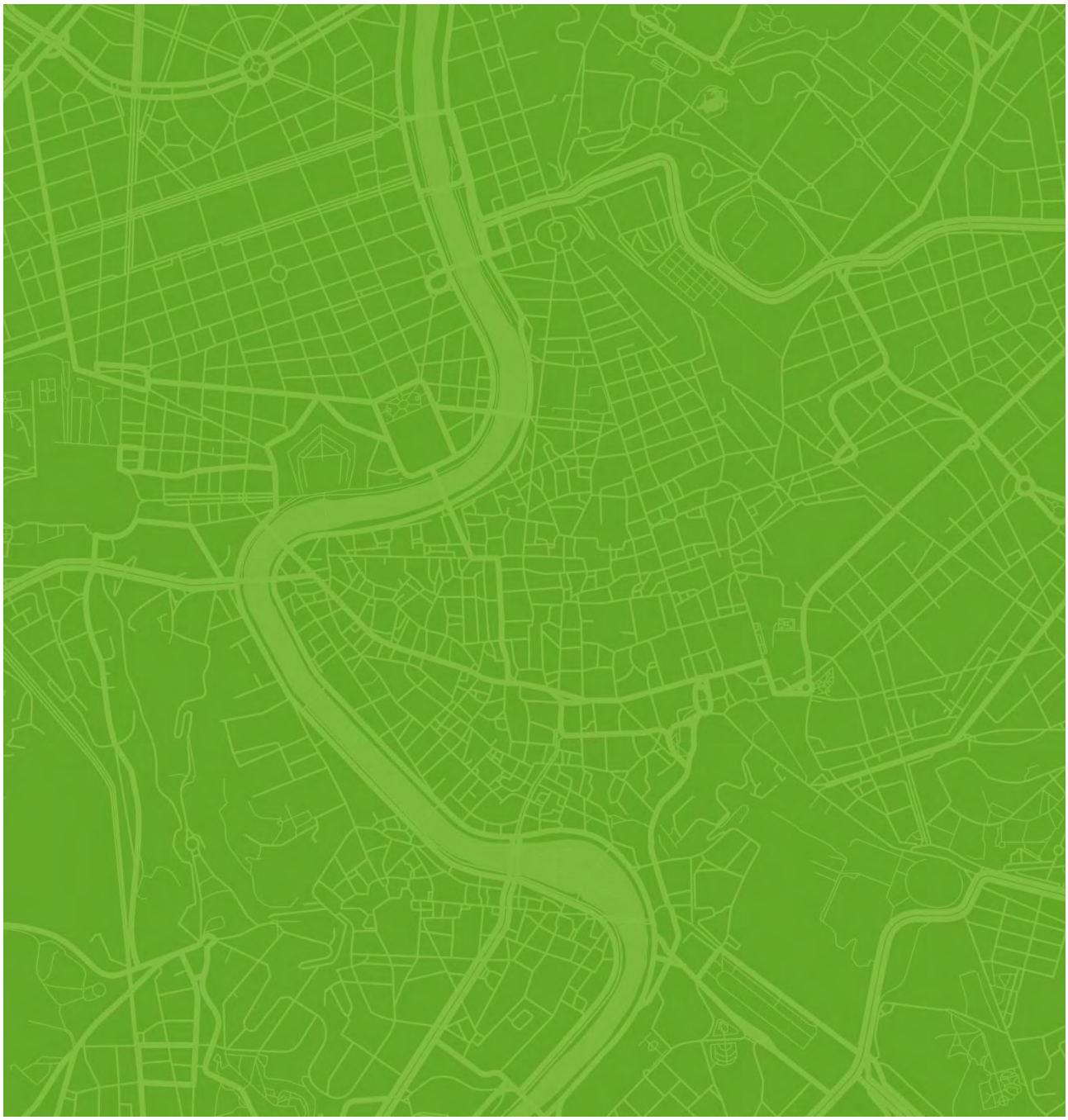
Harborough Council

Climate Change and Renewable Energy Study
Climate Change Risk Assessment

Draft report
Prepared by LUC
September 2024



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Project Number
12482

Version	Status	Prepared	Checked	Approved	Date
1.	Final report	T. Uzuegbunam J. Pearson	T. Uzuegbunam J. Pearson	T. Livingston	26.09.2024

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Land Use Consultants Ltd
Registered in England
Registered number 2549296
Registered office:
250 Waterloo Road
London SE1 8RD

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Contents

Chapter 1
Climate change risk assessment for Harborough District

This chapter sets out a high-level assessment of climate risks for Harborough so that the Council can consider how best to adapt to the impacts of ongoing climate change.

Introduction

1.1 Climate change is already having evident effects on the world. The planet is warming, precipitation patterns are changing, and sea levels are rising. Weather events are becoming less and less predictable, reflecting climate instability and adding increased uncertainty to future planning. Climatic events, such as heatwaves, floods, droughts, and wildfires are having wider effects on human health, ecosystems, and the global economy[1].

1.2 Anticipating and planning for the unavoidable effects of climate change – and climate uncertainty – is as important as reducing carbon emissions. This is known as climate change adaptation, as distinct from climate change mitigation, which is taking action to reduce greenhouse gas emissions. A significant amount of climate change is already locked into the system – the product of emissions over the past 200 years; therefore, climate adaptation is essential even with the most ambitious carbon reduction actions.

1.3 Harborough Council has an important role to play in supporting actions that will increase the resilience of places, communities, and organisations. Development of a new Local Plan for Harborough provides an important opportunity to take a proactive approach to securing climate resilient development and improving the resilience of existing buildings and infrastructure, and this is also being explored within the LUC climate change study and is reported on in a separate report ('Harborough Climate Change and Renewable Energy Study – Policy Review Report').

Structure and methodology

1.4 A high-level assessment has been undertaken to identify the main climate change risks facing Harborough so that the Council can consider how to adapt to these. It has focused on providing information that is particularly relevant to local planning and development.

1.5 The methodology is based on LUC's experience of delivering similar studies for other, including neighbouring, local authorities.

1.6 The climate risk assessment begins by considering the evidence that the District is already experiencing climate change. Past climate trends across England are covered first, followed by those in Harborough. For past climate trends, we drew on authoritative government sources in the form of the most recent (third) UK Climate Change Risk Assessment Summary for England and on Met Office data.

1.7 Having established climate changes that are already happening, the risk assessment then presents climate change projections, first for England, then for the East Midlands and finally some downscaled data

[1] Met Office (undated) Effects of climate change [online] Available at: https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change

for Harborough. For relevant climate change predictions at the national scale, we again drew on authoritative government science in the form of the latest UK Climate Projections from the Met Office, known as UKCP18. We discuss which scenarios we have used from within the Met Office's projections below in the 'Climate change projections and scenarios' sub-section and signpost how these align with relevant practice guidance[2]. For a look at the local level, we used a dataset[3] produced by the Met Office in collaboration with the BBC, to describe the picture in Harborough. Within the limits of the available data, we identify the likely changes to the climate in both the medium-term (2050 for approximate alignment with the Local Plan period) and long-term (2099).

1.8 To provide context for identification of key climate risks, the report then provides a profile of Harborough District and outlines key national planning policy and guidance on climate change adaptation and key local climate change strategies and plans.

1.9 Finally, we identify and discuss the risks that Harborough is likely to face as a result of the expected changes to the climate in relation to:

- health, communities and the built environment;
- infrastructure;
- the natural environment and assets; and
- business and industry.

1.10 The process of risk identification is described in the 'Key climate risks' section. It drew on the information discussed above and on the climate risks identified in the CCC's Third UK Climate Change Risk Assessment (CCRA3)[4].

Past climate trends

Past climate trends in the UK and England

1.11 The UK is typified by an oceanic climate[5] – it experiences a relatively narrow range of temperatures, with cool summers and mild winters and relatively evenly distributed precipitation.

1.12 However, the UK's weather and climate are naturally variable within this range. Cycles of average conditions of the Jet Stream above the North Atlantic can drive significant variations in typical weather patterns over multi-year periods. The Climate Change Committee (CCC) suggests that incorporating this variability into adaptation policies is important due to the following reasons:

- Individual years could still see conditions opposing the long-term average trend.
- The frequency of damaging UK weather patterns may shift due to global climate change.
- Changes in extreme climates may look different to changes in the average climate conditions.

1.13 Table 1.1 below highlights the changes already seen in England's climate since the 1970's.[6]

[2] TCPA, 2023. The Climate Crisis – A Guide for Local Authorities on Planning for Climate Change. Available at: https://www.tcpa.org.uk/wp-content/uploads/2021/11/TCPA-RTPI-Climate-Guide-4th-edition-1.pdf
[3] BBC (2022) What will climate change look like near me?. Available at: https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138. Dataset was a 12km grid square containing Market Harborough Town Centre.
[4] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[5] The UK's oceanic climate falls under the humid temperate climate sub-type known as 'Cfb' in the widely-used Köppen classification of global climate types.
[6] Adapted from Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15

Table 1.1 Changes in England's climate since the 1970s

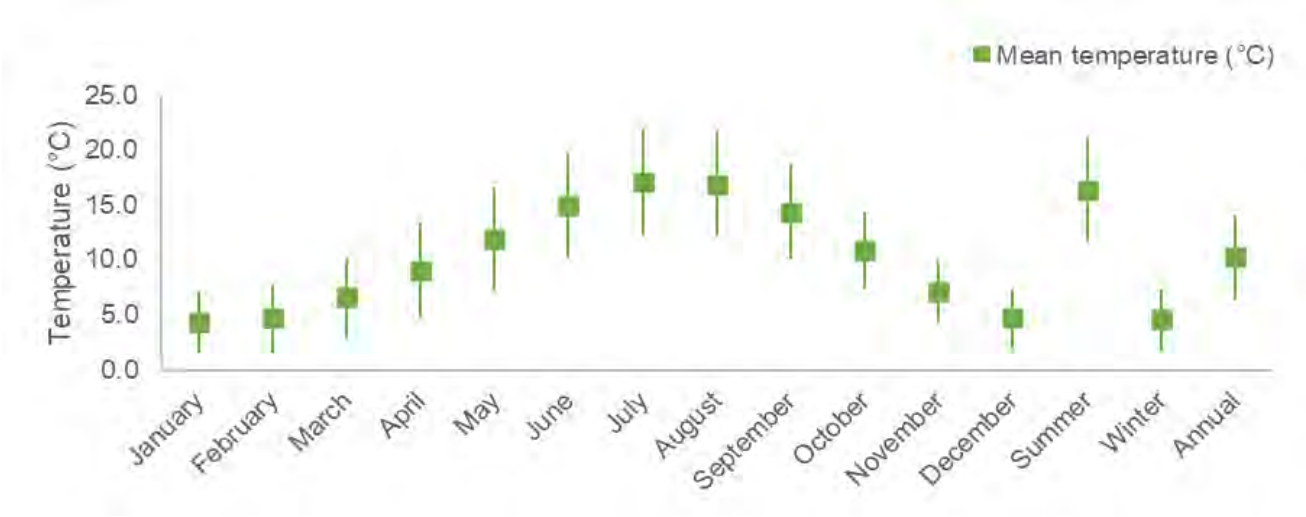
Variable	Observed change in England
Average annual temperature	Increase of 0.9°C from mid-1970s to mid-2010s
Annual mean rainfall	Increase of 4.5% from mid-1970s to mid-2010s
Sunshine	Increase of 9.2% from mid-1970s to mid-2010s
Weather extremes	UK-wide increase in extreme heat events. Little evidence yet on changes in extreme rainfall.

Past climate trends and current climate in Harborough

1.14 The current climate at Harborough has been expressed using 30-year climate averages, between 1991-2020, using data from the nearest climate station at Northampton, Moulton Park[7], 14 miles from Harborough.

1.15 As illustrated in **Figure 1.1**, The mean summer temperature was 16.3ºC while the average maximum and minimum summer temperatures were 21.1ºC and 11.6ºC, respectively[8]. The mean winter temperature was 4.6ºC, while the average maximum and minimum winter temperatures were 7.4ºC and 1.7ºC. The observed change in annual temperatures between 1991 and 2020 is an increase of 0.2°C.

Figure 1.1 Monthly and seasonal mean, maximum, and minimum temperatures climate averages at the climate station

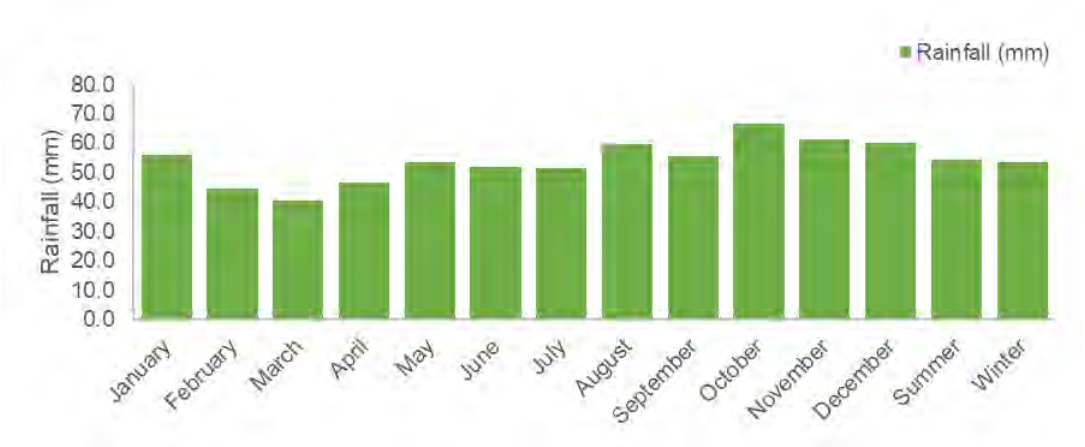


1.16 The average rainfall in Harborough was 54.5 mm in the summer and 53.6 mm in winter, and the average number of days of rainfall was 8.9 in summer and 11.1 in winter (see **Figure 1.2**). The observed change in annual rainfall is an increase of 4.1% between 1991 and 2020.

[7] Met Office; Hollis, D.; McCarthy, M.; Kendon, M.; Legg, T.; Simpson, I. (2018): HadUK-Grid gridded and regional average climate observations for the UK. Centre for Environmental Data Analysis, Available at: http://catalogue.ceda.ac.uk/uuid/4dc8450d889a491ebb20e724debe2dfb

[8] Summer is defined as the months of June, July, and August, and winter is defined as the months of December, January, and February, in meteorological terms. Met Office. Seasons. https://www.metoffice.gov.uk/weather/learn-about/weather/seasons

Figure 1.2 Monthly and seasonal rainfall climate averages at the climate station



1.17 Based on the UK data in the preceding section, it is likely that since the mid-1970s, the climate in Harborough has already changed to a greater extent than these 30-year data show, with a trend towards hotter, drier summers and warmer, wetter winters.

1.18 As already noted, evidence suggests that extreme weather events are becoming frequent and severe in the UK[9]. Harborough has experienced extreme weather events in recent years, including storms, floods, heavy rain, heatwaves, and landslips, leading to infrastructure damage, economic consequences, and potential impacts to health and safety. Examples of such events impacting Harborough are provided in the 'Key climate risks' section in the second part of this chapter.

Climate change projections and scenarios

1.19 The Met Office[10] provides climate change projections for different 'representative concentration pathways' (RCPs) or emissions scenarios through version 18 of the UK Climate model Projections UKCP18.

1.20 The RCPs present projections of how different concentrations of greenhouse gases (GHGs) in the atmosphere from human activities will impact on our climate. The Met Office uses a baseline period of 1981-2000 to maintain consistency across products. The four emissions scenarios range from high (RCP8.5) through to low (RCP2.6) emission scenarios; higher values represent greater effects from GHGs ("radiative forcing"). The numerical values of the RCPs broadly correspond to the projected global temperature rises.

1.21 Data from the UKCP18 projections has been presented based on a high emissions scenario (RCP8.5) and medium emissions scenario (RCP4.5), in line with best practice to account for a worst case scenario. Guidance from the Town and County Planning Association and Royal Town Planning Institute[11] recommends that reasonable worst-case scenarios should be drawn up from climate impact data: *"local planning authorities should consider using 'credible maximum climate change scenarios such as 'High++' when considering particularly vulnerable locations or sensitive development."*

1.22 The high emissions scenario RCP 8.5 represents the most severe scenario; this is generally considered to represent the "high-emission business as usual scenario" if mitigation action is lacking[12], while the medium emissions scenario reflects emissions reductions progress but recognises the emissions output already locked into the system.

[9] Met Office, n.d. What is climate change. https://www.metoffice.gov.uk/weather/climate-change/what-is-climate-change
[10] See the UK Climate Projections (UKCP) website, at https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index
11 The Climate Crisis – a guide for local authorities on planning for climate change (TCPA/RTPI, 2023). https://tcpa.org.uk/resources/the-climate-crisis-a-guide-for-local-authorities-on-planning-for-climate-change/
[12] https://www.carbonbrief.org/explainer-the-high-emissions-rcp8-5-global-warming-scenario/

1.23 The low emissions scenario, RCP2.6, is based on a change in temperature by 2081-2100 of 1.6°C. However, the IPCC reported[13] in 2021 that "global surface temperature was already 1.09°C higher in 2011–2020 than 1850–1900" and in 2023 the UNEP reported that there is "no credible pathway to 1.5°C".[14]

1.24 We therefore assume that RCP 4.5 represents the largest emission reduction pathway that can realistically be achieved assuming immediate, impactful action. As such, **the projected climate is presented for these two scenarios (RCP 4.5 and RCP 8.5) below, so the suite of impacts in each scenario can be understood and planned for by Harborough Council.**

1.25 The analysis uses probability levels to describe the lower and upper limits of change that are considered likely. The 5th percentile marks the lower limit, with change very unlikely to be less than the figure in question. The 95th percentile marks the upper limit, with change very unlikely to exceed the figure in question. The 50th percentile indicates the value that is as likely to occur as not. These probabilities can be useful where decisions have different risk profiles.

England climate change projections[15]

1.26 The most recent climate projections (UKCP18) suggest that, under a high emissions scenario (RCP8.5), by the 2090s average temperatures in England could be over 5°C warmer in summer and over 3°C warmer in winter. Under a medium emissions scenario (RCP4.5), average temperatures in England could be over 3°C warmer in summer and 2°C warmer in winter.

1.27 By the 2050s (around the end of the Local Plan period) average temperatures in England could be over 2°C warmer in summer and over 1°C warmer in winter. Under a medium emissions scenario (RCP4.5), average temperatures in England could be a little under 2°C warmer in summer and 1°C warmer in winter.

1.28 The projections for precipitation suggest that by the 2090s, under a high emissions scenario (RCP8.5), English summers could be 35% drier, while winters could be 20% wetter. Under a medium emissions scenario (RCP4.5), summers could be 23% drier, while winters could be between 12% wetter.

1.29 By the 2050s, under a high emissions scenario (RCP8.5), English summers could be 14% drier, while winters could be 9% wetter. Under a medium emissions scenario (RCP4.5), summers could be 11% drier, while winters could be between 7% wetter.

1.30 Table 1.2 shows these mid-point (50th percentile) projected changes in England temperature and precipitation by 2080-2099 vs. a 1981-2000 baseline. The upper (95th percentile) and lower (5th percentile) limits are also shown to indicate the possible extremes of the projections.

Table 1.2 Projected changes in England mean summer and winter temperatures and precipitation by the 2090s and 2050s

RCP	°C increase in temperature and % increase in precipitation **by 2081-2100**			°C increase in temperature and % increase in precipitation **by 2041-2060**		
	5th percentile	50th percentile	95th percentile	5th percentile	50th percentile	95th percentile
Mean summer temperature						
RCP8.5	+2.1°C	+5.3°C	+8.7°C	+0.7°C	+2.3°C	+4°C
RCP4.5	+1.0°C	+3.2°C	+5.6°C	+0.4°C	+1.7°C	+3.2°C

13 IPCC (2021) Summary for Policymakers: Climate change 2021: The Physical Science Basis. Available at: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf
14 UNEP (2022) Emissions Gap Report. Available at: https://www.unep.org/resources/emissions-gap-report-2022
15 England projections vs. 1981-2000 baseline. UKCP18 Key Results 2022 Spreadsheet. Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/summaries/headline-findings

RCP	°C increase in temperature and % increase in precipitation **by 2081-2100**			°C increase in temperature and % increase in precipitation **by 2041-2060**		
	5th percentile	50th percentile	95th percentile	5th percentile	50th percentile	95th percentile
Mean winter temperature						
RCP8.5	+0.9°C	+3.4°C	+6.2°C	+0.2°C	+1.6°C	+3.1°C
RCP4.5	+0.3°C	+2.0°C	+4.0°C	0°C	+1.2°C	+2.5°C
Mean summer precipitation						
RCP8.5	-66%	-35%	+3%	-41%	-14%	+13%
RCP4.5	-49%	-23%	+2%	-35%	+11%	+12%
Mean winter precipitation						
RCP8.5	-6%	+20%	+54%	-7%	+9%	+27%
RCP4.5	-7%	+12%	+35%	-7%	+7%	+23%

1.31 In summary, it is probable that England will experience hotter, drier summers and warmer, wetter winters. The overall pattern of warming is likely to be accompanied by more frequent episodes of extreme weather, including events such as storms, flooding, drought and unseasonably hot or cold weather.

East Midlands climate change projections[16]

1.32 Climate projections for the East Midlands (the regional projections most relevant to Harborough) show very similar trends to England, as set out in **Table 1.3**.

Table 1.3 Projected changes in East Midlands mean summer and winter temperatures and precipitation by the 2090s and 2050s

RCP	°C increase in temperature and % increase in precipitation **by 2081-2100**			°C increase in temperature and % increase in precipitation **by 2041-2060**		
	5th percentile	50th percentile	95th percentile	5th percentile	50th percentile	95th percentile
Mean summer temperature						
RCP8.5	+2.0°C	+5.2°C	+8.6°C	+0.7°C	+2.3°C	+3.9°C
RCP4.5	+1.0°C	+3.2°C	+5.5°C	+0.4°C	+1.7°C	+3.2°C
Mean winter temperature						

[16] East Midlands projections vs. 1981-2000 baseline. UKCP18 Key Results 2022 Spreadsheet. Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/summaries/headline-findings

RCP	°C increase in temperature and % increase in precipitation **by 2081-2100**			°C increase in temperature and % increase in precipitation **by 2041-2060**		
	5th percentile	50th percentile	95th percentile	5th percentile	50th percentile	95th percentile
RCP8.5	+0.9°C	+3.4°C	+6.2°C	+0.2°C	+1.6°C	+3.1°C
RCP4.5	+0.3°C	+2.0°C	+4.0°C	-0.1°C	+1.2°C	+2.5°C
Mean summer precipitation						
RCP8.5	-71%	-35%	+10%	-47%	-15%	+17%
RCP4.5	-54%	-23%	+7%	40%	-13%	+16%
Mean winter precipitation						
RCP8.5	-6%	+19%	+53%	-7%	+8%	+26%
RCP4.5	-6%	+12%	+34%	-8%	+6%	+22%

1.33 The East Midlands is already one of the driest regions in England and the projections for future summers show even less rainfall. Projected higher summer temperatures together with the requirements of the new housing, required to meet the needs of the growing population, has the potential to increase water demand.

1.34 It is also of note that there is **considerable uncertainty** regarding how precipitation will change into the future under climate change, particularly **summer precipitation**. This uncertainty applies across the world, with projections for most regions for summer precipitation, as opposed to winter, displaying a greater range of potential future outcomes.[17]

1.35 Projections from the Met Office (**Table 1.3**) have a wide range of probable outcomes for summer and winter precipitation in the East Midlands. They indicate that future summers are most likely to be drier but that they could possibly be somewhat wetter. For instance, under the high emission scenario, mean summer precipitation in **Table 1.3** shows that summers in the East Midlands are predicted to be anywhere from 71% drier to 10% wetter[18].

1.36 Uncertainty, as indicated by the range of future outcomes, also grows over time. **Table 1.4** presents projections for precipitation in East Midlands for time periods from the 2030s to the 2080s to demonstrate changes in uncertainty overtime. Whereas the 2030s are expected to see between 38% drier or 21% wetter summers, by 2080-2099, predictions in **Table 1.4** show that summers will be anywhere between 71% drier or 10% wetter.

[17] https://www.carbonbrief.org/explainer-what-climate-models-tell-us-about-future-rainfall/
[18] Where the negative sign represents drier precipitation and positive represent precipitation

Table 1.4 East Midlands high and medium emissions scenario for mean winter and summer precipitation by 2030, 2040 and 2050 and up to 2099

Time period	RCP8.5 5th-95th Percentile	RCP4.5 5th-95th Percentile
Mean winter precipitation		
2030s	6% drier - 21% wetter	6% drier - 18% wetter
2040s	7% drier - 26% wetter	8% drier - 22% wetter
2050s	8% drier - 31% wetter	8% drier - 24% wetter
2080 - 2099	6% drier - 53% wetter	6% drier -34% wetter
Mean summer precipitation		
2030s	38% drier - 21% wetter	33% drier - 20% wetter
2040s	47% drier - 17% wetter	40% drier - 16% wetter
2050s	52% drier - 18% wetter	44% drier - 16% wetter
2080 - 2099	71% drier - 10% wetter	54% drier - 7% wetter

1.37 Despite this uncertainty, we know that in future, across the year as a whole, the East Midlands, as well as the rest of the UK, will experience increased heavy precipitation and prolonged events, particularly during winter, which will result in increased intensity of rainfall (heavy rainfall). This is because, as temperature increases and the atmosphere warms, the atmosphere can hold more moisture, at a rate of about 7% for every degree of warming, which can result in more intense rainfall[19].

1.38 Recent trends also already indicate the occurrence of heavy rainfall. The winters of 2014, 2016 and 2020, recorded the top five wettest winters across England. Similarly, recent trends also indicate the influence of climate changes for extreme precipitation associated with thunderstorms, which are projected to intensify. The Met Office states that in the future, rainfall events exceeding 20mm per hour, which can cause flash flooding, are expected to be four times as frequent by the 2070s compared to the 1980s, under a high emissions scenario[19].

Harborough climate change projections

1.39 Climate projections for Harborough show very similar trends to those for the East Midlands, as set out in **Table 1.5**. Projections for Harborough are available through the Met Office, downscaled from global models to a 25km square grid to cover the entire Harborough District and described using the high (RCP8.5) and medium emission scenarios (RCP4.5), to describe projected temperatures and weather patterns for extremely localised regions.

[19] Met Office, 2024. The influence of climate change on severe weather. The influence of climate change on severe weather | Official blog of the Met Office news team

Table 1.5 Projected changes in Harborough mean summer and winter temperatures and precipitation

RCP	°C increase in temperature and % increase in precipitation by 2081-2100			°C increase in temperature and % increase in precipitation by 2041-2060		
	5th percentile	50th percentile	95th percentile	5th percentile	50th percentile	95th percentile
Mean summer temperature						
RCP8.5	+1.5°C	+5.5°C	+9.8°C	-0.5°C	+2.3°C	+5.3°C
RCP4.5	+0.2°C	+3.3°C	+6.7°C	-0.9	+1.7	+4.4°C
Mean winter temperature						
RCP8.5	+0.3°C	+3.4°C	+6.8°C	-0.7°C	+1.6°C	+4.0°C
RCP4.5	-0.5°C	+2.0°C	+4.7°C	-0.9°C	+1.2°C	+3.4°C
Mean summer precipitation						
RCP8.5	-84%	-43%	+38%	-70%	-20%	+59%
RCP4.5	-76%	-31%	+43%	-67%	-17%	+61%
Mean winter precipitation						
RCP8.5	-28%	+23%	+82%	-31%	+10%	+55%
RCP4.5	-33%	+14%	+65%	-32%	+7%	+51%

1.40 While projections for Harborough follow the same trend as the projections for East Midlands, there are slight variations. For instance by the 2090s, there is an increase of 0.3°C for mean summer temperatures in Harborough compared to East Midlands and no difference for mean winter temperature at the 50th percentiles under the RCP8.5. Similarly, there is a decrease of 8% for mean summer precipitation and an increase of 4% in mean winter temperature at the 50th percentiles under the RCP8.5 scenario. There is greater variation at the 5th and 95th percentiles between the projections for Harborough and the East Midlands.

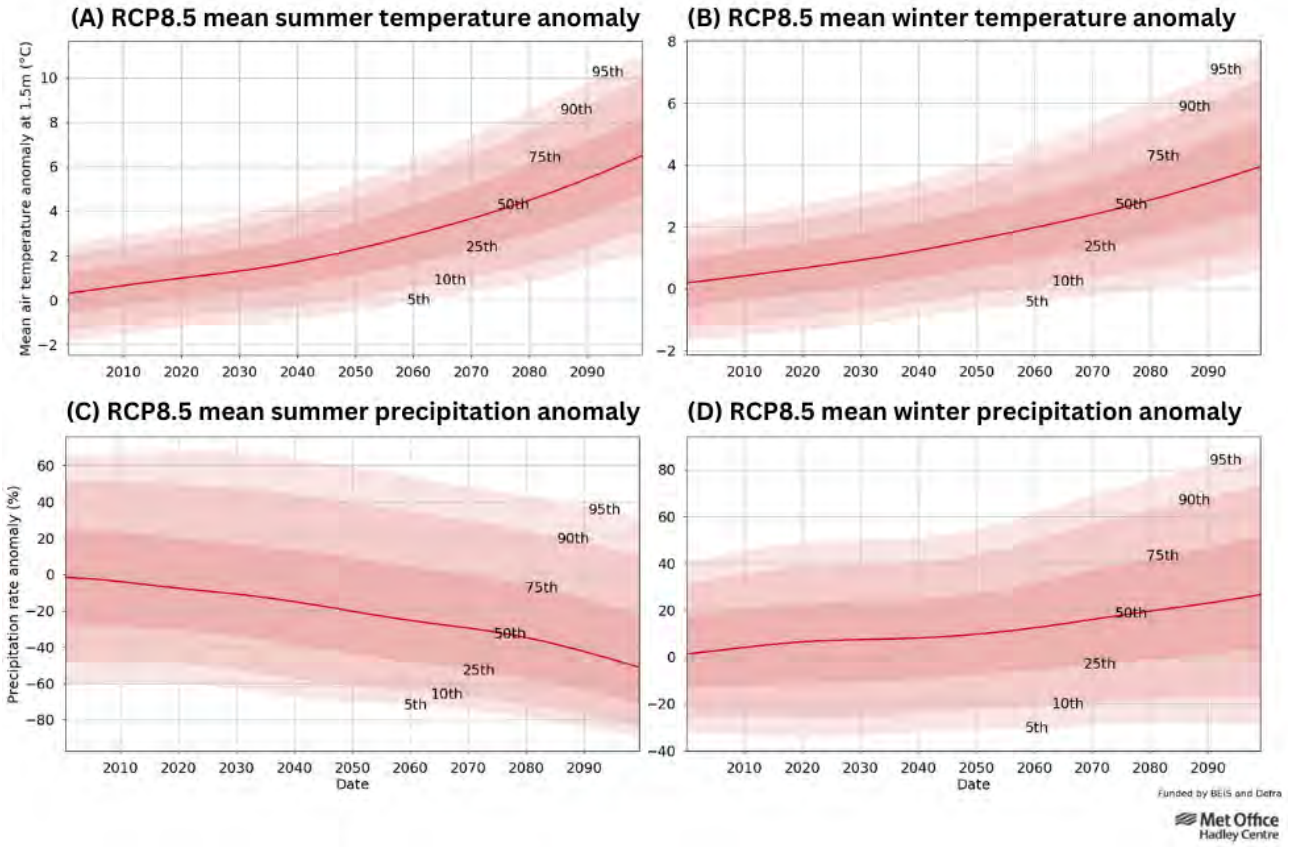
1.41 This is because the higher resolution projections used for Harborough present more physical climate processes than the 60km global projections, such as daily temperature extremes, river catchment flooding, and daily precipitation extremes in winter, to existing processes within the global resolution[20]. As such, some variation is expected as higher resolutions are able to present a better understanding for climate change at smaller scales (such as district scale rather than regional or UK scale). Higher resolution projections therefore typically present a greater range of variations from the mean percentiles, presenting a broader range of future outcomes, as seen in the Harborough projections. This means that HDC will need to take into account the potential for these higher extremes in temperature and precipitation to occur in the district when considering climate mitigation and adaptation policies for the new Local Plan.

[20] Met Office, 2021. UKCP Guidance: Data availability, access and formats. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18_data_availability_jul-2021.pdf

1.42 It should also be noted that the finer model used to produce the higher resolution projections do not necessarily provide greater confidence as the process of generating model data at higher spatial and/or temporal resolution adds detail but also increases the level of uncertainty[20].

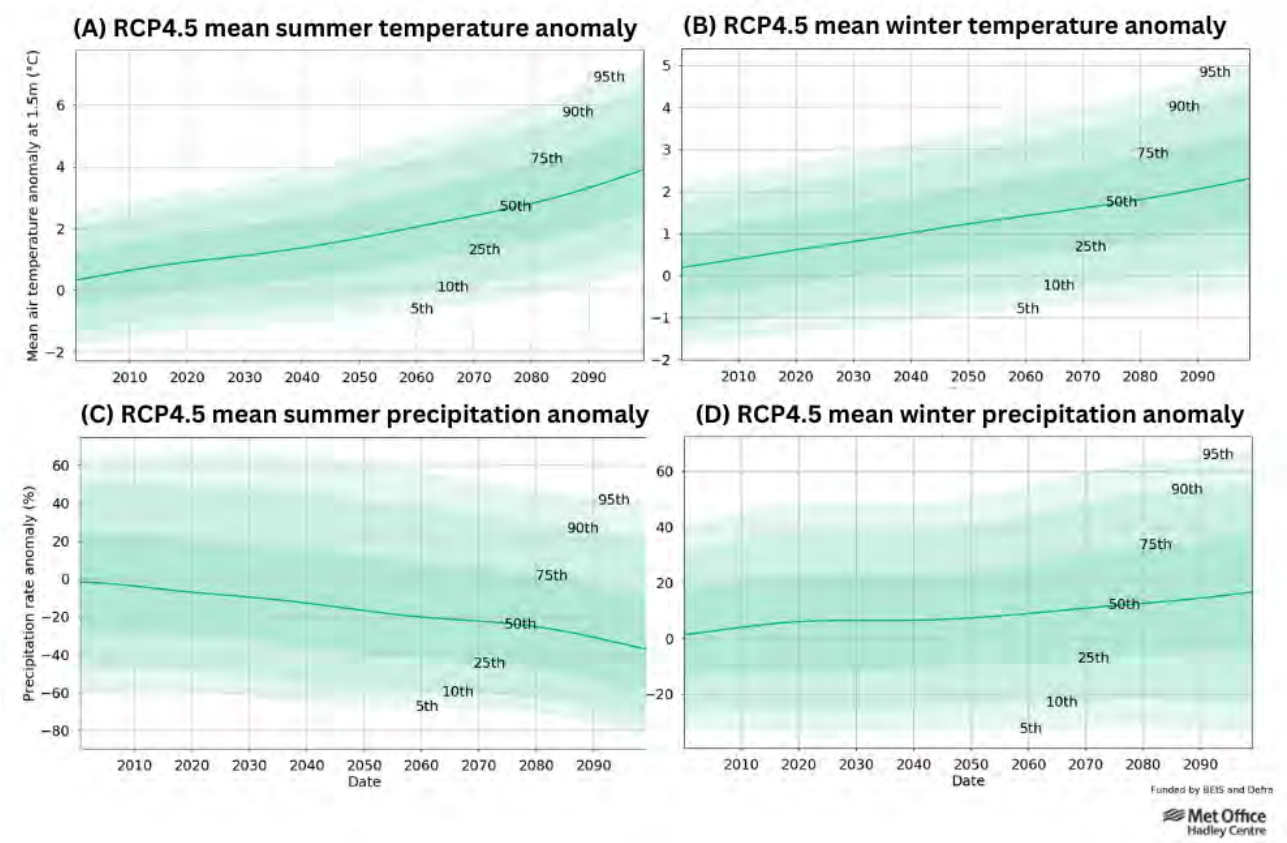
The graphs in **Figures 1.3 to 1.4** provide a visual representation of the projected changes in Harborough, adapted from the UK Climate Projections UKCP18 website[21].

Figure 1.3 Mean summer (A) and winter (B) temperature anomaly, and mean summer (C) and winter (D) precipitation anomaly 25km probabilistic projections, over Harborough. Between 2000-2099 for RCP8.5, using a 1981-2000 baseline and showing the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles.



[21] Available under Open Government Licence. http://www.nationalarchives.gov.uk/doc/open-government-licence/

Figure 1.4 Mean summer (A) and winter (B) temperature anomaly, and mean summer (C) and winter (D) precipitation anomaly 25km probabilistic projections, over Harborough. Between 2000-2099 for RCP4.5, using a 1981-2000 baseline and showing the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles.



1.43 Projections for future summers in Harborough show an even greater reduction in rainfall and increase in temperatures than for the East Midlands, which could have similar implications for increased water demand.

1.44 With regards to **future winters** in Harborough, the projections show that these are **expected to be warmer** under both a medium (RCP4.5) and high (RCP8.5) emissions scenario and throughout the possible range of probabilities. Winters in the Harborough are **also likely to become wetter** under the mid-point (50th percentile) projection for both medium and high-emissions scenarios. By the end of the century, Harborough could be as much as 82% wetter in winter vs. the 1981-2000 baseline under a high emissions scenario.

1.45 As previously stated, there is considerable uncertainty regarding how precipitation will change into the future under climate change. This is particularly important as higher resolution projections, such as provided to cover the Harborough District, typically present a wider range of uncertainty compared to low resolution projections. In addition, this uncertainty grows as we project further into the future, as demonstrated in **Table 1.5**.

1.46 The BBC has collaborated with the Met Office to present UKCP projections downscaled to a 12km square grid. This uses the high emissions scenario (RCP8.5), to describe projected temperatures and weather patterns for extremely localised regions against actual, average weather data for 1991-2019.[22] The data indicates that Harborough's climate change scenarios are similar to those of the East Midlands, above. The data discussed below and set out in **Table 1.6** are based on a 12km grid square containing Market Harborough town centre.

1.47 The hottest summer day in this 30 year baseline period in the locality was 36.1°C. It is estimated that if average global temperatures increase by 2°C above pre-industrial levels, the hottest summer day in

Harborough could increase to 37.9°C and if global temperatures rise by 4°C, it could reach 42.0°C. The projected increases in the warmest winter days are smaller, as shown in **Table 1.6**.

1.48 Within the past 30 summers, on average there were 5 days per month above 25°C in Harborough. However, it is predicted that if average global temperatures rise by 2°C, there could be 10 summer days a month above 25°C in Harborough. With a 4°C global temperature rise, there could be up to 19 days summer days per month above 25°C in Harborough.

1.49 In the past 30 years, on average there were 8 rainy days per summer month in Harborough. If global temperatures increased by 2°C, rainy days may decrease to 7 days per summer month. With a 4°C global temperature increase, there could be as few as 5 days of rain per summer month in Harborough. The average number of rainy days per month in winter is not projected to change under climate change, as shown in **Table 1.6**.

1.50 On the wettest summer day of the past 30 years, 43mm of rain fell in Harborough. At a 2°C global temperature rise, rainfall could increase up to 44mm. And at a 4°C rise, it could be about 51mm, which is 18% more than now. Similarly, there is projected to be a significant increase in the amount of rain falling on the wettest winter day under climate change, as show in **Table 1.6**.

1.51 These trends reflect the trends predicted for England and show that Harborough is also likely to experience on average, hotter, drier summers and warmer, wetter winters.

Table 1.6 Harborough's observed past and projected future summer and winter temperature and rainfall

	Past 30 years (1991-2019)	2°C global increase	4°C global increase
Hottest summer day (°C)	36.1	37.9	42.0
Hottest winter day (°C)	18.3	19.0	20.7
Average summer days per month above 25°C	5	10	19
Average rainy days per month in summer	8	7	5
Average rainy days per month in winter	10	10	10
Wettest summer day (mm rain)	43	44	51
Wettest winter day (mm rain)	31	33	0

Context

To help inform identification of key climate risks, this section provides a profile of Harborough District and outlines key national planning policy and guidance on climate change adaptation and key local climate change strategies and plans.

Profile of Harborough District

1.52 The following profile is reproduced from the Harborough District Climate Emergency Action Plan 2021, updated where possible using data from the 2021 Census.

Harborough District

Harborough District is a mainly rural district covering an area of 238 square miles of South and East Leicestershire. It is within the East Midlands Region, bordering Warwickshire to the West, Northamptonshire to the South and Rutland to the East. The district's population is estimated as 97,625

in 2021[23]. The population is split between the two market towns of Market Harborough and Lutterworth, large villages of Broughton Astley, Great Glen, Kibworth and Fleckney, and the settlements Bushby, Thurnby and Scraptoft, which part of Leicester's Principal Urban Area. The remaining population live in the smaller rural settlements, many of which have a population of less than 500 (see **Figure 1.5**).

The district is generally affluent, and people are generally healthier than the England average[24]. The district has an ageing population; this trend is expected to grow over the next few years to 2030. Housing in the district is made up of a higher proportion of detached homes than the England average. Homes also tend to be larger, and many properties were built before 1900.

Most companies in the district are small and medium enterprises (SMEs) and have smaller numbers of employees. The exception to this is the logistics hub around Magna Park close to Lutterworth. Many residents in the district commute to nearby larger cities and towns for employment.

Harborough is relatively poor in biodiversity and geodiversity terms. 1.21% of the district's area is covered by Sites of Special Scientific Interest (SSSI) while a further 0.42% is covered by Local Wildlife Site (LWS) designations. There are several SSSIs in the East of the district protecting the remains of ancient woodland which are of high nature conservation, landscape and historical importance. The district has one geological SSSI, the Tilton Railway Cutting. The total area of woodland is 2,497ha or 4.21% of the district compared to 10% in England.[25]

Figure 1.5 Map of Harborough district showing main settlements

[23] https://www.nomisweb.co.uk/sources/census_2021/report?compare=E07000131
[24] https://www.localhealth.org.uk/#bbox=434253,314436,66088,41119&c=indicator&view=map7 published 2019
[25] Harborough Local Plan 2011 -2031 Adopted Local Plan | Harborough Local Plan 2011-2031 | Harborough District Council

National planning policy and planning practice guidance on climate change adaptation

1.53 The NPPF[26] makes clear that local plans "should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for **flood risk**, coastal change, **water supply**, **biodiversity** and landscapes, and the **risk of overheating** from rising temperatures. Policies should support appropriate measures to ensure the future **resilience of communities and infrastructure** to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure." (paragraph 158; bold added for emphasis). This covers many of the key risks highlighted in the CCRA3, confirming that LPAs have a role in addressing these through the planning process.

1.54 With respect to climate change adaptation, the NPPF gives greatest coverage to flood risk management. For example, it highlights that strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources (para 166); and that all plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property (para 167). Also note that, regarding health and social care delivery, the NPPF (Annex 3) classifies non-residential uses for health services (as well as nurseries and educational establishments) as "more vulnerable" to flood risk (the most vulnerable development types should be located in the lowest flood risk zones). Extensive further guidance is provided in the Planning Practice Guidance.

1.55 The Planning Practice Guidance on climate change[27] provides further advice on planning for climate change adaptation. For example, it highlights the need to:

- consider availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality;
- maximise summer cooling through natural ventilation of buildings and avoiding solar gain; and
- provide multi-functional green infrastructure to reduce urban heat islands, manage flooding and help species adapt to climate change.

The Net Zero Leicestershire Strategy 2023-2045

1.56 The Strategy confirms this report's analysis (above) that Leicestershire is likely to experience hotter, drier summers and warmer, wetter winters.

1.57 It notes that as a rural county, Leicestershire's vulnerability to climate change is heightened in some ways, for example by a greater need for travel and high levels of agricultural land use.

1.58 Climate risks described for Leicestershire relate to:

- Transport networks
- The built environment
- The natural environment and agriculture
- Business and industry
- Water (flood risk and drought)
- Health and wellbeing

1.59 All of these topics are covered in this report's analysis (below) of the key climate risks facing Harborough.

Harborough Local Plan 2011-2031

1.60 Harborough's adopted Local Plan identifies the following key climate change issues:

[26] DLUHC (2023) National Planning Policy Framework
[27] DLUHC (2019) Climate Change available at: https://www.gov.uk/guidance/climate-change

- Addressing the risk of flooding from rivers, surface water and groundwater to both new development and established communities through the location of new development and ensuring green infrastructure includes sustainable drainage systems (SuDs) that also contribute to improved water quality in the District's watercourses and biodiversity improvements.
- Ensuring that the District is resilient to changes in climate by encouraging building design that minimises carbon emissions through maximising use of renewable energy and connections to decentralised networks, stores and reuses rainwater, remains comfortable in hot and cold weather, and is resilient to the increasing risk of flooding from any source.

Harborough Climate Emergency Action Plan 2022-30

1.61 The Action plan describes climate change adaption actions taken in the District at the time of publication in 2021, namely:

- Establishment of emergency procedures, for example in relation to flooding and close working with parish councils.
- Working with the Welland River Trust, Soar Catchment Partnership and Grand Union Canal Partnership, for example in relation to a project to encourage land management practices in the upper Welland catchment to reduce the run-off from agricultural land.
- Inclusion in the currently adopted Local Plan of policies in relation to climate change resilient design in new development.

1.62 The Action plan identifies seven areas as having the greatest potential for climate change action in the District, of which work with the Environment Agency on a natural flood management pilot in the upper Soar relates to adaptation rather than mitigation. The Action Plan also identifies six key climate change commitments where the Council can act, those relating explicitly to adaptation being:

- Working with residents, communities and businesses to help them increase their resilience to the impacts of climate change.
- Ensuring that new development is designed to be resilient to the impacts of climate change.
- Working in partnership to promote resilient natural systems that will help to reduce the impacts of climate change.

Key climate risks

1.63 Harborough faces a wide variety of risks as a result of the likely changes to the climate discussed above. These risks include threats to individuals and communities, the economy and the environment and emerge both from changes to the local climate as well as from changes to the climate across the UK and overseas.

1.64 The 'Maps' section below contains the mapping work conducted to inform this risk assessment. **Figures A-H** are explored and referred to throughout the text to inform our analysis.

Approach to identifying key climate risks

1.65 To identify Harborough's key climate risks, we used as a starting point all of the climate risks identified in the CCC's Third UK Climate Change Risk Assessment (CCRA3)[28]. Appendix A reproduces the full array of climate-related risks identified by the CCC for England (or for the UK where it was not possible for the CCC to differentiate between the UK nations). The list of risks was arrived at by the CCC through extensive consultation, with the aim of identifying a set of direct relevance to UK Government bodies. Appendix A also indicates the CCC's estimates of the magnitude of each climate impact ('low', 'medium', or 'high') in the

[28] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15

present day and in 2050 under pathways of 2°C or 4°C global warming. The prioritisation assigned to each risk by the CCC included consideration of the urgency of further adaptation action, taking into account:

- The current and future impact magnitude.
- Whether current Government and non-governmental adaptation commitments suggest that the risk will be adequately managed.
- Whether further adaptation action over the next five years would be likely to provide benefits.

1.66 For the more urgent risks, the CCC then considered whether key, UK-wide policy opportunities for adaptation action exist in the next two years.

1.67 Using the long list of climate risks in Appendix A as a starting point, we then made a qualitative assessment of which of these are likely to be most relevant to Harborough District. In making this assessment, we considered the following:

- The climate change adaptation issues that national planning policy and related planning practice guidance suggest local plans should consider and those identified in the adopted Harborough Local Plan (see 'Context' section above).
- The Net Zero Leicestershire Strategy 2023-2045 (see 'Context' section above).
- Harborough Climate Emergency Action Plan 2022-30 (see 'Context' section above).
- Social, economic and environmental conditions in Harborough (see District profile in 'Context' section above and also outlined where relevant throughout the 'Key climate risks facing Harborough' section below, for example the Strategic Flood Risk Assessment[29] and vulnerability maps produced by Climate Just). This information also helped us to rule out certain risks that are unlikely to be relevant or unlikely to be significant in the District, for example risks relating to marine or coastal receptors.
- The risk magnitude predicted by CCRA3 at a national scale in 2050 under 2 degrees and 4 degrees of warming (see Appendix A).
- The climate projections for East Midlands and Harborough District (see 'Climate change projections and scenarios' section above). This ruled out certain risks related to extremes of current temperature and temperature change that are forecasted to occur.
- The fact that a climate risk listed in Appendix A has been excluded from our analysis below does not mean that Harborough District will not face that risk. Instead, it indicates that the risk is judged to be of relatively low significance for local policy making in the District in light of the factors outlined above.

Key climate risks facing Harborough

1.68 The approach described above led us to identify the key climate risks for Harborough District set out in **Table 1.7**. Each of these is then discussed in the following sections.

Table 1.7 Table 1.7: Summary of key climate risks facing Harborough

Receptors	Nature of Risk			
	Flooding	Changing temperatures	Water stress, shortage	Storms
Health, Communities and the Built Environment: health and wellbeing, people, communities, buildings, cultural heritage, health and social care delivery				
Risks to people, communities and buildings from flooding	✓			

[29] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report

Receptors	Nature of Risk			
	Flooding	Changing temperatures	Water stress, shortage	Storms
Risks to the historic environment	✓	✓		✓
Risks to health and well-being and household energy demand from high temperatures		✓		
Risks to health and social care delivery		✓	✓	✓
Risks to household water supply			✓	
Infrastructure: water, energy, and transport, and ICT				
Risks to infrastructure from flooding	✓			
Risks to energy and transport infrastructure from extreme weather		✓		✓
Natural Environment and Assets: terrestrial and freshwater species and habitats, soils and agriculture				
Risks to terrestrial species and habitats from changing climatic conditions and extreme events	✓	✓	✓	✓
Risks to agricultural productivity from extreme events, changing climatic conditions and flooding	✓	✓	✓	✓
Risks to freshwater species and habitats from changing climatic conditions and extreme events	✓	✓	✓	
Risk to soils from changing climatic conditions, including seasonal aridity and wetness		✓	✓	✓
Risks to carbon stores and carbon sequestration from changing climatic conditions		✓	✓	
Risks to terrestrial and freshwater habitats and species, and agriculture from pests, pathogens and invasive species		✓		
Risks from climate change to landscape character		✓		✓
Business and Industry: businesses, employees, finance, insurance and trade (N.B. risks to agriculture/ food production are indicated under Natural Environment and Assets above)				
Risk to businesses from flooding	✓			
Risk to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments		✓		

Health, communities and the built environment

1.69 This section discusses the key climate change risks to the health and well-being of Harborough's communities and to its built environment.

Risk to health and well-being and household energy demand from high temperatures

1.70 Spells of extremely hot weather can negatively affect people's health and can also increase the risk of accidents and affect maternal health and mental health.[30] For example, the 2022 heatwave raised concerns for vulnerable people in Harborough[31] and the 2023 September heatwave lead to daily maximum temperatures exceeding 30°C across most of England[32]. As highlighted in the 'Climate change projections and scenarios' section above, average temperatures are set to rise in both winter and summer and days of extreme summer heat will become more frequent in Harborough.

1.71 As noted in the 'Risk to health, well-being, and productivity from flooding' section, the proportion of Harborough's population aged 65 and over is also projected to increase. Older people are particularly vulnerable to high temperatures with a range of illnesses common to older people likely to be triggered by the highest temperatures. Taken together, these factors will place increasing pressure on local health and care systems.

1.72 Planning-related factors that exacerbate the risks in relation to overheating include inadequate insulation and ventilation of homes, as well as nearby tree cover providing shading of homes and streets. Overheating of people's homes may also result in significantly increased summer energy demand as they may respond by running portable air conditioning units which consume large amounts of electricity.

1.73 Figure F Socio-spatial Heat Vulnerability Index (SHVI), as produced by Climate Just, indicates how the personal, social, and environmental factors which help to explain uneven impacts on people and communities come together in particular neighbourhoods. The map is derived from the following five dimensions of socio-spatial vulnerability:

1. Sensitivity e.g. due to age profile of population
2. Enhanced Exposure e.g. due to amount of built-up area
3. Ability to Prepare e.g. due to income
4. Ability to Respond e.g. due to mobility
5. Ability to Recover e.g. due to personal and community networks

1.74 These five dimensions of socio-spatial vulnerability are underpinned by a variety of personal, environmental and social factors underpinning the social vulnerability of people and places. A list of the vulnerability factors included in the heat vulnerability work, is available on the Climate Just website[33].

1.75 The map indicates that while most of Harborough District has 'Extremely low' socio-spatial vulnerability to heat-related hazard, some neighbourhoods in Market Harborough have 'Relatively high' social vulnerability to overheating. **This suggests that measures to manage peak temperatures and overheating risk, such as the introduction of street trees and other green infrastructure and building design features such as solar shading and increased ventilation, should be targeted/prioritised in these urban neighbourhoods and in buildings designed for children (e.g. schools; nurseries) and older people (e.g. retirement homes) as these age groups are more vulnerable to heat stress. Policies for site allocations in such areas could highlight the need to integrate such features.**

Risk to people, communities and buildings from flooding

1.76 Harborough is subject to a number of different sources of flood risk: rivers (fluvial); surface and rainwater (pluvial); and groundwater. The current extent of each of these in Harborough and the likely impacts of climate change are explored below.

[30] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS1
[31] HFM, 2022. Emergency Services Meet Over impact of Heatwave. https://harboroughfm.co.uk/emergency-services-meet-over-impact-of-heatwave/
[32] Met Office, 2024. Past Weather Events. https://www.metoffice.gov.uk/weather/learn-about/past-uk-weather-events
[33] See Table 2: Domains associated with heat socio-spatial vulnerability. Available from https://www.climatejust.org.uk/messages/user-guide-map-tool#Core

1.77 River flooding occurs when river levels rise, overtop the banks, and inundate neighbouring land. The Environment Agency produces maps showing flood zones that have different probabilities of river (or sea) flooding. These maps show the current likelihood and potential extent of river flooding, assuming no flood defences are in place. **Figure B** shows the distribution of flood zones 2 and 3 across Harborough. Zone 2 indicates land with a medium probability of flooding (between a 1% and 0.1% annual probability of river flooding) and Zone 3 indicates land with a high probability of flooding (a 1% or greater annual probability of river flooding). Most of the areas of river flood risk in the District are associated with rivers, stream and lakes in the Soar catchment (northern part of District, including the River Sence at Great Glen), or the Welland Upper catchment (southern part of the District, including the River Welland at Market Harborough and continuing downstream along the southern boundary of the District around East Langton, Sutton Basset, Weston by Welland, Welham and Bringhurst), with smaller areas of flood risk in the south-west of the District in the River Avon catchment (e.g. to the south of North Kilworth and South Kilworth)[34].

1.78 River flooding after heavy rain has already been an issue in Harborough in recent times, for example the 2016 flooding event which caused major disruptions across the District, including road closures and stuck vehicles.[35] Areas with a history of river or groundwater flooding over a longer period drawn from the Environment Agency's Historic Flood Map are reproduced in the SFRA[36] and broadly correspond with the Flood Zone 3 areas shown in **Figure B**. The increases in winter rainfall and in the frequency of intense rainfall events expected in Harborough as a result of climate change mean that the risk of river flooding to adjacent land is likely to increase. The Environment Agency estimates that peak flows in rivers across the Soar catchment could increase by an additional 16% by the 2050s and 28% by the 2080s as a result of climate change. Peak river flows in the Welland catchment are predicted to increase by 4% by the 2030s and 17% by the 2080s.[37] The SFRA identifies areas in the District where the risk of flooding from rivers is most sensitive to climate change – Great Glen, Market Harborough, Medbourne, Kibworth Beauchamp and Great Easton.[38]

1.79 Surface water flooding occurs when the volume of rainfall exceeds the capacity of drainage systems and infiltration into the land, so that it flows over the land surface. Surface water flooding can be increased by intense rainfall, saturated land, and an increase in hard or impermeable surfaces.[39] Surface water flooding is likely to be most pronounced in urban areas where opportunities for water to infiltrate into the ground are fewer. Harborough has a history of surface water flooding, for example at Kibworth Harcourt and Kibworth Beauchamp in July 2021, when four homes, a care home and two schools experienced internal flooding and other residents reported external flooding[40]. Recent incidents of surface water flooding are also recorded for Market Harborough in the Environment Agency's Anglian Flood Risk Management Plan 2021-2027. This also identifies the town as having a 'nationally significant' level of flood risk from surface water.[41] Surface water flooding is also a growing issue in rural areas where it can be associated with soil erosion from fields as well as flooding of transport and other infrastructure. The current likelihood and potential extent of surface water flood risk in Harborough, as identified by the Environment Agency, is shown in **Figure B**. This map indicates that the areas at risk of surface water flooding in the District broadly align with those at risk of river flooding.

1.80 As noted in the preceding section, extreme rainfall events are expected to become more frequent in Harborough with climate change and winter rainfall is expected to increase. In addition, the hotter, drier summers expected in Harborough in summer can cause soils to become baked dry so that rainwater is unable to infiltrate through the hard soil. These climate change effects together with an increase in impermeable surfaces because of development are likely to combine to increase surface water flood risk in Harborough. The SFRA identifies areas in the District where the risk of flooding from surface water is most

[34] Defra (2023) Catchment Data Explorer. Available at: https://environment.data.gov.uk/catchment-planning
[35] https://www.harboroughmail.co.uk/news/pictures-and-video-flooding-causes-disruption-across-the-harborough-district-789291
[36] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[37] Central allowances per Environment Agency (2022) Peak river flow climate change allowances by management catchment. [online] Available at: https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment
[38] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[39] The Flood Hub (2018) Blog: Surface Water Flooding: All You Need to Know. Available at: https://thefloodhub.co.uk/surface-water-flooding-all-you-need-to-know/#:~:text=Surface%20water%20flooding%20is%20also,instead%20flows%20over%20the%20land.
[40] Leicestershire County Council Section 19 incidents reported in JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[41] Environment Agency (2022) Anglian River Basin District Flood Risk Management Plan 2021 to 2027

sensitive to climate change – a number of roads in Medbourne, Great Glen, Kibworth Beauchamp, Market Harborough, Lutterworth and Broughton Astley.[42]

1.81 Groundwater flooding occurs when the groundwater table rises to levels significantly higher than normal. Groundwater is affected by extremes in the weather. Periods of abnormally high rainfall can result in groundwater flooding of basements and the emergence of groundwater at the ground surface, causing damage to property and infrastructure.[43] The majority of the District is identified by the SFRA as being at negligible risk of groundwater flooding. Areas with the shallowest groundwater levels are generally situated close to sections of watercourses throughout the District. The highest groundwater flood risk areas, where levels are either at or very near (within 0.025m of) the ground surface, are most prominent along the Rivers Welland and Jordan at Market Harborough, the River Avon at South Kilworth, and the River Soar at Claybrooke Magna.[44] Since extreme rainfall events are expected to become more frequent in Harborough under climate change, the risk of groundwater flooding is likely to increase. The SFRA reports that it is not possible to identify the areas of the District where groundwater flood risk is most sensitive to climate change.[45]

1.82 In conclusion, all types of flood risk in Harborough are likely to increase as a result of climate change. This can negatively affect people, communities, and buildings. Residents' homes can be directly impacted by flooding and the associated stress can negatively impact their wellbeing. Flooding may also present structural problems for buildings in the District, depending on their design, use and layout. There may also be indirect effects even where buildings are above flood level if access routes are cut off.

1.83 The risks associated with flooding increase for vulnerable and older people. Moreover, areas with the highest population density (urban areas) often coincide with a higher risk of flooding due to the historic importance of rivers in settlement growth[46], resulting in a higher number of people being subject to flooding risk.

1.84 The index of multiple deprivation shown in **Figure C** illustrates areas with the highest rates of multiple deprivation. Some of the neighbourhoods with the highest rates of multiple deprivation are in Market Harborough and these also have high population density and contain river corridors that have higher risks of flooding. The Neighbourhood Flood Vulnerability Index (NFVI) map, published by Climate Just[47], presented in **Figure D** shows the geography of social vulnerability of neighbourhoods across the District, should a flood occur.

1.85 NFVI is made up of five characteristics of vulnerability as outlined by Climate Just:

1. Susceptibility -– predisposition of an individual to experience a loss of well-being when exposed to a flood. The elderly and very young are generally more susceptible to flooding.
2. Ability to prepare -– an individual's ability to prepare is influenced by their income, capacity to act, local knowledge and property tenure.
3. Ability to respond – the degree to which an individual can respond to a flooding event. An individual's ability to respond can be influenced by their income, capacity to access and use formal and informal information, local knowledge, and physical mobility.
4. Ability to recover – the extent to which an individual can recover from a flood event. This is influenced by income, capacity to use information, and physical mobility.
5. Community support – the capacity of the emergency services in the region along with broader care and social services. The following characteristics are considered to gauge the nature of this support: housing characteristics; the collective experience of past floods; the likely availability of community

[42] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[43] British Geological Survey (no date) Groundwater extremes, climate change and resilience. Available at: https://www.bgs.ac.uk/geology-projects/groundwater-research/resilience/
[44] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[45] JBA Consulting (2024) Harborough District Council Level 1 Strategic Flood Risk Assessment Draft Report
[46] The existence of a ford and later a bridge over the River Welland was an important contributor the town's growth. See https://www.british-history.ac.uk/vch/leics/vol5/pp133-153#h3-s4
[47] https://www.climatejust.org.uk/map

services in a flood (including emergency service providers, schools, GPs, care homes); and the social networks that exist.

1.86 From **Figure D** we can see that areas of 'UK average' social vulnerability in the NFVI are found at Market Harborough, Lutterworth and Kibworth Harcourt with the centre of Market Harborough having 'Relatively high' social vulnerability. There is some correspondence with areas of IMD from **Figure C**. In particular, the neighbourhood of Market Harborough with a 'relatively high' NFVI also has the highest multiple deprivation in the District. Most of the rest of the District has 'relatively low' social vulnerability with pockets of 'very low' social vulnerability at Market Harborough and Broughton Astley

1.87 The level of Social Flood Risk Index (SFRI) at a neighbourhood scale is a measure of geographic flood disadvantage (i.e. where social vulnerability and exposure to flooding coincide). The SFRI river flood risk maps (**Figures E1** and **E2)** do not identify any areas of high or very high risk in the District for the 'present day' or in the '2050s 2°C scenario'. Instead, most of the District has lower than UK average risk or no exposed population. This would suggest that the District does not have neighbourhoods where large numbers of the most vulnerable people are exposed to river flood risk.

1.88 Older people can be more vulnerable to flooding, as their ability to prepare and respond may be constrained because of, for example, ill health, restricted mobility, or lack of finances. In 2021, people aged 65 and over accounted for approximately 22% of Harborough's population[48]; this is projected to increase to approximately 28% by 2043, thereby increasing susceptibility to flood risk.[49]

1.89 The Social Flood Risk Index surface water maps (**Figures E3** and **E4**) also show that most of the District has lower than UK average risk. However, 'high', 'acute' or 'extreme' risk is identified across much of Market Harborough for the 'present day', with these areas having even higher risk ratings for the '2050s 2°C scenario'. This indicates that while most of the District does not have neighbourhoods where large numbers of the most vulnerable people are exposed to surface water flood risk, urban Market Harborough does have such neighbourhoods.

1.90 Opportunities exist for local planning policies in Harborough to reduce flood risk, including by steering new development away from current and future flood risk areas, using the correct application of the Sequential Test and Exception Test, implementing flood defences and natural flood management techniques and ensuring good practice design guidance is adhered to. Policy can also provide strong support for sustainable drainage systems in new development. Policy may seek to prioritise the neighbourhoods in Market Harborough where large numbers of the most vulnerable people are exposed to river or surface water flood risk under climate change, for example by requiring higher standards in those areas.

Risks to household water supply

1.91 The reduced summer rainfall coupled with higher summer temperatures expected in Harborough under climate change could reduce water available to abstract for public water supply to homes. This may be exacerbated by the projected increasing summer temperatures and frequency and intensity of very hot days causing rising demand for water. Water demand is also likely to rise with increases in the resident population and economic growth.

1.92 The water supply for the District is mainly provided by Severn Trent Water with a small part of the east of the District served by Anglian Water. Harborough falls within Severn Trent's 'Strategic Grid' water resource zone (WRZ). Its draft Water Resource Management Plan (WRMP) 2024 identifies that due to a variety of environmental, regulatory, and demographic factors, the Strategic Grid WRZ is projected to be in supply deficit (i.e. demand exceeds supply) by 2029-30 with this deficit rapidly increasing year on year in the absence of supply and demand interventions.[50] The draft Water Cycle Study (WCS) compares the 19%

[48] 2021 Census Area Profile. Available from https://www.nomisweb.co.uk/sources/census_2021/report?compare=E07000131
[49] ONS (2020) Subnational population projections for England: 2018-based. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2018based
[50] Severn Trent Water (2024) Draft Water Resources Management Plan. Available from https://www.severntrent.com/about-us/our-plans/water-resources-management-plan/dwrmp24-draft-documents/

increase in the number of properties predicted by Severn Trent Water's draft WRMP with the housing needs of the local planning across the Strategic Grid WRZ. The WRMP growth figure is in line with the lower growth estimates (based on the Standard Method), for Harborough and Hinckley and Bosworth, but is significantly less than the housing need for Blaby, Oadby and Wigston and the higher growth scenarios for Harborough and Hinckley and Bosworth. The draft WCS highlights the need to investigate this further in a Stage 2 WCS once the final WRMP24 has been published.[51]

1.93 Severn Trent identifies four key climate risks to its provision of public water supplies[52]:

- Abstraction restrictions - Hotter drier summers and extended drought will affect aquifer output and result in reduced reservoir and river levels. This can lead to restrictions on the amount that can be abstracted, and subsequent failure to supply enough water or increase in costs to use alternative sources.
- Customer demand - Hotter drier summers and an increased frequency and severity of hot spells impacts customer behaviour causing an increase in short-term peak demand for water leading to loss of pressure or failure to supply enough water.
- Catchment management challenges - Wetter winters and increased storminess and drier summers with extreme rainfall events mean greater seasonal variability causing challenges for farming. This may reduce opportunities for Severn Trent to engage with farmers which in turn will reduce catchment management schemes leading to a decrease in raw water quality.
- Raw water quality - Increasing temperatures cause an increase in algal blooms in reservoirs affecting water quality, reducing the volume of water that can be abstracted and treated. Treatment works have to work harder to treat the water, reducing the amount of water that can be output into supply to meet customer demand.

1.94 These climate risks may lead to interruptions of household water supplies and associated health, social and economic impacts, particularly for vulnerable households.

1.95 In addition, climate change may increase the risk of contamination of drinking water through increased runoff and flooding events that overwhelm water treatment processes. Risks to health from contact with bathing water in Harborough's lakes and rivers and harmful algal blooms may also increase with climate change.[53]

1.96 The main opportunity for local planning policy to address this issue is through measures to manage water demand such as setting higher water efficiency standards than required by Building Regulations and considering opportunities to capture and reuse water at the household level in new developments. The draft Water Cycle Study[54] recommends the following:

- For homes, the proposed new Building Regulations target of 100l/p/d outlined in Defra's Plan for Water be adopted across the study area as a minimum. This should be achieved using a fittings-based approach. The Local Plan should also allow for a future reduction in the Building Regulations target to 90l/p/d in 2030.
- Non-household development should be required to achieve three credits in the assessment category WAT01 of the BREEAM UK New Construction Standard.

Risks to the historic environment

1.97 Multiple aspects of climate change could affect the historic environment within Harborough, including floods, storms, changing habitats, and hotter or more humid weather.

1.98 Global warming is likely to encourage both fungal and plant growth and insect infestations, affecting historic building material.

[51] Harborough Council (2024) Draft Leicestershire Authorities Water Cycle Study
[52] Severn Trent Water (2021) Climate Change Adaptation Report
[53] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[54] Harborough Council (2024) Draft Leicestershire Authorities Water Cycle Study

1.99 Structural problems may also increase from greater extremes and fluctuations in temperature. In dry conditions soil shrinkage, particularly of clay-rich soils, can lead to building subsidence, structural deformation, and collapse.[55] These problems may be greater in older, heritage buildings depending on their state of repair. The predominant soil type in Harborough District is 'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'.[56]

1.100 Flooding is another major risk to historic buildings and other heritage assets.[57] As noted above in the 'Risk to people, communities and buildings from flooding' section, most of the areas of river or surface water flood risk in the District are associated with rivers, stream and lakes in the Soar catchment or the Welland Upper catchment, with smaller areas of flood risk in the south-west of the District in the River Avon catchment. Some of these flood risk areas coincide with concentrations of historic assets, for example a number of listed buildings and parts of the Conservation Areas in Market Harborough and in Medbourne are within Flood Zone 2.

1.101 Opportunities for local planning policy to help address this risk include requiring measures in new development that avoid increasing flood risk elsewhere, such as sustainable drainage systems to manage run-off. Where development proposals seek to bring historic buildings back into re-use, opportunities may also exist to require incorporation of flood resilient design where this does not detract from the historic significance of the buildings.

Risks to health and social care delivery

1.102 As noted above, the proportion of Harborough's population that is 65 or older has been growing and is projected to increase further. As the population of Harborough ages (older people tend to be more vulnerable to climate hazards) and the likelihood and intensity of climate hazards such as flood risk and overheating increases (as discussed above), health and social care systems are likely to face an increased demand for their services.

1.103 At the same time, climate hazards will impose increasing challenges to the delivery of these services. Health and social care systems consist of people, buildings, infrastructure networks, equipment, and service provision, with numerous providers. All these components are and will be further exposed to climate hazards that will worsen as the climate changes including flooding, overheating and water scarcity.[58]

1.104 There will also be increasing risks from high winds or storms, and changes in air quality.[59] It has been estimated that 90% of hospital wards could be at risk from overheating due to their design[60], while 10% of UK hospitals are located in areas of significant flood risk.[61] In Market Harborough, St Luke's Hospital is not located in an area of river or surface water flood risk but other primary healthcare facilities may be more vulnerable (for example Market Harborough Medical Centre is located close to the River Welland).

1.105 Many of the opportunities for local planning policy to help manage this climate risk are indirect, as described under other risks such as requiring new development to avoid increasing flood risk elsewhere. However, local planning policy can also directly manage climate risks by steering new health and social care development away from current and future flood risk areas and by requiring building design that is resilient to the risk off overheating.

[55] BGS (no date) GeoClimate UKCP09 and UKCP18 Shrink-swell national datasets. Available from https://www.bgs.ac.uk/news/maps-show-the-real-threat-of-climate-related-subsidence-to-british-homes-and-properties/
[56] Soilscapes Viewer. Available at: https://www.landis.org.uk/soilscapes.cfm
[57] Historic England (n.d.) What are the effects on climate change on the historic environment? [online] Available at: https://historicengland.org.uk/research/current/threats/heritage-climatechange-environment/what-effects/
[58] Climate Change Committee (2021) Climate risks and adaptation: People, health systems and the built environment. [online] Available at: https://www.theccc.org.uk/wp-content/uploads/2021/09/UKCRSN-event-1slides.pdf
[59] U.K Climate Risk (n.d.) Health and Social Care. [online] Available at:https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA3-Briefing-Health-Social-Care.pdf
[60] Brooks K, Landeg O, Kovats S, Sewell M, OConnell E. Heatwaves, hospitals and health system resilience in England: a qualitative assessment of frontline perspectives from the hot summer of 2019. BMJ Open. 2023 Mar 6;13(3):e068298. doi: 10.1136/bmjopen-2022-068298. PMID: 36878654; PMCID: PMC9990610.
[61] Ibid.

Infrastructure

1.106 This section discusses the key climate change risks to infrastructure within Harborough.

1.107 In addition to the climate risks to particular types of infrastructure discussed below, vulnerabilities on one infrastructure network can cause problems on others, and therefore be far reaching beyond the initially impacted infrastructure sector. For example impacts on the electricity network from flooding or storms that interrupt the power supply can impact transport networks, telecoms and all other sectors that use electricity.

Risks to infrastructure from flooding

1.108 As described in the 'Health, communities and the built environment' section above, all types of flood risk in Harborough are likely to increase as a result of climate change.

1.109 In addition to the direct risk to communities from flooding, built infrastructure will also be at risk from flooding. Key transport routes in the District include the M1, A6, A47 and the rail corridor between Market Harborough and Leicester. All of these routes, particularly the A6 and the main rail corridor, are within areas that are already subject to flood risk (see **Figure A** and **Figure B**) and these risks are expected to increase with climate change. Similarly, the increased risk of flooding due to climate change is likely to disrupt local highway networks within the District.

1.110 Utilities infrastructure (power, communications, water etc.) is also at risk from flooding. This includes the water treatment works, sewage treatment works, and electricity substations distributed across the District, as well as infrastructure beyond the District's borders (e.g. power stations) forming part of networks on which Harborough relies. Risks to public water supplies from reduced water availability have already been described in the 'Health, communities and the built environment' section above.

1.111 Flooding of transport or utilities infrastructure can cause temporary closures or disruption to services and resulting negative consequences for communities, businesses, and the local and regional economy.[62]

1.112 Opportunities for local planning policy to manage future flood risks to transport and utilities infrastructure will be more limited than for other forms of development but policies addressing flood risk can require all new development, including infrastructure, to avoid increasing flood risk elsewhere.

Risks to energy and transport infrastructure from extreme weather (high temperatures and storms)

1.113 High temperatures affect the rail network. Heat can cause rails to buckle, overhead cables to sag, signals to fail and prevent maintenance from being performed. Network Rail state that failure rates for most of their railway increase dramatically from 26°C.[63] As previously described, Harborough is expected to experience hotter summers and more days of extreme summer heat under climate change, and could therefore experience these impacts on rail services within the District.

1.114 In common with the rest of the UK, climate change is expected to result in Harborough experiencing more frequent storms. Wind-blown debris and fallen trees can damage energy infrastructure such as transmission lines. In addition, high wind speeds can reduce energy inputs from wind farms if speeds are above their safety cut-offs. Lightning also poses threats to energy infrastructure in the form of physical damage, fire and power surges.[64]

1.115 Structural problems may also increase from greater extremes and fluctuations in temperature. In dry conditions soil shrinkage, particularly of clay-rich soils, can lead to damage to buried and surface

[62] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[63] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[64] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15

infrastructure from subsidence.[65] The predominant soil type in Harborough District is clay-rich and described as 'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'.[66]

1.116 There is limited potential for local planning policy to address this climate risk.

Natural environment and assets

1.117 This section discusses the key climate change risks to the natural environment within Harborough, i.e. the District's terrestrial and freshwater habitats and species. The natural environment constitutes our natural capital, which directly or indirectly produces goods and services for people. It underpins provisioning services, such as agriculture and forestry, as well as water, air and soil regulation, whilst also providing opportunities for recreation and the enjoyment of wildlife and landscapes. This section therefore also discusses climate risks to agriculture and the landscape. Forestry is not discussed as it is not a significant industry in Harborough.

Risks to terrestrial species and habitats from changing climatic conditions and extreme events

1.118 A wide range of species and habitats in England are adversely affected by climate change. Reduced populations of species will have lower resilience and will be less able to move between habitat areas, particularly if those habitat areas change or become more fragmented as a result of climate change.

1.119 The hotter drier summers and warmer wetter winters expected in Harborough under climate change are likely to cause changes to terrestrial habitat and species composition and distribution. Direct effects on terrestrial habitats and species may occur through changes in the conditions to which they are adapted, for example air and soil temperature and soil moisture. Some species are likely to disappear from areas where they are currently found, particularly those adapted to northern latitudes that are already inhabiting the southern margins of the climatic zone in which they can thrive. Conversely, southern, warmth-loving species may increase in abundance.[67]

1.120 Extreme climatic events such as heatwaves, periods of drought, and flooding have also been associated with some population crashes and explosions of certain species in England.[68]

1.121 Wildfire can result in serious damage to or loss of habitats and species, with subsequent recovery variable. The habitat types with which it is particularly associated include improved the improved grassland and arable land that cover much of Harborough's rural area. While most wildfires in the UK are accidentally started by people, the hotter, drier summers expected in Harborough under climate change make summer wildfires more likely.[69] For example, the 2022 heatwave increased the risk of such fires in Harborough.

1.122 **Figure G** shows green and blue infrastructure assets across Harborough, including woodland and designated nature sites that may be at risk from climate change impacts.

1.123 There is potential for local planning policy to address this climate risk through nature conservation and green and blue infrastructure policies that protect, maintain and enhance habitat networks at a landscape scale and help to improve their resilience to all threats, including those from climate change.

Risk to soils from changing climatic conditions, including seasonal aridity and wetness

1.124 There is increasing evidence of the negative impacts of climate change on soil resources, often in combination with other factors (notably land use). Climate changes expected in Harborough include more

[65] BGS (no date) GeoClimate UKCP09 and UKCP18 Shrink-swell national datasets. Available from https://www.bgs.ac.uk/news/maps-show-the-real-threat-of-climate-related-subsidence-to-british-homes-and-properties/
[66] Soilscapes Viewer. Available at: https://www.landis.org.uk/soilscapes.cfm
[67] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[68] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[69] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15

heavy rainfall events, which can cause soil erosion and compaction. In addition, the hotter drier summers expected under climate change will result in reduced soil moisture in summer, leading to loss of soil biota and organic matter. Loss of soil and reduced soil fertility have important environmental, economic and social consequences and severe degradation of soil quality would be very likely to have long-term, potentially irreversible, implications.[70]

1.125 There is potential for local planning policy to address this climate risk by safeguarding high quality agricultural land, and requiring sustainable construction methods that seek to protect existing soil structure and reduce erosion, as set out in this useful guidance document prepared by Lancaster City Council and Lancaster university[71].

Risks for natural carbon stores and carbon sequestration from changing climatic conditions

1.126 Loss of habitat and the corresponding breakdown of ecosystems, in both terrestrial and freshwater environments, can not only result in the depletion of species populations and thus biodiversity, but also a reduced potential for natural carbon storage. The increased risk of wildfires described above also poses a risk to natural carbon stores, especially when they occur on carbon-rich organic soils and when they damage major vegetation carbon stocks, notably woodland. Climate warming will interact with spatial variations in aridity/wetness of soils to influence natural carbon storage outcomes, in conjunction with land use decisions.

1.127 There is limited potential for local planning policy to directly influence the effects of climate on carbon stores but land use decisions can nevertheless support carbon sequestration. This could include avoidance of development that would cause land to release a significant amount of stored carbon and support for increased tree and woodland cover.

Risks to agricultural productivity from extreme events, changing climatic conditions and flooding

1.128 Rising temperatures, periods of drought and periods of intense rainfall will negatively impact, or at least change conditions and viability for, existing agricultural practices.

1.129 The reduced summer rainfall coupled with higher summer temperatures expected in Harborough under climate change could reduce water available to abstract for agriculture for crop irrigation and farm animals, as described under ‘Risks to water quality and household water supply’ above. As a mainly rural District supporting mixed arable and livestock farming, limited water available for agricultural use could be a key issue in Harborough. Climate change has the potential to limit agricultural production or require a change in the selection of crops or management of land.

1.130 Figure H illustrates best and most versatile (BMV) agricultural land in Harborough, where the majority of agricultural land outside of urban areas is not ‘best and most versatile’ (i.e. Grades 1, 2 or 3a). There is no Grade 1 (excellent quality) agricultural land in the District; pockets of Grade 2 (very good quality) agricultural land are scattered across the District; and a few very small areas of Grade 3 land (good to moderate quality) are also present. Generally, these areas of higher quality agricultural land do not coincide with areas of flood risk. However, small areas are likely to be under increasing pressures from climatic changes caused by flooding (e.g. Grade 2 areas adjacent to the River Swift, east of Lutterworth) or excessive heat and water scarcity, driving a need to adapt farming practices to maintain food production.

1.131 Farming, as an important land use within Harborough, could benefit from a lengthening of the growing season, from higher temperatures or extended spring/summers and potentially introduce new crops.

1.132 However, farming will be at risk from wetter winters that may lead to more extensive soil erosion and an increased risk of soil compaction and damage. Productive agricultural land may become inundated or too saturated to undertake land management operations (e.g. use of machinery or sowing and management of

[70] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[71] Soils in Planning and Construction Task Force (2022). Building on soil sustainability: Principles for soils in planning and construction (see https://www.lancaster.ac.uk/lec/sustainable-soils/files/2022/09/Soils-in-Planning-and-Construction-Sept-22.pdf)

winter crops) because of flooding and extreme rainfall may also lead to soil erosion and loss of productive capacity.

1.133 Summer droughts are likely to increase soil desiccation. More frequent droughts could reduce yields, while increases in pests, diseases and invasive species could also adversely affect crops and farm animals.

1.134 While there is limited potential for local planning policy to directly influence the effects of climate on agricultural productivity of soils, land use decisions can nevertheless help to protect productive soils by avoiding development of the best and most versatile land. It can also support diversification of the rural economy into activities that are more resilient to a changing climate.

Risks to freshwater species and habitats from changing climatic conditions and extreme events

1.135 The potential impacts of climate change on rivers, lakes and wetlands are numerous and complex. As well as freshwater habitats being vulnerable to reduced water availability in the face of climate change, freshwater species and biodiversity are also highly sensitive to the direct and indirect effects of temperature. Climate change impacts on freshwater habitats and species can be both direct (e.g. species growth and survival responding to water temperature change, water quality change or alterations to river flow regimes) and indirect (e.g. climate effects on predators, competitors, or habitat conditions).[72]

1.136 Freshwater habitats in Harborough District that will be vulnerable to these risks include those of the River Sence, the River Welland, the River Avon and designated freshwater habitats such as the Kilby-Foxton Canal SSSI, Saddington Reservoir SSSI and Eye Brook Reservoir SSSI.

1.137 As described under 'Risks to water quality and household water supply' above, the expected changes in Harborough's climate are expected to result in reduced supply of and increased demand for water, with water demand also increasing in line with population growth and economic growth. As well as reducing the ability of species to move through a river system, low flows can result in reduced dilution and therefore higher concentrations of pollutants, such as nutrient inputs from wastewater treatment works. This, together with rising summer water temperatures can stimulate excessive algal growth and eutrophication.[73]

1.138 In addition, extreme rainfall events, which are expected to become more frequent in Harborough under climate change, can also result in the capacity of combined sewers being exceeded. To avoid overloaded sewers causing flooding and sewage backing up into streets and homes, diluted but untreated sewage is discharged to rivers and the sea ('storm overflows'). Based on monitoring of 45 out of 52 storm overflows in Harborough, there were a total of 2,175 spills in the District in 2023 for a total duration of 21,257 hours. This represents an increase in the number and total duration of sewage spills compared to 2022 and 2021, although the data are not directly comparable due to a steady increase in the proportion of storm overflows that were monitored in these years.[74]

1.139 Storm overflow discharges to rivers and the sea can impact water chemistry and lead to ecological damage, particularly by causing low levels of dissolved oxygen and high levels of ammonia. Discharges from storm overflows can also contain other pollutants harmful to the natural environment such as microplastics, pharmaceuticals, nutrients, and heavy metals, as well as visible litter that is flushed down drains. While there are no designated bathing waters in the District, the untreated sewage in storm overflows can also pose a risk to the health of recreational users of rivers and lakes.

1.140 The Environment Act 2021 put more duties and responsibilities on companies, regulators, and the government to reduce storm overflows and the Government has set out a Storm Overflows Discharge Reduction Plan (SODRP)[75] to require water companies to progressively tackle the issue. Wastewater

[72] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[73] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[74] Based on https://theriverstrust.org/key-issues/sewage-in-rivers
[75] Defra (2023) Storm Overflows Discharge Reduction Plan. Available at: https://assets.publishing.service.gov.uk/media/6537e1c55e47a50014989910/Expanded_Storm_Overflows_Discharge_Reduction_Plan.pdf

treatment is carried out by Severn Trent Water in the west of the District and by Anglian Water in the east.[76] Both Severn Trent's Drainage and wastewater Management Plan (DWMP)[77] and Anglian Water's DWMP[78] include commitments to tackle storm overflows in line with the SODRP targets. Nevertheless, unless such measures keep pace with urban growth and climate change, storm overflows could still increase.

1.141 Both low flows and storm overflows could cause significant ecological issues across the Severn Trent Water supply area[79], including along the River Welland and other watercourses in Harborough.

1.142 Opportunities for local planning policy to help address this climate risk include measures to manage water demand (described under 'Risks to household water supply'), to minimise rainwater runoff to combined sewers, to avoid contamination of surface water during construction and occupation of new development and to require 'nutrient neutrality' in relevant catchments.

Risks to terrestrial and freshwater habitats and species, and agriculture from pests, pathogens and invasive species

1.143 The introduction, establishment and spread of pests and pathogens, including invasive non-native species, and the risks they pose to terrestrial and freshwater species and habitats involves complex interactions between a variety of factors. While changes in these risks are primarily influenced by socio-economic factors, including cross-border trade, within-country movements, biosecurity measures and land use change, climate change also influence these risks. In recent years, warmer winters have favoured the survival and development of many pests and pathogens in the UK and the incursion and establishment of invasive non-native species. The continued warming and changing patterns of extreme events expected in Harborough and across the UK are likely to expand the range of climate suitability for many pest and pathogen species and increase the chance of establishment of invasive non-native species.[80]

1.144 In relation to terrestrial habitats, native UK trees are particularly at risk from these threats. Milder and wetter winters, followed by increased spring rainfall, are likely to enhance the survival and infection potential of many tree pathogens. Hotter, drier summers leading to drought stress in trees will also increase their susceptibility to disease and expand the distribution range of some pathogens. For example, ash dieback (a disease of ash trees caused by a fungus called Hymenoscyphus fraxineus) has now taken hold across much of the UK, including Leicestershire.[81]

1.145 An example of a significant invasive non-native species affecting freshwater habitats is floating pennywort is an ornamental pond plant originating from North America. It grows up to 20 centimetres each day in late summer, forming dense mats over waterways that harm native plant, fish and invertebrate species, through competition and cutting oxygen levels in water. It also impedes navigation routes, disrupts recreational activities like fishing and canoeing and exacerbates flood risk. This and other non-native species are already affecting the Rover Soar in Harborough.[82] Climate change is anticipated to favour its growth and spread.[83]

1.146 Pests, pathogens and invasive non-native species also present serious risks to agricultural productivity, with consequences for livelihoods and businesses. Large-scale outbreaks or invasions may also have ramifications for food security. Climate factors have been particularly highlighted with regard to the changing incidence of some crop diseases. An example in relation to livestock is Bluetongue virus which

[76] Harborough Council (2024) Draft Leicestershire Authorities Water Cycle Study
[77] Severn Trent Water (2023) Drainage and Wastewater Management Plan Level 1 Non-Technical Report. Available at: https://www.severntrent.com/content/dam/stw-plc/about-us/drainage-and-wastewater-management-plan/2023/SVE-fDWMP23-L1-Non-Technical-Report.pdf
[78] https://www.anglianwater.co.uk/siteassets/household/about-us/dwmp/dwmp-1.pdf
[79] Ibid.
[80] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[81] Leicestershire County Council (no date) Ash dieback and other threats. [online] Available at: https://www.leicestershire.gov.uk/environment-and-planning/tree-for-every-person/ash-dieback-and-other-threats
[82] Leicestershire County Council (2023) Wildlife boost as projects get almost £27,000 to tackle invasive species [online Available at https://www.leicestershire.gov.uk/news/wildlife-boost-as-projects-get-almost-ps27000-to-tackle-invasive-species
[83] GB non-native species secretariat (2020) Great Britain Strategy for Managing Floating Pennywort [online] Available at https://www.nonnativespecies.org/assets/Document-repository/Great_Britain_Strategy_for_Managing_Floating_Pennywort_2020_070820.pdf

affects cattle/sheep. The disease has spread from mainland Europe to southeast England. While no outbreaks have occurred as far north as Harborough, the disease is spread by the bites of midges and warmer temperatures accelerate the midge lifecycle, abundance, and range, and hence the warmer summers expected in England under climate change could widen this spread in future.[84] [85]

1.147 There is limited potential for local planning policy to directly address this climate risk. Nevertheless, planning policy can increase the resilience of biodiversity to all threats, including climate change, via a variety of approaches. These include supporting the identification and enhancement of ecological networks at a landscape scale, for example by spatially targeted green and blue infrastructure provision, as well as development management policies that require individual proposals to conserve and enhance biodiversity.

Risks from climate change to landscape character

1.148 Future changes to landscape character will occur from a range of natural environment responses to a changing climate including biodiversity, soils, geomorphology, and hydrological processes. A number of these have been discussed earlier in this 'Natural environment and assets' section. The effects of changing climatic conditions on terrestrial habitats are likely to be incremental while those of extreme events may be more sudden, for example erosion or landslips precipitated by periods of intense rainfall or landscape modification by large-scale wildfires.

1.149 Traditional land management practices are integral to the landscape character of many areas. Landscape (and historic) character will therefore also be indirectly modified as future land management practices adapt to a changing climate.

1.150 There is limited potential for local planning policy to address this climate risk.

Business and industry

Risk to businesses from flooding

1.151 As described in the 'Risk to people, communities and buildings from flooding' section above, all types of flood risk in Harborough are likely to increase as a result of climate change. This can negatively damage business premises and their contents directly, for example where these are in flood zones associated with the River Welland at Market Harborough (see **Figure A** and **Figure B**). It can also have indirect effects if access routes to premises are cut off, if transport routes and other infrastructure on which businesses rely are disrupted (see 'Risks to infrastructure from flooding' section), or if their supply chains are disrupted.

1.152 Opportunities exist for local planning policies in Harborough to reduce flood risk, including by steering new development away from current and future flood risk areas, using the correct application of the Sequential Test and Exception Test, implementing flood defences and natural flood management techniques and ensuring good practice design guidance is adhered to.

Risk to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments

1.153 The likelihood of more frequent days of extreme summer heat in Harborough under climate change and the associated risks to people's health and wellbeing have already been discussed in the 'Health, communities and built environment' section above. These same climate events can also negatively affect employee productivity via a variety of mechanisms.[86] In a hot environment, employees typically decrease

[84] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS15
[85] Defra (2024) 5 March 2024: updated outbreak assessment for bluetongue virus in Europe[online] Available at https://www.gov.uk/government/publications/bluetongue-virus-in-europe/15-march-2024-updated-outbreak-assessment-for-bluetongue-virus-in-europe
[86] Sustainability West Midlands (2022) Third UK Climate Change Risk Assessment Technical Report: Summary for England. Available from https://www.ukclimaterisk.org/publications/summary-for-england-ccra3-ia/#nse-CS1

their work intensity or increase their breaks, with outdoor workers and indoor workers not benefitting from a temperature-controlled environment being particularly affected.

1.154 Some opportunities exist for local planning policies in Harborough to reduce this climate risk by requiring design in new development that is resilient to overheating.

Conclusion and next steps

1.155 This report has demonstrated that the UK and England's climate is changing, and that continued change should be expected in the near and long term. Under all likely emissions pathways, there will be significant changes to the country's climate, and therefore, to the climate in Harborough.

1.156 The urgency of action cannot be overstated. The lowest emissions scenario (RCP2.6), with the least associated change in climate and resulting risks, could still result in more than 1.5°C of warming which would have catastrophic effects – and that may already be unattainable, according to a recent UN report.[87] A number of studies suggest that the temperature outcomes of RCP4.5, highlighted above, may be the most likely if, after 2030, no further GHG emission reductions are achieved but emissions are successfully prevented from rising.[88] However, even this achievement would require significant global political and social will.

1.157 The most pessimistic climate change projections, and resulting risks for Harborough, under RCP6.0 and RCP8.5 must therefore be considered.

1.158 The mapping for the District presented in this chapter has highlighted spatially specific risks and vulnerabilities linked to the impacts of climate change that present management opportunities for local planning policy, particularly in relation to flood risk from rivers and surface water and overheating.

1.159 Planning policies need to consider how such climate change risks over different timescales will impact new and existing buildings (including retrofit requirements) as well as transport delivery, natural capital (including nature sites and high-quality farmland), and infrastructure. The decisions made in the planning process now will have implications for generations as new building developments, energy and transport infrastructure will be in place and be operational for many decades and even centuries and will also tend to influence future patterns of development. Advice on climate change adaptation policies for the new Local Plan is included in a separate chapter.

[87] https://news.un.org/en/story/2022/10/1129912
[88] https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf

Maps

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Figure A: Risk of flooding from rivers

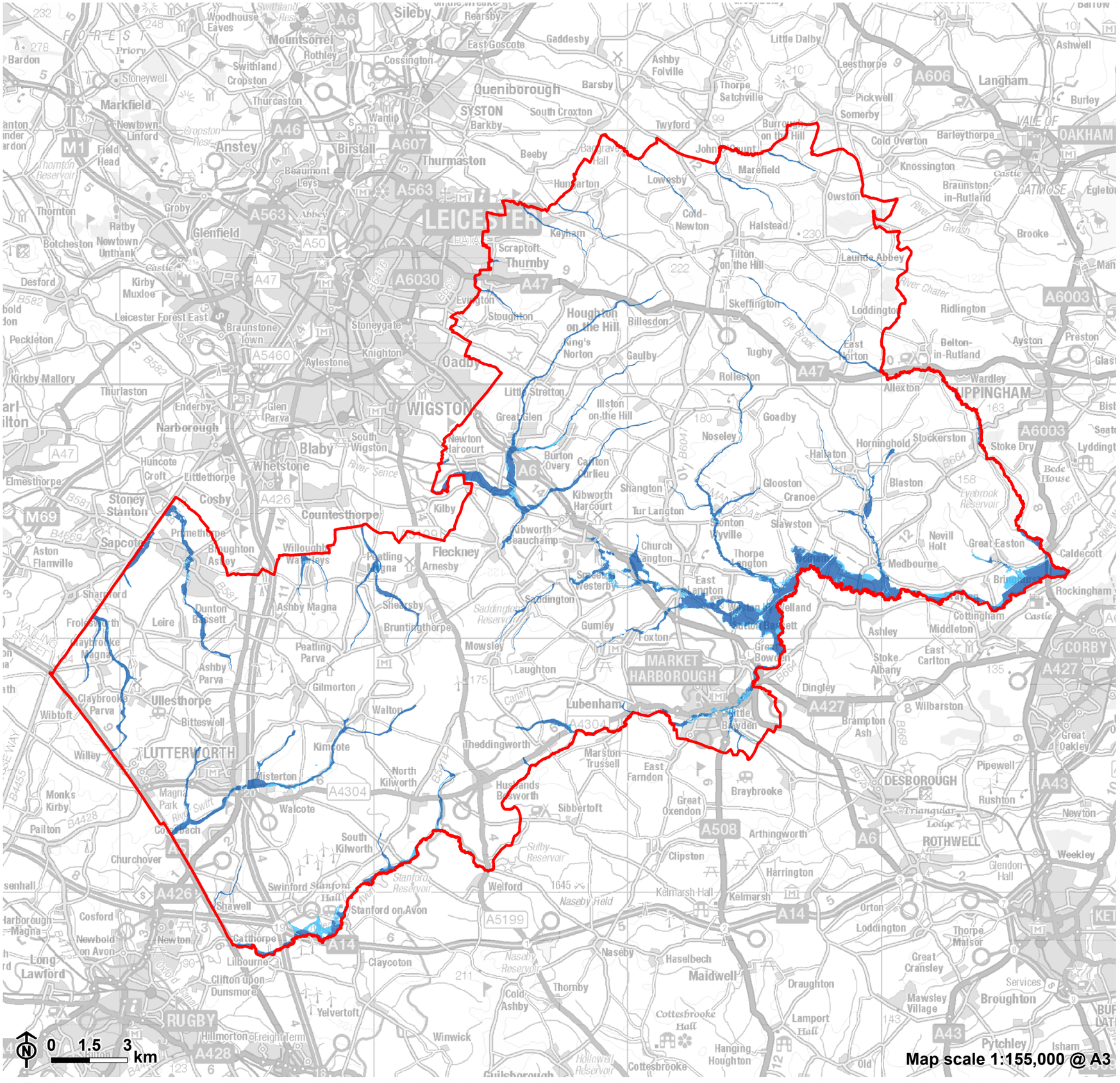

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Figure B: Risk of surface water flooding

- Harborough Council
- High risk (more than 3.3% chance each year)
- Medium risk (between 1% and 3.3% chance each year)
- Low risk (between 0.1% and 1% chance each year)

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure C: Indices of Multiple Deprivation (IMD) 2019

Harborough Council

Indices of multiple deprivation (IMD) 2019

IMD Decile

- 30 - 40% (most deprived)
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80%
- 80 - 90%
- 90 - 100% (least deprived)

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure D: Neighbourhood Flood Vulnerability Index (NFVI)

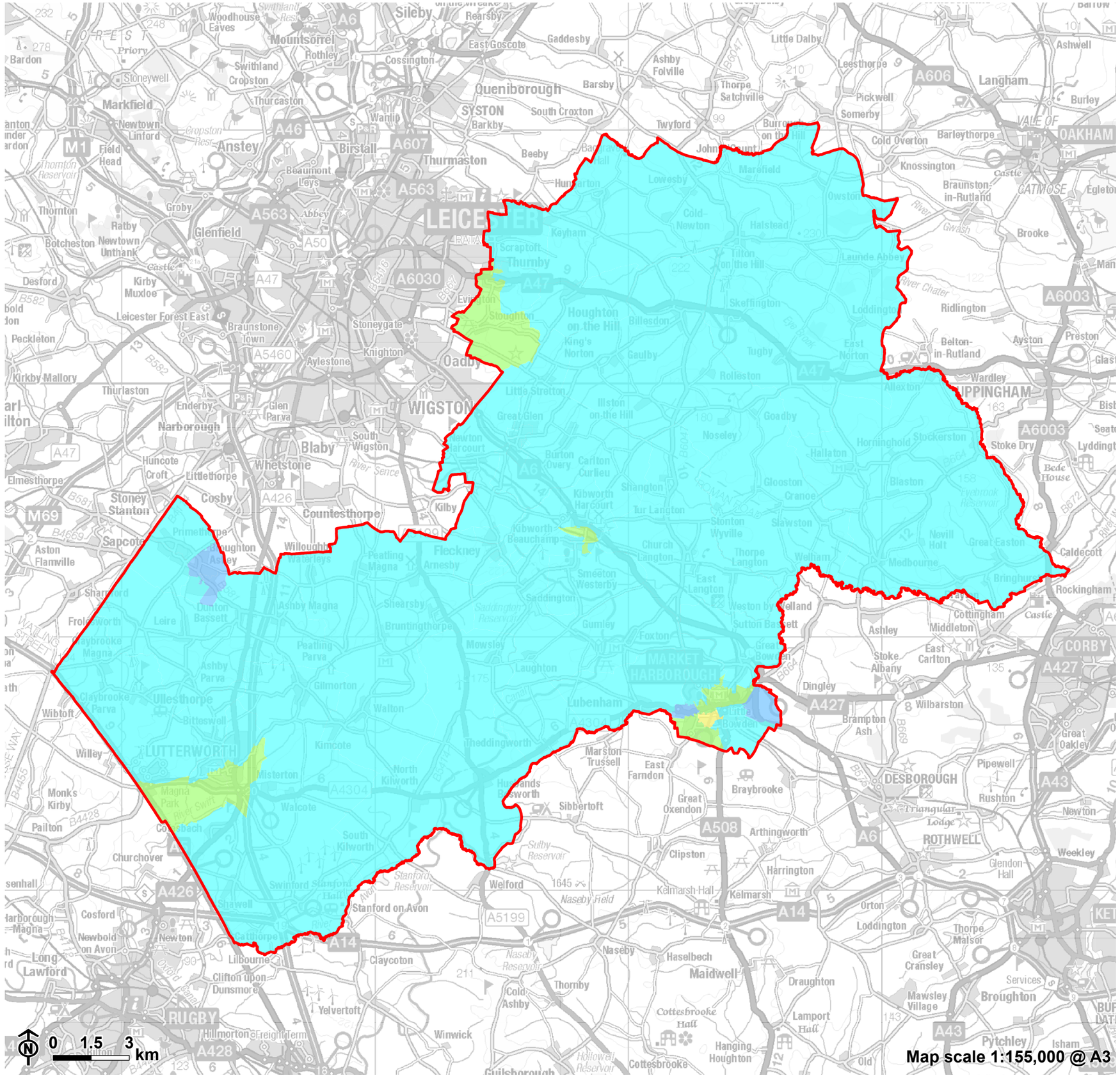

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Figure E1: Social Flood Risk Index (SFRI) –river & coastal – group – present day

Harborough Council

Social Flood Risk Index (SFRI)

- No exposed population
- Exposed, NFVI below the UK mean
- Low
- Moderate
- High
- Very high
- Acute
- Extreme

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure E2: Social Flood Risk Index (SFRI) –river & coastal – group – future 2050s 2°C scenario

Harborough Council

Social Flood Risk Index (SFRI)

- No exposed population
- Exposed, NFVI below the UK mean
- Low
- Moderate
- High
- Very high
- Acute
- Extreme

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure E3: Social Flood Risk Index (SFRI) –surface water – group – present day

Harborough Council

Social Flood Risk Index (SFRI)

- No exposed population
- Exposed, NFVI below the UK mean
- Low
- Moderate
- High
- Very high
- Acute
- Extreme

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure E4: Social Flood Risk Index (SFRI) –surface water – group - future 2050s 2°C scenario

Harborough Council

Social Flood Risk Index (SFRI)

- No exposed population
- Exposed, NFVI below the UK mean
- Low
- Moderate
- High
- Very high
- Acute
- Extreme

0 1.5 3 km

Map scale 1:155,000 @ A3

Contains Climate Just data: Contains derived data from the Office for National Statistics licensed under the Open Government Licence.
Contains Ordnance Survey data 100023843. © Crown copyright and database right 2024

FIG5d_SFRI_r0_AL3 07/05/2024EB:dhane_r

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Figure F: Socio-spatial Heat Vulnerability Index (SHVI)

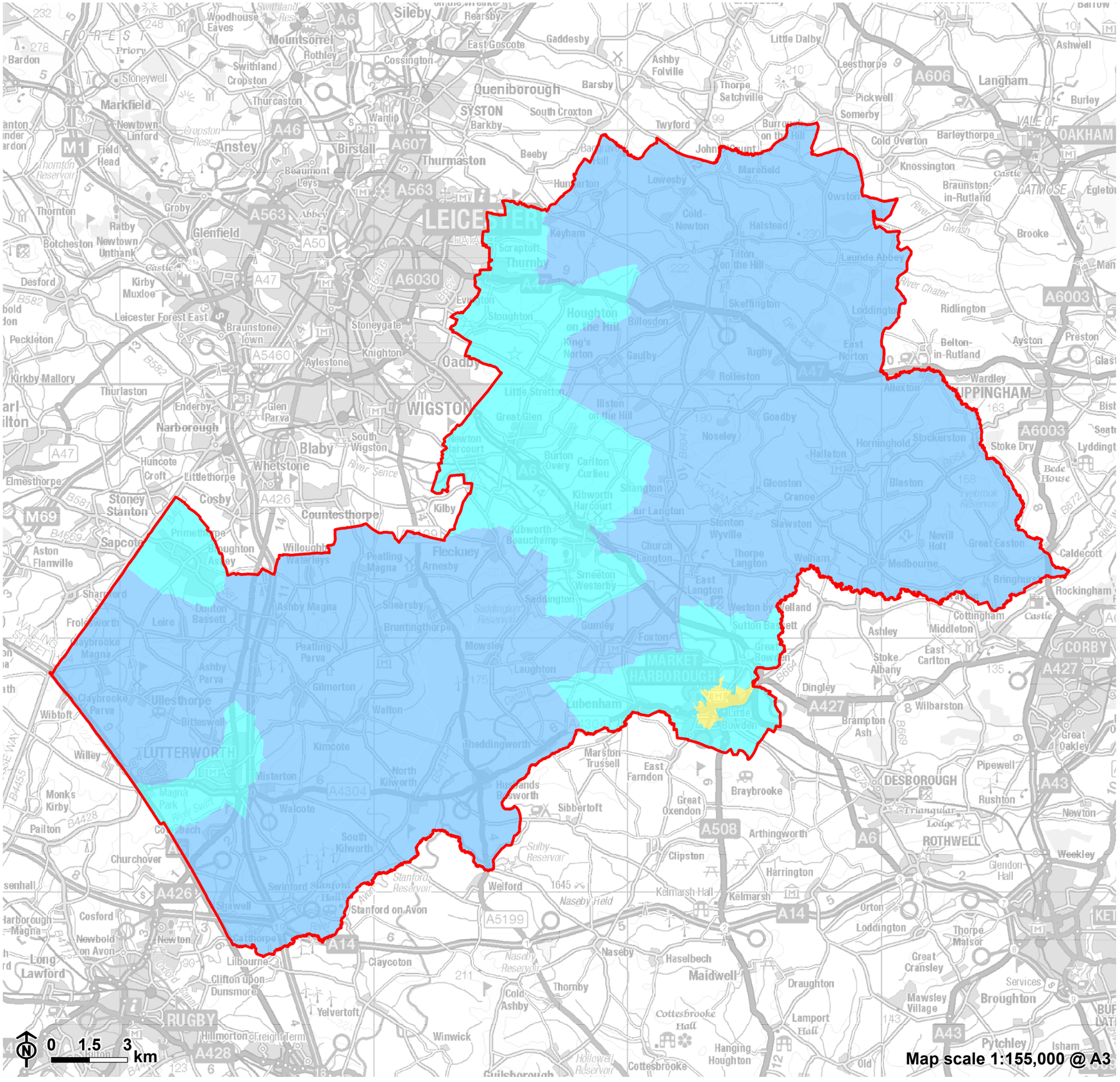

FIG6_spatial_heat_VI_r0_AL3 02/05/2024EB:dhane_r

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Figure G: Green and blue infrastructure assets

- Harborough Council
- River
- Public right of way
- Local Wildlife site
- Local Nature Reserve
- Local green space
- SSSI
- Priority habitats
- Ancient woodland
- National Forest Inventory Woodland
- Registered Parks and Gardens

0 1.5 3 km

Map scale 1:155,000 @ A3

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Figure H: Best and most versatile agricultural land and flood zones

- Harborough Council
- Flood zone 2 (between 0.1% and 1% chance each year)
- Flood zone 3 (more than 1% chance each year)
- Grade 2 agricultural land
- Grade 3a agricultural land

Note:
The agricultural land data shown includes the Natural England Provisional Agricultural Land Classification data, and the Natural England Agricultural Land Classification Grades - Post 1988 Survey data. Where the post 1988 data was available, this is shown layered on top of the provisional data.

0 1.5 3 km

Map scale 1:155,000 @ A3

Appendix A

Risks to England and the UK from climate change considered in CCRA3

Table A1: Priority climate risks for England identified by the CCC in the Third UK Climate Change Risk Assessment

		Magnitude Score		
Risk or Opportunity Descriptor (**BOLD** = Committee priority risks)	Nation	Present Day	2050, 2°	2050, 4°
Natural Environment and Assets				
N1 Risks to terrestrial species and habitats from changing climatic conditions and extreme events, including temperature change, water scarcity, wildfire, flooding, wind, and altered hydrology (including water scarcity, flooding and saline intrusion)	England	High	High	High
N2 Risks to terrestrial species and habitats from pests, pathogens and invasive species	England	Medium	High	High
N3 Opportunities from new species colonisations in terrestrial habitats	England	Medium	Medium	Medium
N4 Risk to soils from changing climatic conditions, including seasonal aridity and wetness.	England	Medium	High	High
N5 Risks and opportunities for natural carbon stores, carbon sequestration and GHG emissions from changing climatic conditions, including temperature change and water scarcity	England	Medium	High	High
N6 Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind and saline intrusion).	England	Medium	High	High
N7 Risks to agriculture from pests, pathogens and invasive species	England	Medium	High	High
N8 Risks to forestry from pests, pathogens and invasive species	England	Medium	High	High
N9 Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable.	England	Medium	High	High

		Magnitude Score		
Risk or Opportunity Descriptor (**BOLD** = Committee priority risks)	Nation	Present Day	2050, 2°	2050, 4°
N10 Risks to aquifers and agricultural land from sea level rise, saltwater intrusion	England	Low	Low	Low
N11 Risks to freshwater species and habitats from changing climatic conditions and extreme events, including higher water temperatures, flooding, water scarcity and phenological shifts.	England	Medium	Medium	Medium
N12 Risks to freshwater species and habitats from pests, pathogens and invasive species	England	High	High	High
N13 Opportunities to freshwater species and habitats from new species colonisations	England	Low	Low	Low
N14 Risks to marine species, habitats and fisheries from changing climatic conditions, including ocean acidification and higher water temperatures.	England	Medium	High	High
N15 Opportunities to marine species, habitats and fisheries from changing climatic conditions	England	Medium	High	High
N16 Risks to marine species and habitats from pests, pathogens and invasive species	England	Medium	High	High
N17 Risks and opportunities to coastal species and habitats due to coastal flooding, erosion and climate factors	England	Medium	High	High
N18 Risks and opportunities from climate change to landscape character	England	Medium	High	High
Infrastructure				
I1 Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures	England	High	High	High
I2 Risks to infrastructure services from river, surface water and groundwater flooding	England	High	High	High
I3 Risks to infrastructure services from coastal flooding and erosion	England	Medium	Medium	Medium
I4 Risks to bridges and pipelines from flooding and erosion	England	Medium	Medium	Medium
I5 Risks to transport networks from slope and embankment failure	England	Medium	Medium	Medium
I6 Risks to hydroelectric generation from low or high river flows	England	Low	Medium	Medium
I7 Risks to subterranean and surface infrastructure from subsidence	England	Low	Medium	Medium

		Magnitude Score		
Risk or Opportunity Descriptor (**BOLD** = Committee priority risks)	Nation	Present Day	2050, 2°	2050, 4°
I8 Risks to public water supplies from reduced water availability	England	Medium	High	High
I9 Risks to energy generation from reduced water availability	England	Low	Medium	Medium
I10 Risks to energy from high and low temperatures, high winds, lightning	England	High	High	High
I11 Risks to offshore infrastructure from storms and high waves	England	Low	Medium	Medium
I12Risks to transport from high and low temperatures, high winds, lightning	England	Medium	High	High
I13 Risks to digital from high and low temperatures, high winds, lightning	England	Low	Medium	Medium
Health, Communities and the Built Environment				
H1 Risks to health and wellbeing from high temperatures	England	High	High	High
H2 Opportunities for health and wellbeing from higher temperatures	England	Low	Low	Low
H3 Risks to people, communities and buildings from flooding	England	High	High	High
H4 Risks to people, communities and buildings from sea level rise	England	Low	Medium	Medium
H5 Risks to building fabric	England	Medium	Medium	Medium
H6 Risks and opportunities from summer and winter household energy demand (a) Opportunity - winter	England	Low	High	High
H6 Risks and opportunities from summer and winter household energy demand (b) Risk - summer	England	Medium	High	High
H7 Risks to health and wellbeing from changes in air quality	England	High	Medium	Medium
H8 Risks to health from vector-borne diseases	England	Medium	Medium	Medium
H9 Risks to food safety and food security	UK	High	High	High
H10 Risks to health from water quality and household water supply (a) water quality	England	Medium	Medium	Medium

		Magnitude Score		
Risk or Opportunity Descriptor (**BOLD** = Committee priority risks)	Nation	Present Day	2050, 2°	2050, 4°
H10 Risks to health from water quality and household water supply (b) water quantity	England	Medium	High	High
H11 Risks to cultural heritage	England	Medium	Medium	High
H12 Risks to health and social care delivery	England	Medium	Medium	Medium
H13 Risks to education and prison services	England	Medium	Medium	Medium
Business and Industry				
B1 Risks to business sites from flooding	England	High	High	High
B2 Risks to business locations and infrastructure from coastal change from erosion, flooding and extreme weather events	England	Medium	High	High
B3 Risks to businesses from water scarcity	England	Low	Medium	Medium
B4 Risks to finance, investment and insurance including access to capital for businesses	England	Medium	Medium	High
B5 Risks to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments	England	Low	Medium	Medium
B6 Risks to business from disruption to supply chains and distribution networks	England	Medium	Unknown	Unknown
B7 Opportunities for business from changes in demand for goods and services	England	Low	Medium	Medium
International Dimensions				
ID1 Risks to UK food availability, safety, and quality from climate change overseas	UK	High	High	High
ID2 Opportunities for UK food availability and exports from climate impacts overseas	UK	Low	Low	Low
ID3 Risks and opportunities to the UK from climate-related international human mobility	UK	Low	Low	Low
ID4 Risks to the UK from international violent conflict resulting from climate change on the UK	UK	Low	Medium	Medium
ID5 Risks to international law and governance from climate change overseas that will impact the UK	UK	Low	Medium	High
ID6 Opportunities from climate change (including arctic ice melt) on international trade routes	UK	Low	High	High

		Magnitude Score		
Risk or Opportunity Descriptor (**BOLD** = Committee priority risks)	Nation	Present Day	2050, 2°	2050, 4°
ID7 Risks from climate change on international trade routes	UK	Medium	Medium	High
ID8 Risk to the UK finance sector from climate change overseas	UK	Low	Medium	Medium
ID9 Risk to UK public health from climate change overseas	UK	High	High	High
ID10 Risk multiplication from the interactions and cascades of named risks across systems and geographies	UK	High	High	High