Oxford Local Plan 2040 preferred options
Climate change risks background paper

1. Introduction

Alongside efforts to reduce our carbon emissions and to mitigate out impacts on climate, the other equally important element of responding to climate change is that of climate adaptation. Due to the long lifetime of carbon and other greenhouse gases once they are emitted into the atmosphere, we can expect the climate to continue to change, even if we were to reduce emissions to zero from today. It is well documented that a changing climate will bring about a range of negative impacts on weather and climate that can increase the risk of severe impacts upon people and ecosystems. As such, adapting to these changes and building the resilience of the city and its communities is a vitally important objective as we plan for 2040 and beyond. The policies set out in the new Local Plan will have an important role in supporting adaptation to climate change in Oxford as new development comes forward in future.

Adaptation
In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects

Resilience
The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure.

IPCC – Sixth Assessment, Climate Change 2022: Impacts, Adaptation and Vulnerability Report (2022)

2. Climate risk in Oxford

What do we mean by climate risk?

The concept of 'risk' when discussing climate change is a complex one. Climate change risk arises from the interplay of three distinct components which are *hazards, vulnerability, and exposure* as detailed in the figure below.

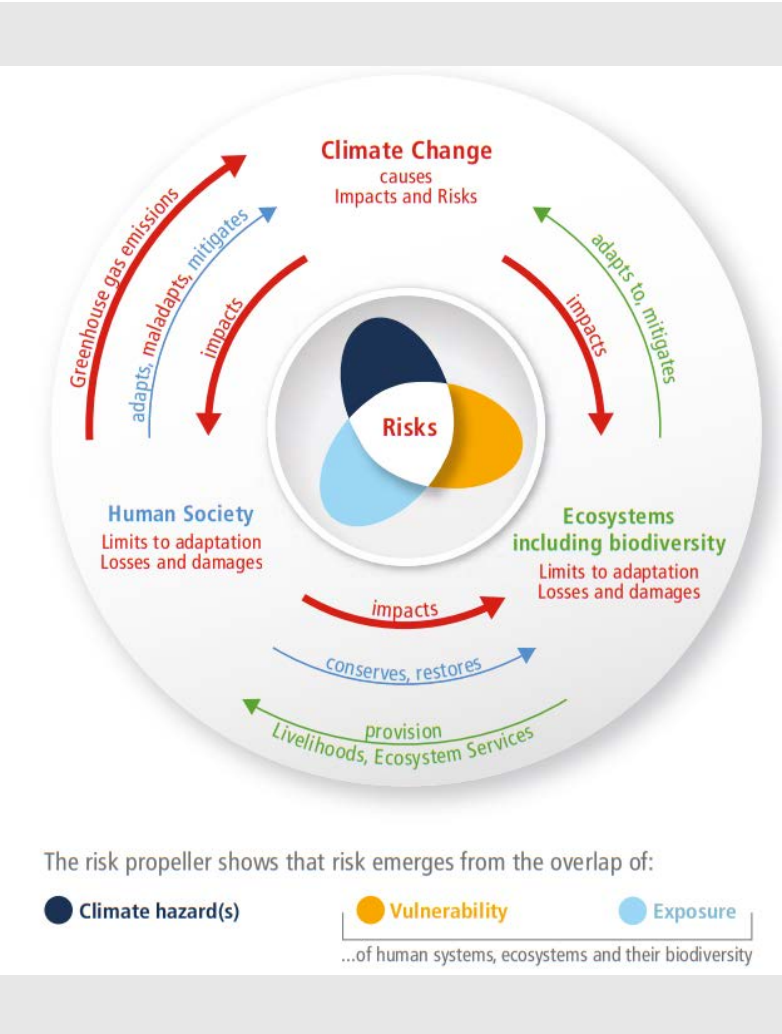

Figure 1 – Interactions and trends that produce climate change risk(s) – *IPCC Sixth Assessment Report: Impacts, Adaptation and Vulnerability – Technical summary (2022)*[1]

Climate hazards will vary depending upon location. In Oxford, the most pressing hazards that will be discussed in this paper include warmer, dryer summers and prolonged extreme events; as well as more intense periods of rainfall and associated flooding from a range of sources (e.g. surface water, rivers, sewers etc.). But these hazards are not 'risks' in isolation, rather, the risk arises when such impacts as heat waves or flooding begin to occur around people and places where vulnerable ecosystems reside. This is where the other two components of vulnerability and exposure come into play.

Exposure of communities, buildings, assets and ecosystems to climate hazards is an important determiner of climate risk. If people live far away from sources of flooding for example, then the risk of being flooded due to more intense and heavy rainfall events in future will be minimal, whereas living within the flood plain increases that risk. Being exposed to a climate hazard however may not necessarily result in higher climate risk in of itself or increased vulnerability. It is possible to live within areas of high flood risk with appropriate resilience/resistance measures that can mitigate risk (e.g. raised flood levels and emergency refuges). Increased climate risk will however arise where more vulnerable people, buildings or ecosystems are exposed to climate hazards.

[1] https://www.ipcc.ch/report/ar6/wg2/

Vulnerability, by which we mean the likelihood of suffering adverse impacts from a climate hazard, is not equal. Vulnerability will vary between groups of people, but also more broadly, between our businesses and personal lives, our homes and workplaces, as well as the infrastructure that supports the city, the wildlife that inhabit these areas and the history and culture that characterise Oxford.

Vulnerability of communities to climate hazards is often exacerbated by socio-economic qualities such as levels of deprivation, age and general health and wellbeing. For example:

- More deprived communities may be more likely to be living in poorer quality accommodation that is more exposed to the impacts of climate change. Equally, they may lack the money and resources to put in place measures that can build their own resilience to climate change (for example, insurance for flooding, or air conditioning to cope with high heat).
- The elderly often find it more difficult to cool down during high heat events and may struggle with mobility hindering the ability to evacuate during a flood.

Vulnerability of buildings and infrastructure can also be impacted by how it has been designed. Where future climate and weather extremes have not been considered in choice of materials or construction, they may be more likely to fail when exposed to such impacts.

Key climate hazards in Oxford

The two key hazards we will discuss in this paper are flooding and overheating.

Flooding

The city is already susceptible to flooding from a variety of sources, primarily the rivers, with large areas of functional flood plain particularly within the green belt. The flood risk background paper prepared for the Issues consultation included a detailed review of the sources of flood risk in the city. The SFRA prepared for the adopted Local Plan 2036 also includes a range of information – though this will need to be updated for the new Local Plan, we do not expect to see significant changes in this assessment.

The Environment Agency web mapping highlights that significant areas of the city fall within higher risk from flooding from the rivers (flood zones 2 and 3) as is detailed in the figure below.

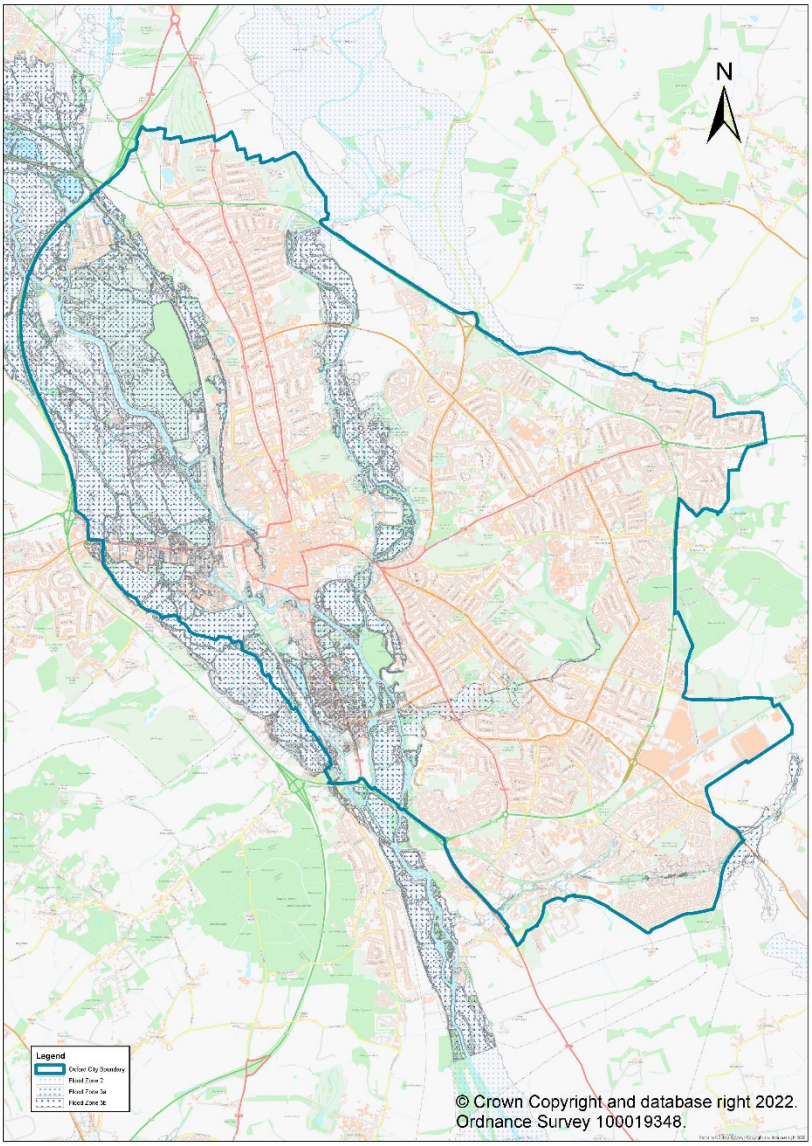

Figure 2: Oxford Flood Zone Map.

There are also varying levels of surface water flood risk throughout Oxford, often tied to road networks and more urbanised locations in the city, as can be seen in figure below.

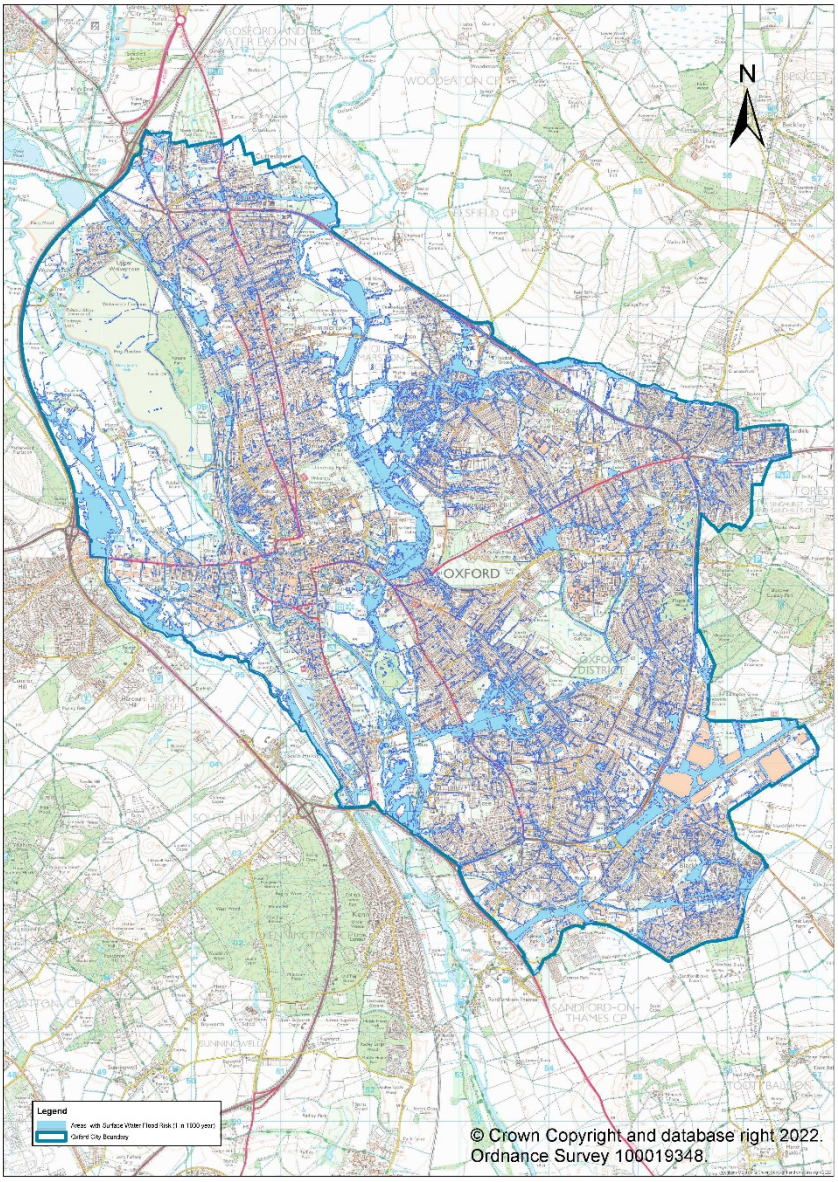

Figure 3: Oxford Map of surface water flood risk areas

What is apparent from the distribution of flood risk in Oxford, is that this is not even across the city, and certain areas are faced with higher potential for flooding than others, especially those areas adjacent to the rivers. The projections of more intense rainfall events in future due to climate change means will potentially exacerbate flood risk in terms of the number of times we could see rivers bursting their banks, or surface water overwhelming drainage systems, within a certain period of time.

Overheating

Projections are for warmer, dryer summers including more high heat events (heatwaves).

It is well-recognised that urban areas typically experience warmer micro-climates than rural ones. This is termed the Urban Heat Island (UHI) effect and occurs because of the higher proportion of artificial surfaces that are typically found in urban locations, which absorb radiation during day and re-radiate at night. More rural areas, with higher proportions of natural surface cover like trees and

grass, are typically cooler due to a variety of effects like shading and evaporation of moisture (evapo-transpiration).

The figure below shows that air temperatures across Oxford are not uniform. Areas of the city typically have slightly warmer air temperatures on average, than other areas, though the difference is admittedly not substantial. The central core of the city and areas to the north and south are slightly warmer on average than areas to the east.

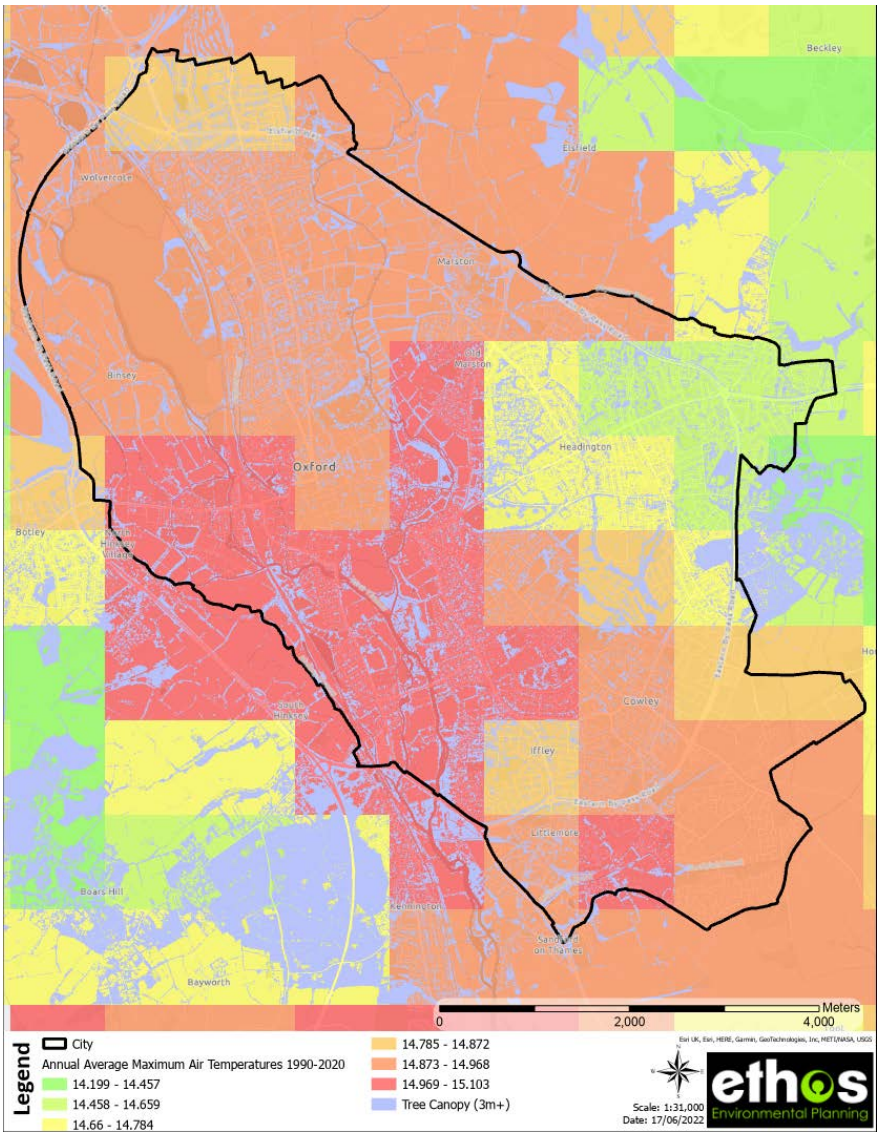

Figure 4: Annual average air temperature data for the city - Source: Met Office HadUK-Grid

Equally, the distribution of green surface cover across the city is not even and there are clearly areas of Oxford with higher proportions of artificial, grey surface cover compared with other greener locations. As noted above, greenery like trees and grass can have a noticeable cooling effect of the immediate area within their vicinity and can help to provide relief during times of high heat both through shading of the ground, buildings and of the people moving through these spaces, but also by retaining moisture which can then cool through evaporation processes. Meanwhile, areas with lots of artificial surface cover, e.g. tarmac, act to retain and re-radiate heat.

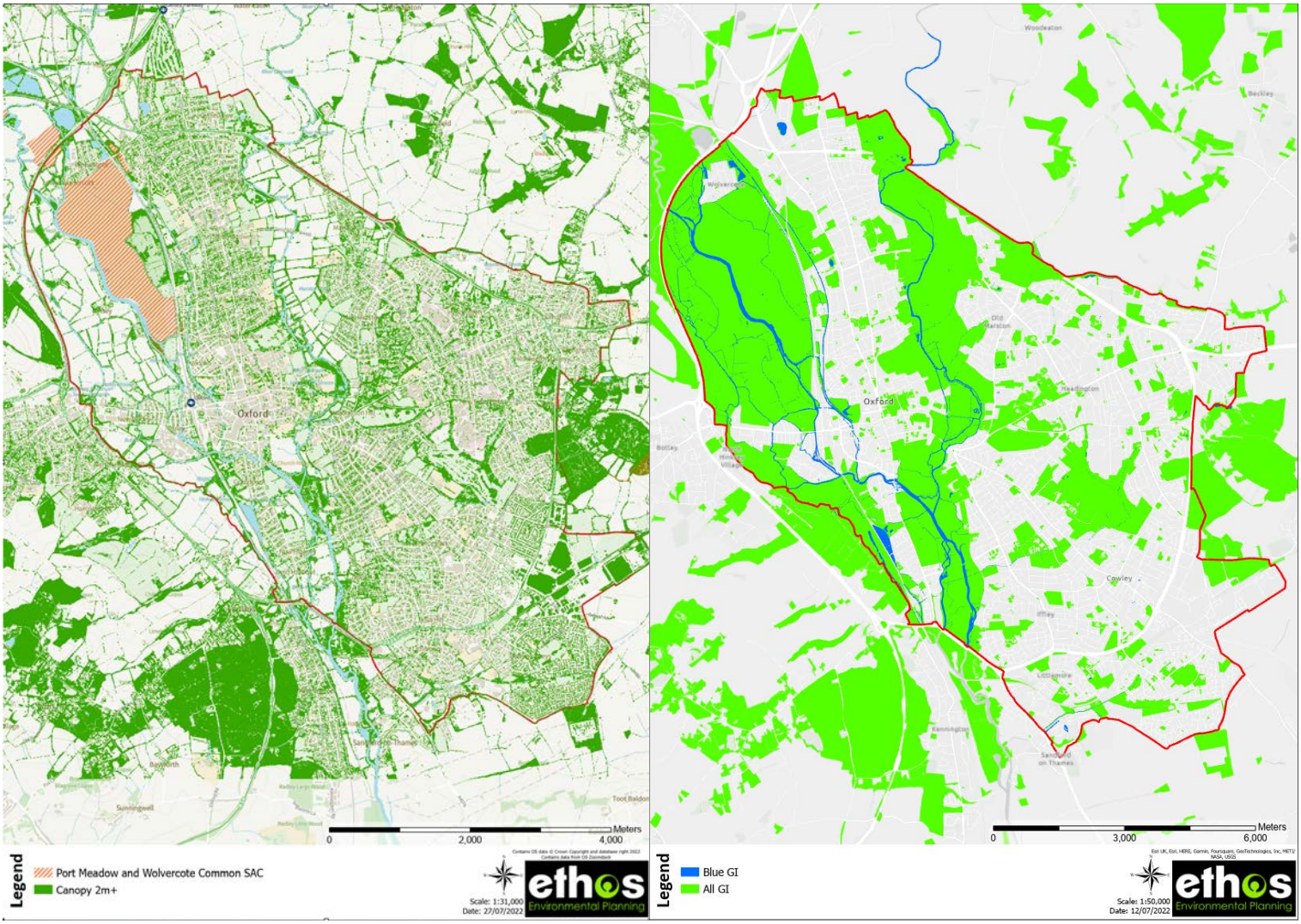

Figure 5: Distribution of Green Cover across the City

The projections of higher summer temperatures in future, as well as more incidences of extreme heat events, such as those experienced over this summer, could exacerbate Urban Heat Islands. Equally, it would seem reasonable to conclude that areas with reduced green surface cover will be impacted by these higher heat events than areas that benefit from greenery.

Socio-economic vulnerabilities in our communities

Oxford is an unequal city, according to the Indices of Multiple Deprivation[2] which measure relative deprivation in local neighbourhoods across the country. The city has several areas that fall within the 10% least deprived in England, particularly in the north, but also has areas that fall within the 10% most deprived, particularly in the south and east, as is highlighted in Figure 4 below. This topic has been discussed in greater detail within the health and wellbeing background paper that was prepared for the Issues consultation 2021.

[2] https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

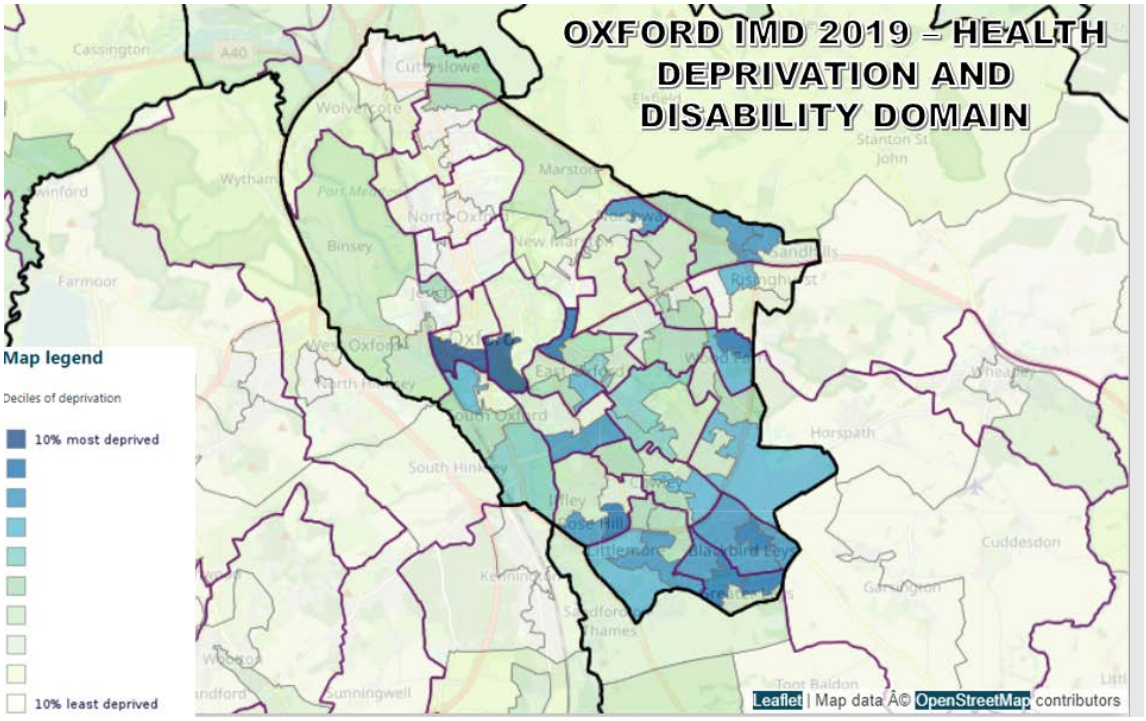

Figure 6: Oxford Indices of Multiple Deprivation

When considering climate change risks and that greater risk occurs where climate hazards overlap with vulnerable, exposed communities who are potentially at greater risk of experiencing negative impacts, we can begin to build a picture of where the greatest risk is likely to occur by comparing where areas of deprivation overlap with the hazard areas set out earlier. For example, there is overlap between the warmest air temperatures and areas of reduced green, natural surface cover seen in the city centre and extending into the south of Oxford where we also find pockets of higher deprivation. There is also some limited overlap between higher flood risk areas (flood zone 2 and 3) and areas of higher deprivation where they fall adjacent to the rivers.

Looking at population health more generally, we can see that there are some health trends that could also influence vulnerability and therefore increased climate change risk. The ongoing impacts of climate change are projected to include wetter winters and increased incidences of intense rainfall events which are likely to exacerbate these risks in the future, with a variety of negative consequences for property, economy and ecosystems as well as human health. The ongoing stress that is caused by flooding events including the threat of flooding, can be taxing on the mental health of those living near flood zones and this could exacerbate challenges faced by those already in poor mental health. Furthermore, those living in deprivation, or with little disposable income, may have fewer resources (financial and material) to adapt to increasing flood risk, which can exacerbate the impacts they face, for example, being unable to pay for insurance that can cover damages during a flood event.

The other climate hazard of increasing significance is likely to be that of warmer, drier summers and more intense and prolonged heat waves. We are likely to see more heat wave events of a similar nature to those that affected the country this summer, with significant implications for health and wellbeing of the most vulnerable. Such events create issues for temperature regulation leading to increased risk of overheating and heat stress, and the impacts of prolonged heat wave events have been shown to be particularly threatening for those with pre-existing health conditions such as heart and lung disease, as well as the young and the elderly. Risks of overheating are exacerbated by the

urban environment around us, including poorly designed buildings (e.g. those with insufficient ventilation and other cooling measures), and outdoor spaces that are lacking in green infrastructure and other forms of shading.

3. Local Plan options to build resilience in city

We have made sure that seeking to build resilience to climate change has a strong thread throughout the consultation document, alongside actions to reduce our impact on climate change. In practice, there will be several policy areas that can contribute to resilience building, these are mainly laid out in chapter 4, and should help to ensure that adaptation measures are built into new development from the outset.

Resilient design and construction

The most direct area addressing resilience building is this policy options set – here we set out a preferred approach of having a specific policy that addresses resilience building to climate change that cross reference other relevant policies where relevant. This would be preferred over a less explicit approach, which simply relies on meeting requirements of other policy areas (e.g. greening, flood risk), but without specifically setting these in the context of changing climate. It also sets out that adaptation to climate change is a priority in designing new buildings.

The policy area will likely carry forward a lot of the principles currently contained within Local Plan 2036 policy RE1, including water saving measures, requiring assessment against an independent sustainability certification scheme and evidencing flood resilience/resistance measures. We have also identified the need for cooling strategies to inform new developments. These strategies would need to be proportionate to the size of the development and would be where applicants demonstrate actions that have been taken to address overheating risks, such as passive cooling measures, designing elements of the building to shade windows during summer, as well as incorporating green features.

We would envisage that applicants demonstrate compliance with the various components of this policy through completing either the broader design checklist which will be required through the design policies (and would therefore be designed to include key resilience concerns), or else through a separate checklist.

Green infrastructure policies

Our suite of green infrastructure policy options sets will also play an important role in this topic. As touched upon earlier, green infrastructure plays a multi-functional role in the benefits it provides for the city, this includes acting as flood storage and to reduce surface water run-off during heavy rainfall; as well as through providing shading and cooling which are essential during hot summers and heat wave events.

Policies that protect existing green infrastructure will help to ensure that resilience is not reduced needlessly through inappropriate development. Equally, policies that encourage additional greening, such as our proposed Urban Greening Factor, can help to ensure that resilience capacity is increased wherever possible, with new development adapted to better withstand negative weather events in future. These are discussed more in the green infrastructure background paper.

Alone these policies are about addressing wider concerns than just climate adaptation, hence the resilient design and construction policy will help to ensure that provision that accords with these

policies is designed with climate adaptation as a key concern separately. It will likely cross reference to these greening policies rather than repeat requirements unnecessarily.

Flooding policies

We have also set out policy options sets for how best to address flood risk in the city. Policies that seek to ensure flood risk is considered in the location and design of new development are crucial for reducing risks to occupants, whilst also ensuring that flood risks are not exacerbated elsewhere because of poor design. Ensuring that drainage on development sites is appropriately considered and that Sustainable Drainage Systems are incorporated within new developments helps to ensure that risks from heavy rainfall events that could otherwise inundate sewer systems will also be crucial.

Once again, the resilient design and construction policies refers to flood resistance and resilience measures with a specific focus on addressing increasing risks because of climate change. It will likely cross reference to these flooding policies rather than repeat requirements unnecessarily.

Health Impact Assessment policy

As with the current Local Plan 2036, we propose to include requirements for Health Impact Assessment on new development again. As this paper has touched upon, health and wellbeing of residents plays an important role in determining levels of risk from climate change, thus is important context that needs to inform design. HIAs can play an important role in this area, through helping to ensure that health and wellbeing impacts of changing climate are considered and encouraging applicants to design their developments in a way that mitigates these risks wherever possible (and avoids measures that could inadvertently increase risks).