditions in England to March 2019.*

4.10 Telecoms, digital and ICT infrastructure

Progress summary – Telecoms, digital and ICT infrastructure		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score – low** • The plan score remains low, however there are signs of progress beginning to appear. Resilience planning in the data centre sector is conducted at corporate level by individual private operators, who compete on their ability to ensure business continuity for their customers. Resilience standards for the digital sector do not include requirements pertaining specifically to climate change risks. In its final report on the Resilience Study, the NIC recommended Government should introduce a statutory requirement by 2022 for clear, proportionate and realistic standards every five years for the resilience of digital (and other) services, with obligations on infrastructure operators to meet these resilience standards by 2023. These standards must include requirements pertaining to climate change risks. **Risk management score – medium** • The risk management score remains medium. There is still a lack of data to assess how risks to telecoms, digital and ICT are changing. However, all major providers have flood defences compliant with the National Flood Resilience Review requirements and DCMS continues to engage with the EC-RRG on resilience and emergency response. ARP3 reports from the EC-RRG and TechUK should provide valuable information on steps the industry is taking to manage risks, however the reporting deadline exceeds the timeframe for this report. While data centres do not appear to have been affected by recent extreme weather events, CCRA3 has assessed the current climate risks to digital infrastructure as medium magnitude, increasing to 'high' under more extreme climate scenarios.	2
Notes: See annex for full datasets Key Indicators: There remains a lack of data on risks to and resilience actions by digital infrastructure operators.		

Summary of 2019 report score

In our last report, telecoms, digital and ICT infrastructure scored a 2 (low plan score, medium risk management score).

There was no visible clear plan or process by the industry or Government with actions to manage long-term climate risks to the sector. The Committee highlighted the opportunity to show a plan to manage risks through the Adaptation Reporting Power (ARP), however in the absence of reporting being mandatory there is no guarantee that organisations will continue to report. Recent Ofcom and industry guidance asks providers to maintain services during flooding incidents but does not include a consideration of climate change.

Data were not available to assess how the risk was changing. There had however been activity since the first NAP period, especially in relation to flooding, which should reduce the vulnerability of some assets.

Has the plan score changed?

No, the plan score remains low, however there are signs of progress beginning to appear.

Resilience planning in the data centre sector is conducted at corporate level by individual private operators, who compete on their ability to ensure business continuity for their customers. There remains no visible plan or process by the industry or Government with actions to manage long-term climate risks to the sector. The level of resilience offered by commercial providers and the standards they adhere to are set out in contractual SLAs (Service Level Agreements). A number of data centre facilities are designated Critical National Infrastructure. The EC-RRG* Resilience Guidelines for Providers of Critical National Telecommunications Infrastructure do provide design considerations and operational processes for communications providers to build resilience to physical threats, including extreme weather, floods and lightning. However, there is no consideration of climate scenarios and how these may affect the prevalence or impact or such impacts. Ofcom's general conditions require communications providers to maintain uninterrupted access to emergency organisations "to the greatest extent possible", with significant fines for failures.

A standard for availability of service can to some extent be considered a proxy for the resilience of the infrastructure, however there remains a need for future climate risks to the sector to be reflected in industry standards.

Resilience standards for the digital sector do not include requirements pertaining specifically to climate change risks.

EN50600 is an availability standard which covers all aspects of data centre infrastructure including power, cooling and telecommunications. It also provides recommendations for operations and management, security and energy and sustainability. EN50600 is being harmonised with ISO and with the practices of the EU Code of Conduct for Data Centres. Provisional data from Tech UK† suggests that almost 80% of data centre sites are working towards practices compliant with EN50600 (representing 75% of sector activity) and over half of the sites in the UK conform to ISO50001 (representing around 70% of sector activity).‡ Tech UK will report formally on the uptake of standards in their ARP3 report by the end of 2021.

The NIC has recommended a statutory requirement for resilience standards for the sector by 2022 – these must include requirements pertaining to climate change risks.

In May 2020, in its final report on the Resilience Study, the NIC recommended Government should introduce a statutory requirement by 2022 for clear, proportionate and realistic standards every five years for the resilience of digital (and other) services, with obligations on infrastructure operators to meet these resilience standards by 2023. This presents a real opportunity to incorporate consideration of climate change risks and adaptation actions into the standards.

Recommendation

Resilience standards for the digital sector must include requirements pertaining to climate change risks. In addressing the National Infrastructure Commission recommendations from the Resilience Study, Government should incorporate consideration of climate change risks and adaptation actions into any new standards being developed. Standards for digital infrastructure operators should include requirements to:

- assess climate risks under both 2°C and 4°C global climate scenarios
- consider interdependencies with other critical infrastructure, and
- set out actions to reduce risk and monitor progress

Department: DCMS, Timing: 2022

* EC-RRG is a cross government and telecoms industry forum whose aim is to ensure the telecoms sector remains resilient to threats and risks to services.

† Tech UK is the UK's technology trade association, whose remit is digital infrastructure, comprising communications networks and data centres.

‡ Provisional data collated by Tech UK in preparation of the ARP3 report.

Has the risk management score changed?

No, the risk management score remains medium.

There remains a lack of data to assess how risks to telecoms, digital and ICT are changing.
However, all major providers have flood defences compliant with the National Flood Resilience Review requirements and DCMS continues to engage with the EC-RRG on resilience and emergency response. ARP3 reports from the EC-RRG and TechUK should provide valuable information on steps the industry is taking to manage risks, however the reporting deadline exceeds the timeframe for this report.

Data centres do not appear to have been affected by recent extreme weather events.
The Data Centre Incident Reporting Network (DCIRN) does not currently collect quantitative data on climate change related outages to data centres, however there has been no publicly reported disruption from data centre outages as a result of recent extreme weather events (see introduction to this chapter). There are observations within the sector that older sites are more likely to be vulnerable to heatwaves than newer sites, especially if they are working to capacity, because their cooling systems will be challenged by sustained high temperatures.[40]

CCRA3 has assessed the current climate risks to digital infrastructure as medium magnitude, increasing to 'high' under more extreme climate scenarios.
While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking.

While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking.

However, there remains a lack of evidence. While there is a general understanding of the interactions between ICT infrastructure and weather, quantitative projections assessing how climate change will affect the frequency and magnitude of these interruptions are lacking. This is compounded by a lack of information in the public domain on the location or specification of assets for interests of security and commercial sensitivity. ICT is critical to the operation of wider infrastructure networks as well as underpinning business activities, access to key services and wider communication. Outages can therefore have significant effects on the locality and more broadly via interdependent infrastructure. Overall, CCRA3 concludes that further attention to the climate resilience of this sector and quantitative information on current and future risks under climate change is needed, to better assess its vulnerability and exposure to climate change.[41]

Endnotes

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Chapter 5

Business

5.1 Introduction

Businesses that are better prepared for the impacts of climate change will be able to capitalise on opportunities and avoid future damages.
Opportunities to businesses include those through an increase in demand for existing and new goods and services, which might specifically relate to adaptation. Businesses and industry in England face a number of opportunities and risks from climate change. Through international supply chains, distribution networks and global markets, businesses are exposed to risks from extreme weather, including flooding and water shortages around the world.

Since our last report in 2019, the context for businesses in England and outlook for the immediate future has changed dramatically.

Since 2019, the context for businesses in England has changed dramatically due to factors like the Covid-19 pandemic, the end of the EU exit transition period and the setting of the Net Zero target.

The economic impacts of Covid-19 have been severe though varied among sectors and business types. It has highlighted the importance of business resilience and the reliability of key supply chains for people and the economy. The ways in which people work may change. Before the pandemic, around 5% of people in employment worked from home regularly.[1] As a result of the COVID-19 pandemic, levels of homeworking have risen substantially, with an average of around 30% of the workforce working exclusively from home each week during 2020.[2] Some businesses and workers may choose to adopt this style of working on a permanent basis.

There is also change for many businesses who trade internationally following the end of the transition period after leaving the EU, who may reorganise their supply chains due to this and the impacts of Covid-19.

Many businesses have also responded positively to the UK's legislation of the Net Zero target and are undertaking long-term planning to ensure their operations align with the target. As demonstrated by the Government's plans for a green recovery, there are opportunities for industrial strategies and policies, and for businesses to do things differently to achieve key policy goals, including Net Zero. Helping businesses and industry prepare for the impacts of climate change should be among these goals.

As in our 2019 report, the continuing growth of support for the Task Force on Climate-Related Financial Disclosures (TCFD) remains a key development for assessing businesses' preparedness for climate change.
TCFD, and similar initiatives, such as the Taskforce on Nature-Related Financial Disclosures (TNFD), are relevant to all of the adaptation priorities within this chapter, though they are discussed primarily in the first 'Impact on business of extreme weather events.'

It is critical to distinguish between different types of business in assessing preparedness and considering where further support may be required.

It is important to distinguish between different types of business, particularly between larger businesses and SMEs, and between those who engage with climate change surveys and the general corporate sector.

It is important to note that the TCFD and other initiatives including compulsory reporting are primarily focussed on large, publicly listed organisations, with a focus on the financial sector. Small and Medium Enterprises (SMEs), as defined by the number of employees, account for 5.9 million or 99.9% of all UK private sector businesses, 61% of employment and 52% of turnover.[3] These businesses are a significant part of the UK economy and have fewer resources to adapt to the risks and opportunities arising from climate change than those targeted by TCFD and other initiatives.

The increasing growth of 'green' business practices and strategies may also mean that survey responses and other evidence better reflect this 'green' sector, rather than the general corporate sector.

5.2 Impact on business from extreme weather events

Progress summary – Impact on business from extreme weather events		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - medium** • The plan score has increased from low to medium. Government has set out a roadmap for mandatory climate-related disclosures following legislation of the Net Zero target. This has been complemented by important work from other organisations to strengthen reporting of climate risks and adaptation through new standards and guidance. There remains a gap, where SMEs, the majority of businesses in England, are unlikely to benefit from most of these measures. A new SME Climate Hub is a welcome development, though the vast majority of its resources and promotion are focussed on Net Zero rather than adaptation. **Risk management score - medium** • There is no change in the risk management score from 2019. The number of large businesses, particularly in the financial sector, aligning with TCFD and assessing climate risks continues to increase and mandatory reporting should lead to further improvements. However, there remain significant gaps, such as scenario analysis and reporting of adaptation measures, which will hinder the effectiveness of new reporting initiatives unless addressed.	5
Notes: See annex for full datasets Key Indicators: TCFD disclosure (various surveys), Contingency planning for extreme weather, Economic impact of extreme weather events / Insurance losses due to extreme weather.		

Summary of 2019 report score

In our last report, impact on business from extreme weather events scored a 2 (low plan score, medium risk management score).
Our 2019 report found that while there were incentives for businesses to plan for how they might be impacted by climate change through initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD), there was little evidence that planning was taking place for more than a 2°C increase in global temperature or that plans were in place to help smaller businesses prepare for climate change.

There was evidence of increasing action in response to climate change by businesses and the investment community. However, support for initiatives like TCFD had not yet led to better assessment and planning for climate change risks, particularly higher climate change scenarios relevant for adaptation.

Has the plan score changed?

Yes, the plan score has increased from low to medium. There have been significant steps to help businesses better prepare for the impacts of climate change, such as setting out a clear roadmap for making TCFD-aligned disclosures mandatory. To improve the score further, there need to be clear plans and support for smaller businesses and measures to ensure that approaches to considering physical risk continue to progress.

Government has taken welcome steps over the past two years to improve consideration and reporting of the impacts of climate change by businesses and the finance sector.

100% of listed commercial companies could be covered by regulation or legislation regarding climate disclosures by the end of 2022.

The UK announced its intention to make TCFD-aligned disclosures mandatory in 2020. A cross-Whitehall/cross-regulator UK Taskforce developed a roadmap that sets out an indicative path over the next five years for different categories of organisation.[4] For example, 100% of listed commercial companies could be covered by regulation or legislation regarding disclosures by the end of 2022, while for occupational pension schemes it could be 72% by the end of 2022, rising to 85% by the end of 2025, though this roadmap could be affected by consultations or other reviews.

Most action is planned to occur over the first three years, with the overall aim of proving comprehensive and high-quality information on how climate-related risks and opportunities are being managed across the UK economy. This will be achieved by incrementally increasing the coverage of supervisory expectations, disclosure rules or legislative requirements for seven categories of organisation: listed commercial companies; UK-registered companies; banks and building societies; insurance companies; asset managers; life insurers and Financial Conduct Authority (FCA)-regulated pension schemes; and occupational pension schemes.

Government has published several supporting consultations and will provide an update on progress in the 2022 refresh of the Green Finance Strategy.

The Government has already published related consultations. New pension regulations propose that trustees must establish and maintain oversight of the climate-related risks and opportunities which are relevant to their scheme, including publishing a report on a publicly available website free of charge.[5] It recently consulted on mandatory climate-related disclosures by certain UK publicly quoted companies, large private companies and Limited Liability Partnerships (LLPs) as well.[6]

Other consultations, such as on government procurement criteria which is discussed further in the following supply chains section, will also lead to greater consideration of climate change by affected businesses, if the proposed changes are implemented effectively. The Government will provide an update on progress in the 2022 refresh of the Green Finance Strategy. The Bank of England also confirmed the next step of its Climate Biennial Exploratory Scenario, after postponement due to the pandemic, would be published in June 2021.

The Government's steps have been complemented by the work of other climate-related reporting organisations which aim to improve the consistency and quality of information globally through new standards and guidance.

The International Financial Reporting Standards (IFRS) published a consultation paper on sustainability reporting in 2020.[7] Feedback to this consultation identified an urgent need for better information about sustainability matters, including climate-related information. As a result, the IFRS confirmed its intention to produce a proposal by the end of September 2021, and possibly make an announcement on the establishment of a global sustainability standards board at COP26.

Five of the major organisations in sustainability disclosure; CDP, the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC) and the Sustainability Accounting Standards Board (SASB), proposed a vision for a global and comprehensive corporate reporting system.[8] This system would seek to reduce complexity in reporting and incorporate both financial accounting and sustainability disclosure, connected via integrated reporting.

In December 2020, these five organisations published a prototype climate-related financial disclosure standard for illustrative purposes to contribute to the IFRS' development of a sustainability standards board.[9] The work of the IFRS and these five organisations has received public support from the UK Taskforce and the Financial Reporting Council (FRC). The FRC has stated it plans to 'raise the bar' on climate change reporting and encouraged UK public interest entities to report in line with the TCFD recommended disclosures and make use of the SASB's metrics.[10]

The new Taskforce on Nature-related Financial Disclosures (TNFD) aims to complement TCFD and will provide a framework for corporates and financial institutions to assess, manage and report on their dependencies and impacts on nature, aiming to improve the appraisal of nature-related risk and redirect global financial flows away from 'nature-negative outcomes' and towards 'nature-positive outcomes.'

The new Audit, Reporting and Governance Authority could oversee annual Resilience Statements which would include climate change, if proposals are implemented.

BEIS published a consultation on 'Restoring trust in audit and corporate governance' which aims to respond to separate independent reviews of the audit system by Sir John Kingman, Sir Donald Brydon and the Competition and Markets Authority.[11] The proposals included establishing a strengthened regulator to replace the FRC, the Audit, Reporting and Governance Authority (ARGA) which would protect and promote the interests of investors, other users of corporate reporting, and the wider public interest. It is proposed that directors of public interest entities would need to publish an annual Resilience Statement setting out how directors are assessing the company's prospects and addressing challenges to its business model over the short, medium and long-term, including risks posed by climate change.

These improvements in reporting could be undermined unless businesses are better supported when trying to assess physical risk and adaptation.

More organisations are considering higher climate change scenarios, such as 4°C than two years ago, though reporting of physical risks and adaptation remains a concern.

As described in the section below, the evidence from reviews such as the latest TCFD status report suggest that there are aspects of reporting that organisations are struggling with.[12] This includes aspects that are critical for assessing physical risk and adaptation such as scenario analysis, the financial impacts of climate change and metrics and targets beyond those related to reducing emissions.

However, there are more examples of organisations considering higher climate change scenarios, such as a 4°C increase in global temperature, than at the time of our report two years ago. Unless this is addressed and regulators and auditors have the necessary expertise to monitor the quality of reporting, initiatives as described above will not be effective in ensuring businesses are prepared for the impacts of climate change.

There are some good examples of work by organisations to address this, which could be further promoted and developed.

There are some good examples of work by organisations in the past two years to address this. In 2020 Acclimatise et al. published a detailed set of questions to assist non-executive director oversight of physical climate change risk management.[13] The TCFD published further guidance on scenario analysis and consulted on forward looking financial metrics including metrics specifically for physical risk such as Climate Value at Risk (Climate VAR).[14] The Goal 13 Impact platform aims to help businesses collaborate on similar climate change initiatives and share best practice on aspects such as target setting, drivers of change and lessons learned.

There are also more examples of risk management and advisory firms offering services to help organisations assess their physical risk. These are all promising developments; however, progress needs to accelerate. Alongside effective enforcement of reporting requirements, organisations must be able to afford and access such information or services, otherwise preparation for physical risks will likely be ineffective. Without government support, there is likely to be a capacity barrier for SMEs in particular.

The BSI also has continued to work on adaptation-related standards which set out principles that organisations can follow, rather than set out an overly prescriptive approach. In addition to ISO 14090 *Adaptation to climate change – Principles, requirements and guidelines,* new adaptation-related standards have been published since 2019:

- *ISO 14091 Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment*
- *BS 8631:2021 Adaptation to climate change. Using adaptation pathways for decision making. Guide*
- *PD ISO/TS 14092:2020 Adaptation to climate change. Requirements and guidance on adaptation planning for local governments and communities*

There is ongoing work on standards focussing on financing local adaptation to climate change and reporting investments and financing activities related to climate change. Other standards on sustainable finance and natural capital accounting can also help organisations better plan for the impacts of climate change, such as PAS 7340 *Framework for embedding the principles of sustainable finance in financial services organizations,* published in January 2020, and BS 8632 *Natural Capital Accounting for Organizations,* published in June 2021.

New reporting initiatives are less likely to influence smaller businesses, who make up the majority of businesses in England, and have fewer resources to adapt. The impacts of Covid-19 have hit these businesses particularly hard and has highlighted the importance of contingency planning for their resilience.

The impacts of flooding and extreme weather can be severe for small businesses, but many do not have contingency plans for extreme weather.

The full impact of Covid-19 is still being understood but it and the resulting economic volatility has clearly had a significant effect on small businesses. Smaller firms were more likely than bigger ones to have had to temporarily close or pause trading during the pandemic, although this was not necessarily the same across all industries.[15] Analysis by the Bank of England in 2020 found that the pandemic reduced cash flows for many companies, with smaller companies 'more likely than larger companies to operate in sectors that have been most affected by the shock, such as accommodation and food, arts and recreation, and construction.'[16]

Previous research by the FSB in 2015 suggests the impacts of flooding and extreme weather can be severe for small businesses, but many do not have contingency plans for extreme weather, despite the benefits of doing so exceeding the costs.[17]

In the recovery from Covid-19 there will be many new small businesses established and some operating in different ways than before due to enforced changes from Covid-19. There is an opportunity to increase the level and effectiveness of contingency planning, including for extreme weather, by providing updated guidance and accessible information. Small businesses, including very small businesses working largely from home, will also benefit from investment in resilient digital infrastructure.

A new SME Climate Hub offers several resources for physical risk and understanding climate impacts, though most of its promotion and resources focus on reducing emissions to Net Zero.
A new SME Climate Hub was launched in December 2020 and is an initiative of the International Chamber of Commerce, the Exponential Roadmap Initiative, the We Mean Business coalition and the United Nations Race to Zero campaign. This is a welcome development as it aims to provide a 'one-stop-shop' for SMEs to make a climate commitment and access 'best-in-class' tools and resources, which was highlighted as something needed in the CCC's 2019 Adaptation Progress Report. It already offers several resources for physical risk and understanding climate impacts, though the vast majority of its promotion and resources focus on reducing emissions to Net Zero.

It will be important to monitor feedback for the SME Climate Hub and whether action from Government is required to develop resources accordingly to ensure the needs of different types of business and organisations are met. A NAP Action update reports that 'the Small Business Engagement campaign, led by Andrew Griffith MP, the UK's Net Zero Business Champion, will embed the need for adaptation and resilience to climate change in stakeholder-related activity.'

Recommendation (Joint CCC 2021 Progress Report)
Support businesses to play their full role in the Net Zero transition and in adapting to climate risks and opportunities, for example by extending and expanding the role of the Net Zero Business Champion beyond COP26, building on the Race to Zero and Race to Resilience campaigns and providing sufficient resources to fully support businesses of all sizes to engage in the transition, to input to policy development and to set their own robust Net Zero and adaptation action plans. Department: BEIS, Timing: 2021-22.

Even with the challenges of Covid-19, many businesses and investors have continued to demonstrate a desire for improved climate-related information and aligning their operations and portfolios to be consistent with the goals of achieving Net Zero and being prepared for the impacts of climate change.
The Principles for Responsible Investment (PRI) report that climate change has remained a top priority for its signatories, particularly in advance of COP26. ShareAction proposed a Responsible Investment bill, stipulating in law that the 'best interests' of beneficiaries includes environmental and social considerations. Major asset management firms such as BlackRock have taken further steps to make consideration of climate change a central part of their investment decisions.

The UK Government set out plans for a green recovery in line with the majority preference of the UK Citizens' Assembly on climate change. Government can help further meet this demand by addressing the above weaknesses in planning for and supporting climate-positive behaviours by businesses and investors by providing clear signals about future policy and timescales.

Has the risk management score changed?

No, the risk management score remains medium. New evidence published since 2019 suggests continued progress in some aspects of reporting, but others, which are particularly important for physical risk and adaptation, show very limited progress. The availability of indicators focussed on physical risk and adaptation for this priority remains limited and there is little new information on the economic impacts of extreme weather.

The TCFD Status Report states that there have been improvements both in terms of the number of companies reporting and the quality of such reporting. The percentage of reviewed reports disclosing information aligning with a particular TCFD disclosure (for example, climate-related targets) increased on average by six percentage points between 2017 and 2019.

Only one in 15 companies reviewed by the TCFD disclosed information on the resilience of its strategy.

However, companies' disclosure of the potential financial impact of climate change on their businesses and strategies remains low. Only one in 15 companies reviewed disclosed information on the resilience of its strategy. The percentage of companies disclosing the resilience of their strategies, taking into consideration different climate-related scenarios, was significantly lower than that of any other recommended disclosure.

Some of the highlighted case studies demonstrated good approaches for assessing physical risk, such as use of a 4°C or higher scenario and the reporting by hazard in scenario analysis.[18] However, even those reports highlighted as best practice had some weaknesses related to assessing physical risk. Most of the reported physical risk metrics were related to water use. Physical and transition risks were often considered separately and only vague measures like the percentage of sites affected were reported with little information on the adaptation response.

Recommendation (Joint CCC 2021 Progress Report)

Develop further ways to embed Net Zero and climate risk in financial decisions by UK firms, building on the UK's Green Finance Strategy. This should include implementing mandatory climate disclosure, adoption of a robust green taxonomy with clear guidance on how it should be used, and considering the recommendations of the Committee's Finance Advisory Group, such as making Net Zero and adaptation plans mandatory for financial institutions and monitoring financial flows into climate action.

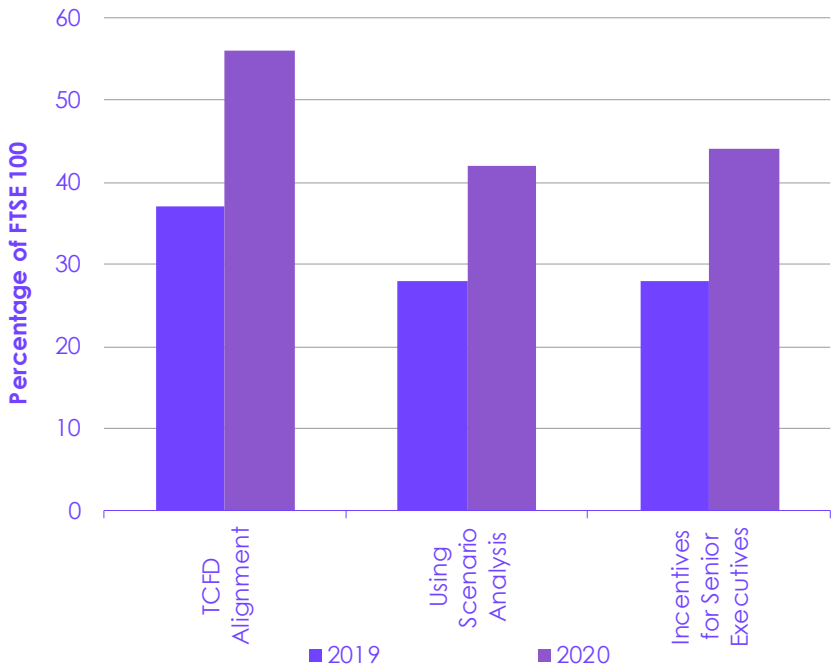
Department: BEIS and HM Treasury, Timing: 2021-25.

The proportion of companies reporting that they are planning for climate change is increasing but further progress is needed.

Figure 5.1 sets out responses from FTSE 100 companies to specific questions from Eco Act's most recent sustainability research. While there is improvement since the previous survey, the results still suggest a significant proportion of FTSE100 companies are not reporting in alignment with the TCFD recommendations, using scenario analysis, or taking steps like offering incentives for Senior Executives.

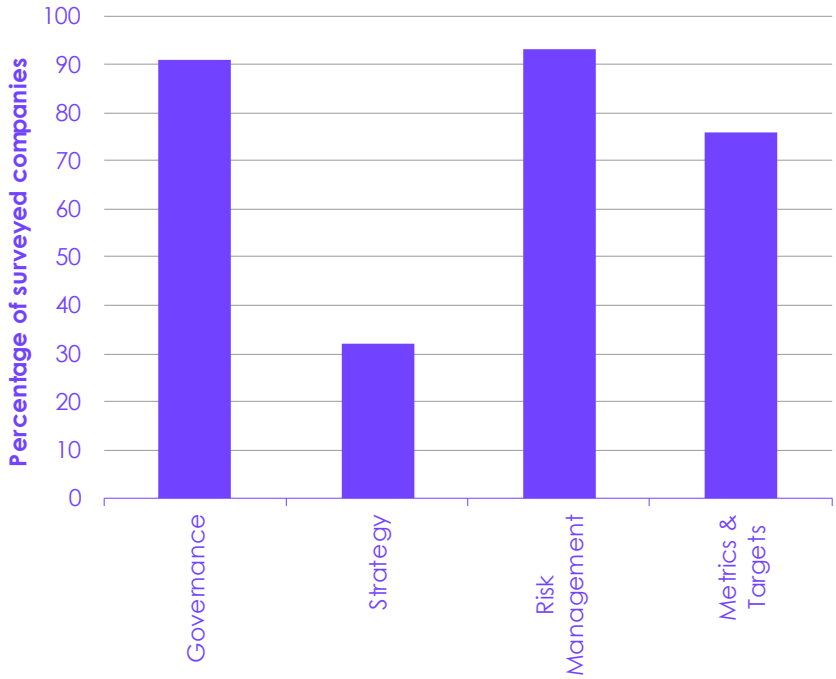
Figure 5.2 shows a survey by CDP which found a high proportion of respondents were providing information on three of the four thematic TCFD areas. However, two-thirds were not reporting under the strategy theme. This is largely because scenario analysis, which businesses have struggled with, is assessed under this theme. This suggests that many organisations are still unable to effectively assess the potential impacts of climate-related risks and opportunities on their businesses, strategy, and financial planning.

Figure 5.1 Survey responses from FTSE100 companies on climate risk



Source: The Sustainability Reporting Performance of the FTSE 100 (EcoAct, 2020)

Figure 5.2 Percentage of CDP respondents reporting under TCFD thematic areas



Source: Disclosure and the TCFD Recommendations: United Kingdom (CDP, 2020)

There are some initial estimates for the impact on businesses of the Autumn-Winter Floods 2019-20 based on insurance claim information from the ABI.[19]

- Of the estimated £110 million payouts, £45 million covered damaged homes and possessions; £58 million for business property and stock, with £7.5 million relating to damaged vehicles.

- The average household flood claim is likely to be around £31,000, and £70,000 for a flooded business. This compares to the average claim across all insured risks of £2,200 under a home insurance policy and an average claim of £11,500 on a commercial policy.

Sayers et al. for the CCC used the new UKCP18 climate projections to provide an updated assessment of future flood risk in 2020.[20] The results did not suggest a significant increase in risk for non-residential properties from flooding compared to their previous assessment in 2015 using UKCP09.

5.3 Supply chain interruptions

Progress summary – Supply chain interruptions		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - medium** • The plan score has increased from low to medium. The first part of the National Food Strategy has been published and Government has made further commitments to report and better understand issues related to food supply chains, including climate change. There are also examples of private sector initiatives to inform supply chain planning for climate change and efforts by Government to revise its procurement rules. There still needs to be greater assurance for key supply chains and assessment of the impacts of climate change in new industrial and economic policies. **Risk management score - low** • The risk management score has decreased from medium to low. The risks of supply chain interruptions are greater than in our last report. Action to respond to the risk is at roughly the same level as in 2019, with some surveys suggesting that businesses are increasingly prioritising resilience in their supply chain planning rather than speed and cost-efficiency, but others suggesting engagement with suppliers on climate change is still limited.	3
Notes: See annex for full datasets Key Indicators: Supplier engagement on climate change (various surveys), Economic impact of supply chain interruptions.		

Summary of 2019 report score

In our last report, supply chain interruptions scored a 2 (low plan score, medium risk management score).
Our last report found that there were no stated goals or specific planning for adapting supply chains, and the UK Industrial Strategy did not make any references to helping supply chains become more resilient to the impacts of climate change. NAP2 did not address the risks that the UK faces from the international impacts of climate change.

The limited survey evidence available suggested some businesses were taking action but also suggests some did not engage with their suppliers on climate change.

Has the plan score changed?

Yes, the plan score has increased from low to medium. There are some promising new initiatives from Government and the private sector and surveys suggest that businesses are increasingly balancing the need for resilience in their supply chain planning alongside speed and cost-efficiency. To increase the score further there needs to be greater assurance for key supply chains, and plans for industry and the economy should incorporate the impacts of climate change on supply chain resilience.

Key supply chains such as food and medical supplies require stronger assurance about their resilience to future shocks, including the impacts of extreme weather. Covid-19 has highlighted the importance of having reliable and resilient supply chains, particularly for food and medicine. A report by the House of Commons International Trade Committee in July 2020 identified various adverse effects from the disruption caused by the pandemic, though also noted that UK supply chains for medicines and food had withstood many of the challenges at the time of writing.[21] In the Government's response to this report, it stated that the 'DEFEND programme, led by DIT, interrogates vulnerabilities in UK global supply chains for critical goods (excluding food) and develops strategies to strengthen supply chain resilience.'[22]

It is not clear to what extent extreme weather is currently considered alongside other current and future supply chain vulnerabilities. The CCRA3 Advice Report and CCRA3 Technical Report assessed that extreme weather is already causing supply chain disruption and that exposure to climate hazards is set to increase.[23] It also noted that there are 'opportunities to learn from the lessons on supply chain resilience during the COVID-19 pandemic' and that 'enhancing supply chain resilience should be a priority for post-COVID recovery planning and should also be a factor in the development of new trade agreements as trade patterns change following EU-Exit.'

The Government is making progress with its work on food security and supply chains.

The Dimbleby review assessed that climate change is currently the biggest threat to food security.

The first part of the independent Dimbleby review of the new National Food Strategy was published in July 2020.[24] Part one focussed on the impacts of Covid-19 and the end of the EU exit transition. It assessed that the food supply chain proved resilient during Covid-19 but reminded us there is no room for complacency and that 'the fact that the food system didn't, in the end, break down is largely due to the nature of this particular crisis.'

On climate the Dimbleby review assessed that 'Climate change is currently the biggest threat to food security, perhaps the most serious the world has ever seen. The problems it creates are likely to be disruptions of supply rather than demand. One worst-case scenario would be the failure of multiple harvests worldwide. If that happened, there might not be enough food to go around. This is a food security issue on a grand scale.'

Government has committed to publishing a white paper six months after part two is published and has asked Henry Dimbleby to review progress six months after this.

Part two of the review will assess the entire national food system, including the issues of climate change in more depth.

The UK Government committed in the Agriculture Act 2020 to publish a regular food security report, with the first report published before the end of 2021, and subsequent reports every 3 years.[25] The Food Standards Agency (FSA) has published its Areas of Research Interest (ARI), including considering climate change's influence on patterns of foodborne disease prevalence, the availability or need for new or novel foods, and its impact on international trade.[26]

Recommendation
Set out measures to ensure the resilience of the food supply chain, including to the risks of extreme weather in England and internationally, as part of its white paper responding to the independent review of the National Food Strategy for England. Department: Defra, Timing: 2022.

Recommendation

Ensure that adaptation is integrated into major upcoming policies in the next two years related to the eight priority risks identified in the Committee's advice on the third UK Climate Change Risk Assessment (CCRA3) for which BEIS has lead responsibility, coordinating work with other relevant departments as necessary:

- Risks to the supply of food, goods and vital services due to climate-related collapse of supply chains and distribution networks (with Defra and DIT)
- Risks to people and the economy from climate-related failure of the power system

In addition, for the coming five-year period 2023-2028, BEIS should outline appropriate actions in the next National Adaptation Programme to address the adaptation gap identified for the other risks and opportunities in the CCRA for which it is the lead department (see Annex).

Department: BEIS, Timing: By 2023.

Government has consulted on changing its procurement processes to better take account of climate change. These are good proposals but require strengthening to really drive progress in planning.

Suppliers should provide evidence of their contribution to environmental and climate change goals, and these criteria should be considered as widely as possible across contracts.

Public procurement accounts for around a third of all public expenditure at £290 billion according to a 2020 consultation by the Cabinet Office.[27] Government has consulted on ways to improve its public procurement process, including supporting national priorities such as the environment and tackling climate change.

Proposed changes would permit contracting authorities to assess how suppliers are operating across the whole of their business, not just criteria related to the delivery of the contract, for example a supplier's plans for achieving environmental targets across its operations. However, the proposals also state that this would only be allowed in a limited number of circumstances so as not to disadvantage small businesses.

Creating a level playing field for smaller businesses is important, however it is imperative that public procurement sends the right messages to suppliers by asking them to demonstrate their planning for and response to the impacts of climate change. In a previous consultation on social value in procurement, mitigating and adapting to climate change were listed as criteria that departments could use to assess a supplier's contribution to environmental policy objectives.[28]

Guidance should accompany any changes in procurement to ensure that suppliers are asked to provide useful qualitative and quantitative information on their contribution to environmental and climate change goals, and that these criteria are considered as widely as possible across contracts.

Government confirmed it is progressing the development of a new Greening Government Commitments (GGC) framework for 2021-25. There is an opportunity to increase the coverage of adaptation in GGC reports.

In its NAP action update the Government confirmed it is progressing the development of a new Greening Government Commitments (GGC) framework for 2021-25. It is looking to include climate adaptation commitments as part of this framework and aims to publish new commitments in spring 2021. There is an opportunity to increase the coverage of adaptation in GGC reports, such as requesting more detailed information and highlighting best practice through case studies to help departments learn from one another. Reporting requirements for the most recent GGC report were reduced to the impact of Covid-19 on government departments.

There are also examples from the private sector of greater consideration of the sustainability and resilience of their supply chains.
HSBC and the Sustainability Consortium published a report in 2020 on improving supply chain resilience to manage climate change risks.[29] It discusses physical risk and why this may be different to other supply chain risks that organisations may face, as well as strategies to improve supply chain resilience.

There are other examples which do not currently focus on the risks from climate change specifically but have developed approaches which could be applied and learned from. WRAP's Sustainable Clothing Action Plan aims to reduce the environmental footprint of clothing by bringing together industry, government and the third sector. Industry includes both retailers and suppliers, as well as trade bodies. One of the working groups focuses specifically on metrics. The Courtauld Commitment 2025 has similar aims and processes to address sustainability issues in food and drink supply chains.

These and other approaches could help inform new industrial and economic strategies and policies, which must take into account the long-term impacts of climate change on supply chain resilience.

Has the risk management score changed?

Yes, the risk management score has decreased from medium to low. This is because of new evidence published since 2019 that points to a higher degree of underlying risk, while action has remained at roughly the same level, with mixed progress.

In addition to the impact of Covid-19, recent survey evidence from the Economist Intelligence Unit suggests high costs associated with supply chain disruption. It also suggests businesses are rethinking their approaches to supply chain management following Covid-19.

A recent Economist Intelligence Unit survey suggests supply chain disruptions have incurred substantial financial costs over the past three years, averaging 6 to 10% of annual revenues, as well as reputational costs.

In 2021 The Economist Intelligence Unit assessed the business costs of supply chain disruption across eight countries, including the UK.[30] In November and December 2020 it surveyed 400 senior supply-chain and procurement executives in five sectors (agriculture and food, industry, consumer goods and retail, healthcare and pharmaceuticals, and energy and utilities).

Its research found that disruptions have incurred substantial financial costs over the past three years, averaging 6 to 10% of annual revenues, as well as reputational costs, in terms of customer complaints and damage to brand reputation, as companies have struggled to maintain supplies of their goods. 54% of the executives surveyed said that organisations must make significant changes in order to effectively manage supply-chain disruptions in the next five years.

The report assesses that 'until now, companies have emphasised efficiency. But this is changing, with firms recognising a need to prioritise supply-chain resilience. Six in ten respondents agreed that redundancy and resilience in their company's supply chain are more important than speed and efficiency, with a third of respondents strongly agreeing. Climate-related risks and natural disasters are among the factors considered most likely to impact supply chains in the next five years, though geopolitical and pandemic-related risks were cited by a higher proportion of respondents.

UK respondents to CDP reported $2.2 billion of revenue at risk over the next five years due to physical and transition climate change risks, deforestation and water insecurity risks in their supply chains.

Other recent survey evidence suggests mixed progress for the responses of business to supply chain risks.

In response to CDP's Supply Chain Survey in 2020, respondents from all countries expected total increased costs of $120 billion in the next five years, caused by physical environmental impacts as well as addressing regulation and market changes, which could be passed on to buyers.[31] UK respondents reported $2.2 billion of increased costs over the next five years due to climate change (including mitigation), deforestation and water insecurity risks in their supply chain.

Research by Eco Act in 2020 found that 64% of FTSE100 companies assessed value chain risks. It found businesses in the fast-moving consumer goods sector, a key sector for supply chain risks, generally performed better on its survey responses, though only half of respondents, across the FTSE100, DOW30, IBEX35 and CAC40 indexes, made use of scenario analysis. 89% of all FTSE 100 companies reported some engagement with their suppliers on climate change issues, though this includes mitigation as well as adaptation. The number of businesses disclosing to CDP in 2020 through its supply chain survey published in 2021 was nearly 8,100, more than double the amount in 2015.

5.4 Water demand by industry

Progress summary – Water demand by industry		
2019 score:	**What has changed since 2019:**	**2021 score:**
5	**Plan score - medium** • There is no change in the plan score from 2019. The Environment Agency's National Framework identifies key sectors for regional water groups to engage with and agree strategies for managing their water use. The retail market continues to only deliver limited benefits in terms of improved water efficiency. However, the Retailer Wholesaler Group (RWG) water efficiency sub-group, supported by the Environment Agency and Ofwat, has set out an action plan to improve this. There remains a lack of clear targets for the contribution of industry to managing water availability. **Risk management score - medium** • There is no change in the risk management score from 2019. Non-household consumption of the public water supply is roughly the same as a decade ago. There is no more recent data on abstraction by industry than there was in 2019. Survey evidence published since 2019 suggests some sectors and businesses are reducing their water use. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency in the future.	5
Notes: See annex for full datasets Key Indicators: Abstraction by industry (Ml/d), Non-household consumption of the public water supply (Ml/d), Businesses reporting water use per unit of production.		

Summary of 2019 report score

In our last report, water demand by industry scored a 5 (medium plan score, medium risk management score).
Our last report found that there were some plans in place to reduce water use by businesses through abstraction reform, the water retail market and company initiatives and targets. However, there was no overarching plan or target and the effect of the water retail market on improving water efficiency was limited.

Direct abstraction from freshwater sources had fallen between 2012 and 2017 but consumption from the public water supply was the same as in 2012. There was good evidence that some businesses were reducing water use, for example reporting members of the Food and Drink Federation.

Has the plan score changed?

No, the plan score remains medium. There has been significant progress through the Environment Agency's National Framework and joint letter with Ofwat to improve uptake of water efficiency measures by business. There remains a lack of clear targets for the contribution of business to managing future water availability.

The Environment Agency's National Framework sets out how regional groups should work with local business sectors to help manage water availability in their regions.

Based on the analysis for the National Framework for water resources in 2020, the Environment Agency identified key abstractors and water using sectors for regional groups to engage with:[32]

- Water Resources East should continue to engage with the agricultural sector (particularly spray irrigation), the food and drink industry, power sector and wider industry.
- Water Resources South East should engage with industry, particularly paper and pulp, and agriculture. This includes previously exempt abstractors using trickle irrigation for a range of purposes such as soft fruit growers.
- West Country Water Resources should engage with the minerals sector and agriculture (particularly the livestock subsector).
- Water Resources West should engage with navigation operators and industry, particularly the chemicals sector, as well as agriculture.
- Water Resources North should engage the power generation sector, industry and agriculture.

Reducing the demand for water from the non-household sector would have co-benefits such as improving the efficiency of business processes and reducing energy consumption.

The assessment identifies that reducing the demand for water from non-household sectors will play an important part in reducing demand overall and would have co-benefits such as improving the efficiency of business processes and reducing energy consumption. Regional groups' engagement is expected to include the approach to planning for water resources, managing droughts, reducing demand, and forecasting and monitoring non-household use of mains water. It will also consider a range of solutions such as re-using process water for other neighbouring businesses or large and business scale grey and rainwater harvesting.

Ofwat's review of the retail market suggests it is still only having a limited impact on water efficiency. However, the Retailer Wholesaler Group (RWG) water efficiency sub-group, supported by the Environment Agency and Ofwat, has set out an action plan to improve this.

Only around 6% of businesses who switched suppliers in 2019 received new water efficiency or leak detection devices as a result of switching.

Ofwat's third review of the impact of the water retail market for businesses in 2020 found that take-up of water efficiency services has increased but remains low.[33] Only around 6% of businesses who switched suppliers in the year preceding the report received new water efficiency or leak detection devices as a result of switching. Ofwat acknowledged this lack of progress in a joint open letter with the Environment Agency.[34]

The Retailer Wholesaler Group (RWG) water efficiency sub-group has since consulted and signed off a Headline Action Plan with a series of actions and milestones, mostly over the coming year, which Ofwat and the Environment Agency have publicly supported.[35] The plan has now been presented to the Senior Water Demand Steering Group (SWDSG), a new group established by Defra, as part of a new monitoring and reporting framework to report on progress on demand management.

As part of the environmental targets under the Environment Bill, it is being considered whether to set a target for the overall demand for water. By including non-household use, this would help to drive progress in conjunction with the retail market.[36]

Recommendation

Work with the Environment Agency, Ofwat and other stakeholders to set out targets and supporting measures for reducing water use by business. This could be through ensuring that any water reduction targets linked to the Environment Bill include business as well as household water use, as well as responding to advice and recommendations from Defra's new Senior Water Demand Reduction Group.

Department: Defra, Timing: 2022.

There are examples of private sector initiatives which plan to reduce water at sector or company level.

The Food and Drink Federation (FDF) and several member companies are supporters of the Courtauld 2025 Water Ambition. This commits signatory businesses to monitor water use in their own operations, improve efficiency and work collectively to improve the quality and availability of water in key sourcing areas by 2025. It includes a catchment project in the UK and going forward, the FDF and WRAP will look to develop a Water Roadmap for businesses.

Has the risk management score changed?

No. There is some evidence of positive action by industry to reduce water use. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency in the future.

Non-household consumption of the public water supply is at roughly the same level as a decade ago.

Non-household consumption of the public water supply was 2,700 Ml/d in 2019/20. This is the same as for our last report two years ago, but also the same as consumption in 2009/10.

Data from the Environment Agency suggest that non-household consumption of the public water supply was 2,700 Ml/d in 2019/20.[37] This is the same as for our last report two years ago, but also the same as consumption in 2009/10. Due to the impacts of Covid-19 on resources for data collection, there are no updated data for abstraction. Additional data which take into account production levels are still required to assess genuine improvements in water efficiency.

Reports and survey data suggest positive action by businesses to address water efficiency, though this is not necessarily widespread across sectors.

In CDP's most recent Global Water Report published in 2021, disclosures indicate that not addressing water risks is more costly than addressing them, though this includes flooding in addition to water availability.[38] The information submitted suggested the potential financial impact of global water risks to businesses is five times higher than the cost of addressing them. The sectors facing highest financial impacts are manufacturing, power generation, and food, beverage, and agriculture.

Since 2018, almost two-thirds of responding companies state they are reducing or at least maintaining their water withdrawals compared to the previous year. 27% of respondents reported adopting water efficiency, conservation, re-use and recycling measures and the proportion that factor water availability at a basin or catchment level into water risk assessments had increased from the previous year's survey from 48% to 65% of respondents.

There are good examples of businesses developing processes to re-use or recycle water for which they report that the benefits exceed the costs.

CDP's Global Water Report also highlighted case studies of action by businesses. L'Oréal uses a 'waterloop' standard, where all process water is reused or recycled on site. It reports that the cost of equipping facilities with the water recycling technology required is lower than the potential financial impact of water-related risks. It aims to use this approach in all of its factories by 2030. Nissan uses rainwater

harvesting and wastewater recycling at one its sites, allowing it to be independent of external water sources and save on water bills through reducing use.

Food and Drink Federation (FDF) members reporting in 2019 had reduced their absolute water consumption by 41.5% between 2007 and 2019 and the amount of water consumed per tonne of product was reduced by 44.5% over the same period.[39]

5.5 Business opportunities from climate change adaptation

Progress summary – Business opportunities from climate change adaptation		
2019 score:	**What has changed since 2019:**	**2021 score:**
2	**Plan score - low** • There is no change in the plan score from 2019. There has been progress in planning for a green recovery in response to the economic impacts from Covid-19, launching a race for resilience and some promising pilot schemes for adaptation. However, the business opportunities from climate change adaptation specifically are generally not considered in relevant national plans or strategies. **Risk management score - medium** • There is no change in the risk management score from 2019. From the available data it is not possible to tell the extent to which UK businesses are planning for any direct opportunities from climate change (such as potentially longer growing seasons). There is some evidence published since 2019 suggesting businesses are considering opportunities from climate change adaptation.	2
Notes: See annex for full datasets Key Indicators: Number of businesses reporting that they assess opportunities from climate change adaptation, Issues of resilience or other sustainability bonds to finance adaptation opportunities, Sales of adaptation goods and services.		

Summary of 2019 report score

In our last report, business opportunities from climate change adaptation scored a 2 (low plan score, medium risk management score).
Our last report found that there was no overarching plan and the Industrial Strategy did not mention climate change as a potential driver of business growth or city regeneration through adaptation-related technologies. There were no specific schemes from Innovate UK or use of the Industrial Strategy Challenge Fund to encourage climate-related adaptation opportunities.

Opportunities were identified for banking and green finance which had the potential to direct more finance towards adaptation and develop new adaptation products and services. The available data did not demonstrate the extent to which businesses were realising the opportunities from climate change.

Has the plan score changed?

No, the plan score remains low. There has been progress in planning for a green recovery in response to the economic impacts from Covid-19 and achieving Net Zero, and some promising pilot schemes for adaptation. However, to improve the score, there needs to be better plans at national level.

The Government has set out plans for transforming the financial system to better support environmental objectives. These plans reference the opportunities from climate change adaptation, though there is little detail at this stage.
Shortly after our last report in 2019, the Government published its Green Finance Strategy.[40] The strategy specifically mentioned 'championing the resilience agenda' and exploring measures to unlock new revenue streams in areas such as natural capital and resilience.

It is due to conduct a formal review of progress against the ambitions and plans across all parts of the Green Finance Strategy in 2022.

A report by the London Stock Exchange Group in December 2020 highlighted examples of the use of new green finance products around the world, including for adaptation and resilience, such as green and sustainability bonds.[41] The review of the Green Finance Strategy should consider these and other new products and services. The review should also consider how the use of these or similar products and services could be increased and therefore create more opportunities for UK businesses from climate change adaptation.

The new sovereign green bond could help provide green and resilient infrastructure and create jobs.

In addition to announcing plans for making TCFD reporting mandatory, the UK Government announced a sovereign green bond in 2020. The Green Finance Institute assessed that this 'delivers on plans to move towards a resilient, Net Zero carbon economy,' it will 'bring a range of positive social benefits such as creating green collar jobs, skills and regional revitalisation,' and 'provide finance for green infrastructure, it will create green jobs and catalyse the sterling green bond market.'[42]

The 2021 Dasgupta Review of the economics of biodiversity highlights the need for new standards, data and tools to help businesses and financial institutions integrate nature-related considerations into their decision-making.

The 2021 Dasgupta Review of the economics of biodiversity identified the need for a financial system that channels financial investments – public and private – towards economic activities that enhance the stock of natural assets and encourages sustainable consumption and production activities.[43]

Much like for TCFD reporting and climate change, it sets out that 'what is ultimately required is a set of global standards underpinned by credible, decision-grade data, which businesses and financial institutions can use to fully integrate Nature-related considerations into their decision-making, and assess and disclose their use of, and impact on, Nature.'

Transforming the financial system to achieve this should incorporate the long-term impacts of climate change and consider the opportunities this transformation could create for business in the financial sector and more widely. Tools such as ENCORE (Exploring Natural Capital Opportunities, Risks and Exposure) could be promoted to help businesses become aware of new opportunities related to natural capital.

A 'Race to Resilience' has been launched for COP26. This and other international initiatives can help to raise awareness of adaptation opportunities at the same time as improving resilience in the UK and other countries.

The 'Race to Resilience' was announced in January 2021 and aims by 2030, to catalyse action by non-state actors* that builds the resilience of 4 billion people from vulnerable groups and communities to climate risks.[44] The campaign will report back on progress annually starting at COP26. Mark Carney also announced a strategy for building a private finance system for Net Zero, with one of the four pillars being 'returns.' Similar principles could be used to consider the opportunities for adaptation.

There could also be more opportunities for UK businesses if measures for a green recovery are able to better integrate adaptation and resilience.

* Non-state actors for the Race to Resilience could be individual companies, cities, regions, NGOs or organizations.

If more people work at home, there will be opportunities for new products and services which help people to be productive, including during periods of hot weather now and in the future.

In 2020, the Government has also announced a series of measure to help support a green recovery from the economic impacts of Covid-19, such as a ten-point plan for a green industrial revolution and a green jobs taskforce on skills, both currently focussed on Net Zero.[45] The Institute for Apprenticeships and Technical Education has also launched a green apprenticeships advisory panel.[46] Many of the areas under the ten-point plan will require consideration of mitigation and adaptation in parallel.

There could also be more opportunities for adaptation-related jobs and apprenticeships schemes particularly given possible changes in work and supply chains as a result of Covid-19 and the end of the transition period after leaving the EU. For example, if more people work at home, there will be opportunities for new products and services which help people to be productive, including during periods of hot weather now and in the future.

A report published by the Green Alliance in May 2021 considers the potential for creating new green jobs across Britain and found opportunities in seagrass planting, tree planting and wetlands restoration, peatland restoration initiatives and creating new green spaces.[47]

There are examples of regional or project use of green finance which support adaptation and could be scaled up to provide greater opportunities for business. The IGNITION project aims to increase investment in Greater Manchester's natural environment and build the city region's ability to adapt to the increasing impacts of climate change.

An example is the Greater Manchester IGNITION project which aims to develop innovative financing solutions for investment in Greater Manchester's natural environment and build the city region's ability to adapt to the increasing impacts of climate change.[48] It focuses on solutions such as rain gardens, street trees, green roofs and walls and development of green spaces. The aim is to develop a model that enables major investment in large-scale environmental projects which can increase climate resilience.[49]

From 12 February 2021, organisations can apply for a natural environment investment readiness fund (NEIRF) grant.[50] The NEIRF is a competitive grants scheme providing grants of between £10,000 and £100,000 to support environmental projects in England. Projects should have the ability to produce revenue from ecosystem services to attract and repay investment. Ecosystem services could include selling biodiversity units from a habitat bank or selling 'catchment services' such as improved water quality and natural flood management benefits resulting from natural environment improvements.

Has the opportunity score changed?

No, the opportunity score remains medium. From the available data it is not possible to tell the extent to which UK businesses are realising the opportunities from climate change. There is some evidence published since 2019 suggesting businesses are considering opportunities from climate change adaptation.

There is some work being undertaken by government departments and agencies to create adaptation-related export opportunities for UK businesses.
There are several NAP Action updates related to opportunities. UK Export Finance is undertaking work with the Environment Agency and OGDs on export opportunities related to 'flood control risk management,' with the aim of producing a 'prospectus' in 2021.

The Department for International Trade (DIT) carried out work to help businesses and the City of London demonstrate leadership in finance and insurance, including through the 2021 Global Resilience Summit. DIT is also undertaking work to link UK firms with international partners to help deliver resilient infrastructure in other countries.

There is evidence of a growing demand for adaptation-related advisory services and data.

In January 2020 a special issue of the journal 'Climate Services' summarised the findings of two EU-funded projects, called MARCO and EU MACS.[51] These projects aimed to characterise the current and untapped market for climate services in Europe and derive opportunities for market growth. For the UK they identified a range of case studies and examples for different types of services:

- adaptation and engineering solutions;
- risk assessments and reporting;
- climate models and scenario analyses
- climate finance;
- climate data;
- climate communications; and
- climate intelligence.

This demand for better business capability when it comes to assessing physical risk and adaptation can also be seen in recent corporate acquisitions; insurance broker Willis Towers Watson recently acquired adaptation consultancy Acclimatise, and McKinsey acquired consultancy Vivid Economics and climate analytics platform Planetrics.

Survey evidence published since 2019 suggests there may be significant opportunities for businesses and that some are planning specifically for adaptation. However, much of this evidence is either for both mitigation and adaptation (making adaptation difficult to separate out) or for companies based outside the UK.

70% of FTSE 100 companies reported they assess the opportunities from climate change mitigation and adaptation.

Research by Eco Act in 2020 found that 70% of FTSE 100 companies assess the opportunities from climate change, though this is for both mitigation and adaptation. Data published by FTSE Russell in 2020 suggest that the green economy, and potentially related opportunities for climate change adaptation, is increasing in size. FTSE Russell's analysis found that the global green economy has grown from US$2 trillion in 2009 to US$4 trillion in 2018, an annualized growth rate of 8%.[52] However, it still remains a small proportion of all finance and the UK in particular has relatively low exposure to the green economy compared to other countries. In the 2020 TCFD Status Report, a case study from Pfizer stated that it was seizing the opportunities presented by climate change adaptation, particularly in terms of sustainable product development. It claims it is the first company in the pharmaceutical sector to issue a green bond.

Based on the responses of the 500 biggest companies by market capitalization that disclosed to CDP in 2018, $236 billion of potential increased revenue through new solutions to adaptation needs was identified in a 2019 CDP report. The responses covered a range of sectors, though manufacturing businesses identified the most potential revenue of any sector.[53]

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Departmental risk owners

This report assesses progress for 33 adaptation priorities representing different policy teams in the UK Government. In CCRA3, there are 61 risks and opportunities that should be included in the next iteration of the National Adaptation Programme. Table 1 below shows the departmental owners for the risks and opportunities in CCRA3, which are linked to the Committee's recommendations (see Executive Summary). It also shows a rough mapping to the priorities assessed in this report.

Table A2
CCRA3 risks, departmental owners and adaptation priorities

CCRA3 Risk or opportunity	Lead department	Secondary departments	Progress Report Adaptation Priority
N1 - Risks to terrestrial species and habitats from changing climatic conditions and extreme events	Defra		Terrestrial habitats and species Farmland habitats and species
N2 - Risks to terrestrial species and habitats from pests, pathogens and invasive species	Defra		Terrestrial habitats and species Farmland habitats and species
N3 - Opportunities from new species colonisations in terrestrial habitats	Defra		Terrestrial habitats and species Farmland habitats and species
N4 - Risk to soils from changing climatic conditions, including seasonal aridity and wetness.	Defra		Terrestrial habitats and species Agricultural productivity Commercial forestry
N5 - Risks to natural carbon stores and sequestration from changing climatic conditions, including temperature change and water scarcity.	Defra		Terrestrial habitats and species Agricultural productivity Commercial forestry
N6 - Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions	Defra		Agricultural productivity Commercial forestry Water management
N7 - Risks to agriculture from pests, pathogens and invasive species	Defra		Agricultural productivity
N8 - Risks to forestry from pests, pathogens and invasive species	Defra		Commercial forestry
N9 - Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable.	Defra		Agricultural productivity Commercial forestry
N10 - Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	Defra		Agricultural productivity
N11 - Risks to freshwater species and habitats from changing climatic conditions and extreme events	Defra		Freshwater habitats and species Water management

N12 - Risks to freshwater species and habitats from pests, pathogens and invasive species	Defra		Freshwater habitats and species
N13 - Opportunities to freshwater species and habitats from new species colonisations	Defra		Freshwater habitats and species
N14 - Risks to marine species, habitats and fisheries from changing climatic conditions, including ocean acidification and higher water temperatures.	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N15 - Opportunities to marine species, habitats and fisheries from changing climatic conditions	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N16 - Risks to marine species and habitats from pests, pathogens and invasive species	Defra		Marine and coastal habitats and species Commercial fisheries and aquaculture
N17 - Risks and opportunities to coastal species and habitats due to coastal flooding, erosion and climate factors	Defra		Marine and coastal habitats and species
N18 - Risks and opportunities from climate change to landscape character	Defra		N/A
I1 - Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	Cabinet Office	BEIS, DfT, MHCLG, DCMS	Infrastructure interdependencies Design/location of new infrastructure
I2 - Risks to infrastructure services from river, surface water and groundwater flooding	Defra	BEIS, DfT, MHCLG	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding Development – river or coastal flooding Energy sector Rail network Strategic road network Local road network Ports Airports Design/location of new infrastructure Telecoms, digital and ICT
I3 - Risks to infrastructure services from coastal flooding and erosion	Defra	BEIS, DfT, MHCLG	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding

			Development – river or coastal flooding Energy sector Rail network Strategic road network Local road network Ports Airports Telecoms, digital and ICT Design/location of new infrastructure
I4 - Risks to bridges and pipelines from flooding and erosion	Defra	DfT, BEIS, MHCLG	River and coastal flood alleviation Rail network Strategic road network Local road network Energy
I5 - Risks to transport networks from slope and embankment failure	DfT	MHCLG	Rail network Strategic Road Network Local road network
I6 - Risks to hydroelectric generation from low or high river flows	BEIS		Energy
I7 - Risks to subterranean and surface infrastructure from subsidence	Defra	BEIS, DfT, DCMS, MHCLG	Energy Telecoms, digital and ICT
I8 - Risks to public water supplies from reduced water availability	Defra		Public water supply infrastructure Water demand – built environment
I9 - Risks to energy generation from reduced water availability	BEIS		Energy
I10 - Risks to energy from high and low temperatures, high winds, lightning	BEIS		Energy
I11 - Risks to offshore infrastructure from storms and high waves	BEIS		Energy
I12 - Risks to transport from high and low temperatures, high winds, lightning	DfT	MHCLG	Rail network Strategic road network Local road network
I13 - Risks to digital from high and low temperatures, high winds, lightning	DCMS	MHCLG	Telecoms, digital and ICT
H1 - Risks to health and wellbeing from high temperatures	MHCLG	DHSC, BEIS	Health impacts from heat and cold
H2 - Opportunities for health and wellbeing from higher temperatures	DHSC		Health impacts from heat and cold

H3 - Risks to people, communities and buildings from flooding	Defra	MHCLG, Cabinet Office,	River and coastal flood alleviation Surface water flood alleviation Development – surface water flooding Recovery from flooding Property-level flood resilience
H4 - Risks to people, communities and buildings from sea level rise	Defra	MHCLG	River and coastal flood alleviation Recovery from flooding Coastal erosion risk management
H5 - Risks to building fabric	MHCLG	BEIS	N/A
H6 - Risks and opportunities from summer and winter household energy demand	BEIS		Energy
H7 - Risks to health and wellbeing from changes in air quality	Defra	DHSC	Air quality
H8 - Risks to health from vector-borne diseases	DHSC		Human pathogens
H9 - Risks to food safety and food security	Defra		Human pathogens
H10 - Risks to health from water quality and household water supply	Defra		N/A
H11 - Risks to cultural heritage	DCMS		N/A
H12 - Risks to health and social care delivery	DHSC	MHCLG	Emergency planning system Health impacts from heat and cold
H13 - Risks to education and prison services	MoJ and DfE		Health impacts from heat and cold
B1 - Risks to business sites from flooding	Defra	BEIS, MHCLG, DfT	Extreme weather impacts on business
B2 - Risks to business locations and infrastructure from coastal change from erosion, flooding and extreme weather events	Defra	BEIS, MHCLG, DfT	Extreme weather impacts on business
B3 - Risks to businesses from water scarcity	Defra	BEIS	Water demand by industry
B4 - Risks to finance, investment and insurance including access to capital for businesses	BEIS	DIT, DWP, HMT	N/A
B5 - Risks to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments	BEIS	DHSC, DWP	Health impacts from heat and cold Extreme weather impacts on business

B6 - Risks to business from disruption to supply chains and distribution networks	BEIS	DfT, MHCLG, DIT	Supply chain interruptions
B7 - Opportunities for business from changes in demand for goods and services	BEIS	DIT	Business opportunities from adaptation
ID1 - Risks to UK food availability, safety, and quality from climate change overseas	Defra	FCDO, DIT	Supply chain interruptions
ID2 - Opportunities for UK food availability and exports from climate impacts overseas	Defra	FCDO, DIT	N/A
ID3 - Risks to the UK from climate-related international human mobility	FCDO	Home Office	N/A
ID 4 - Risks to the UK from international violent conflict resulting from climate change on the UK	FCDO	Home Office, MoD, Cabinet Office	N/A
ID5 - Risks to international law and governance from climate change overseas that will impact the UK	FCDO	MoD, Cabinet Office	N/A
ID6 - Opportunities from climate change (including arctic ice melt) on international trade routes	DIT	FCDO	N/A
ID7 - Risks from climate change on international trade routes	DIT		Supply chain interruptions
ID8 - Risk to the UK finance sector from climate change overseas	HM Treasury	DIT, FCDO	N/A
ID9 - Risk to UK public health from climate change overseas	DHSC	FCDO	Human pathogens
ID10 - Risk multiplication from the interactions and cascades of named risks across systems and geographies	Cabinet Office		N/A

Source: CCC, Defra

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Climate Change Committee

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