

# Portsmouth Climate Change Risks



2040 - 2100

Portsmouth Climate Action Board  
March 2021

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The gas is on full, but the kettle takes a few minutes to boil. We're still waiting for the earth to start simmering, but by 2020 the bubbles will be appearing.

**-Tim Radford, 2004**

# Executive summary

## Built environment

Portsmouth is a flat and condensed city; it is one of the only two island cities in Europe and is the second most densely populated city in the UK. This makes Portsmouth uniquely vulnerable to extreme weather events. If CO<sub>2</sub> continues to be emitted at its current rate the sea surrounding Portsmouth is likely to rise by 0.37m to 0.59m by 2059. While new sea defences are due to be constructed, they could struggle to protect the city if carbon emissions are not curtailed.

By 2050 the maximum average summer temperature is forecasted to increase by 3-5°C. The dense urban environment makes Portsmouth particularly vulnerable to high levels of heat. The abundance of concrete means that heat from the sun is readily absorbed. Combined with the additional human activity in a densely populated area, Portsmouth is vulnerable to prolonged and intense heat waves.

## Natural environment

Green space and trees play an important role in cooling the urban environment and mitigating the impact of flooding. Green space in Portsmouth is sparse, particularly in lower-income areas, with a canopy cover of just 9.8%. Increasing heat will worsen this situation if drought starts to erode green space. As one of the most southern cities in the UK, and home to a major international port, Portsmouth will also be at risk to the introduction of vector-borne diseases from mosquitoes and invasive species.

## Residents

By 2050 higher temperatures will have an increasing impact on vulnerable residents; this will include those over 65 (born before 1985), those living in poor health and the socially isolated. This will be exacerbated by the already high levels of air pollution. If the city continues to maintain and increase its car use, by 2050 thousands of residents will have died from cardiovascular and respiratory conditions linked to air pollution.

## Economy

Shopping districts, institutions and businesses are already at risk of flooding in Portsmouth, with an approximate 1% chance each year, or 25% chance over 30 years. Several train stations, roads and transport hubs are equally at risk of flooding. The immediate cost of a flood event in Portsmouth could be devastating. Business properties and assets could be destroyed while supply chains in and out of the city, and the ability of workers to enter and leave the city, could be affected for some time afterwards. In the long term, the constant threat of a major flooding event could adversely affect the value of both business and residential properties in the city.

# 1.0 Introduction

The world is complex, interconnected and volatile; each decision has a bearing on predictions for the future. Risk assessments for climate change tend to assume that some sort of action will be taken in the future to alleviate climate risks. The extent to which these mitigation efforts will be successful is hard to predict. It relies on determining the global political, economic, technological and sociological developments over the next 50 years; this would be far beyond the scope of this report. Therefore this risk assessment focuses upon the situation right now, not what we could, should or may plan to do in the future. The report looks at the current climate risks in Portsmouth and extrapolates how these risks will intensify. The scientific modelling and projections are clear that current climate risks will become more intense if we do not reduce our emissions. However, the exact year these risks will occur, and the level of intensity, is not clear. To mitigate these risks all governments, institutions, businesses and citizens will need to take action to reduce carbon emissions.

## 1.1 Global context

The Intergovernmental Panel on Climate Change<sup>1</sup> (IPCC) has warned we have until 2030 to prevent global temperatures exceeding 1.5°C above pre-industrial levels (the mean temperature between 1850 and 1900). To achieve this, global carbon emissions will need to almost halve between 2010 and 2030, and reduce to net zero by 2050. If the Earth's atmosphere exceeds this temperature the risk of climate disasters will increase exponentially. Intense storms, extensive flooding, extreme heat and drought will happen much more frequently<sup>1</sup>. If we do not take action to reduce our emissions by 2050 major cities like Portsmouth could look drastically different. The one hundred million car trips<sup>2</sup> taken in Portsmouth each year would continue to worsen air pollution. Consequently, the air pollution could force residents to avoid exercising outside during the summer months<sup>3</sup>. The chances of a catastrophic flood striking Portsmouth will continue to increase; which could leave tens of thousands of residents' homeless and businesses destroyed. Extreme heat could exacerbate existing health conditions leading to hundreds of heat related casualties.

The urgency of this situation has been reflected in the term 'climate emergency', which conveys the existential threat climate change poses both to ourselves and future generations. The nature of this emergency means we need to take immediate action to avert irreversible harms. The imperative of this target is compounded by the risk of climate feedback loops. The Earth is a complex and interconnected system; each action has an impact on countless events and processes<sup>4</sup>. For example, while the Earth's oceans absorb about 30% of CO<sub>2</sub>, the warming of the ocean itself damages vital carbon absorbing organisms<sup>5</sup>.

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<sup>1</sup> The IPCC was formed by the United Nations and works to coordinate work from scientists around the world.

# CLIMATE WARMING SCENARIOS TO 2100

4°C

## **Unchecked emissions**

If we do not take action to reduce our emissions we will reach 4°C by 2100 with catastrophic consequences.

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3°C

## **Current policies**

Political leaders have ambitions to reduce carbon emissions in the future. Current models predict we will reach 3°C warming by 2100.

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2°C

## **Paris Climate Agreement goal**

The international community has committed to keep warming well below 2°C. This would help limit the most damaging effects of climate change.

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1.5°C

## **Limit to prevent further risks**

Keeping below 1.5°C would help to protect key ecosystems and reduce impacts on poorer regions around the world.

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1°C

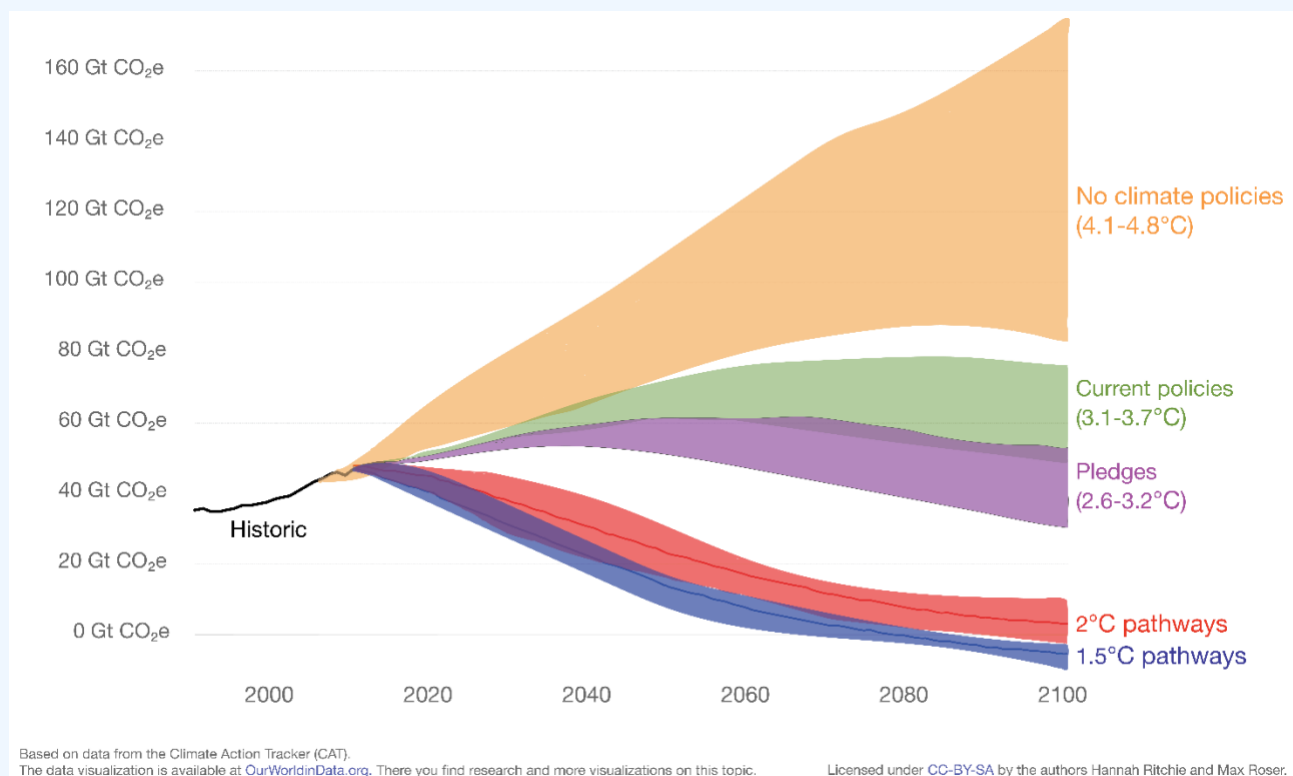
## **Existing warming today**

Since industrialisation the Earth is 1°C warmer. Damaging climate impacts are already being felt around the world.

**Figure 1** - Projections sourced from the Committee on Climate Change (CCC)

It is therefore unclear if the same level of carbon absorption will continue if the temperature of the ocean increases. For this reason, there is a risk that feedback loops could lead to a tipping point in which the climate warms exponentially and the damage to the climate is irreversible<sup>6</sup>. Inertia in the Earth's climate system also means that, even if carbon emissions were to stop today, temperatures will continue to rise in the immediate future<sup>7</sup>. It is therefore imperative that we stop emitting carbon as soon as possible and prepare for a changing climate.

To address this global and existential threat in 2015 political leaders signed The Paris Climate Agreement. The Paris Climate Agreement proposes an international carbon reduction plan, which aims to keep the global average temperature below 1.5°C<sup>8</sup>. While countries are commended for signing up to the agreement, the international community is not on track to meet its long-term climate targets<sup>9</sup>. Consequently, the global temperature is likely to reach 3-4°C warming in 80 years; far exceeding the target of <1.5°C<sup>10</sup>. Likewise, the World Meteorological Organisation has predicted that there is a ~20% chance that we will reach 1.5°C for at least 1 year by 2025<sup>11</sup>.

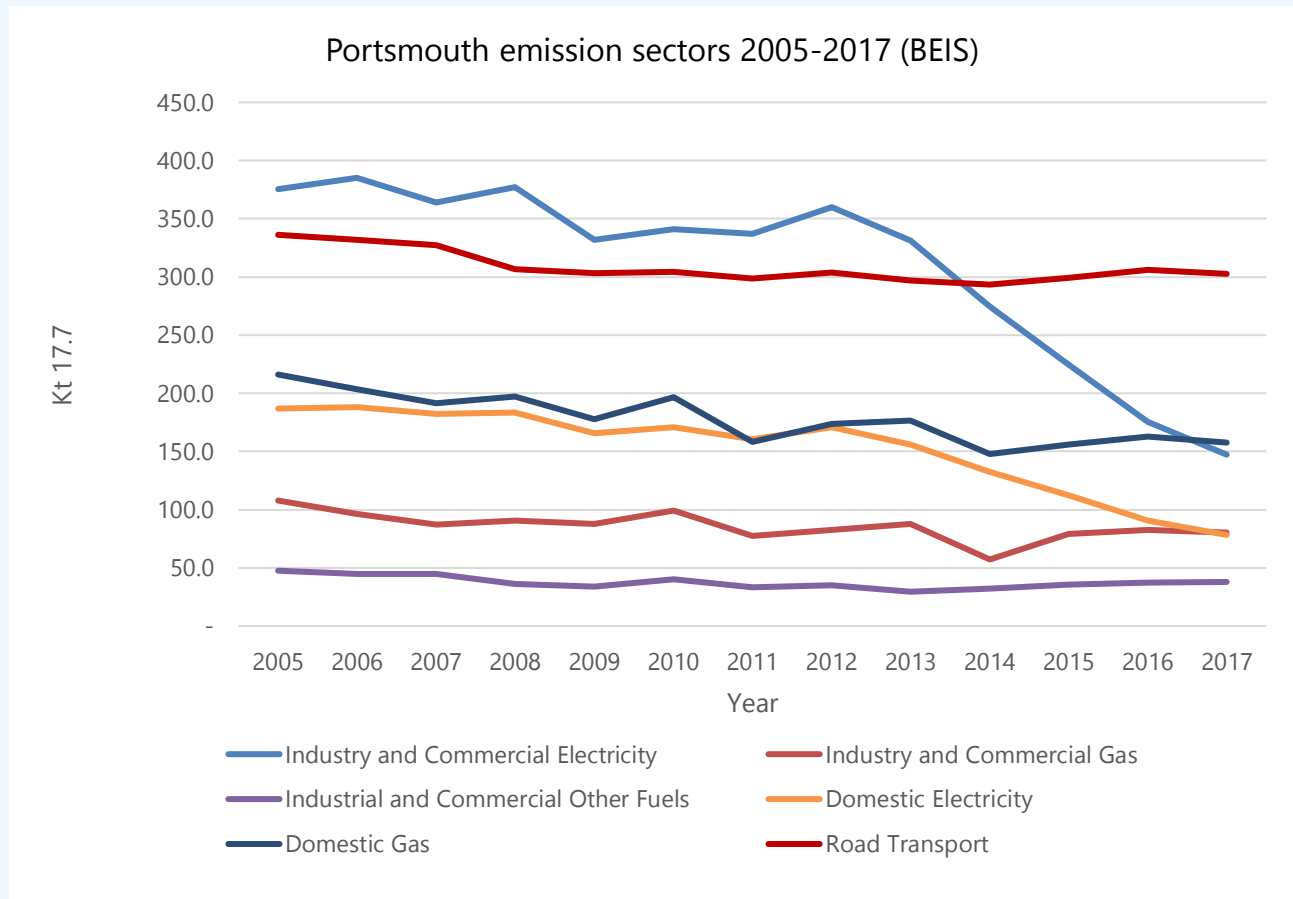


**Figure 2** - Our World in Data: Projected warming pathways to 2100, temperature figures represent the estimated average global temperature increase from pre-industrial levels.<sup>12</sup>

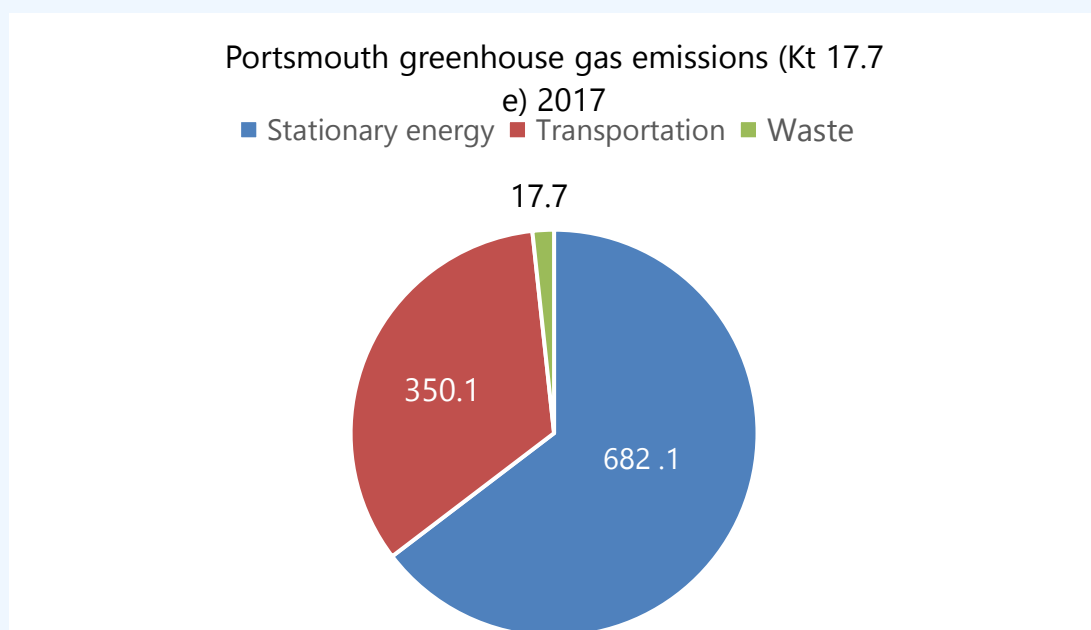
## 1.2 Regional context

In 2017 Portsmouth emitted 813 kilotonnes of CO<sub>2</sub>; over 300kt CO<sub>2</sub> was emitted by road transport, 265 kt CO<sub>2</sub> was emitted by industry and 241kt CO<sub>2</sub> was emitted from energy used in homes<sup>13</sup>. Since 2005 CO<sub>2</sub> emissions in Portsmouth have reduced by over 30% from 1280 kt CO<sub>2</sub>. This is the equivalent of all car owning residents (66% of households<sup>14</sup>) halving their driving for 2 years. This demonstrates that progress is possible. However, most of this reduction is due to the national grid reducing the use of coal to generate electricity nationwide; the carbon emissions from electricity have decreased by 60%. The people of

Portsmouth have not yet made significant changes to their lives to reduce carbon emissions. For instance, the emissions from transport in Portsmouth have remained constant for almost 10 years. Despite Portsmouth being one of the most condensed, flattest and temperate cities in the UK; transport emissions in 2017 were higher than larger cities like Southampton, Brighton and Oxford.



**Figure 3** - BEIS: CO<sub>2</sub> emitted within the city boundaries (scope 1) and from the national grid (scope 2).



**Figure 4** - SCATTER Cities: Greenhouse gases emitted within the city boundary (scope 1) from the national grid (scope 2) and sites outside of the city (scope 3).

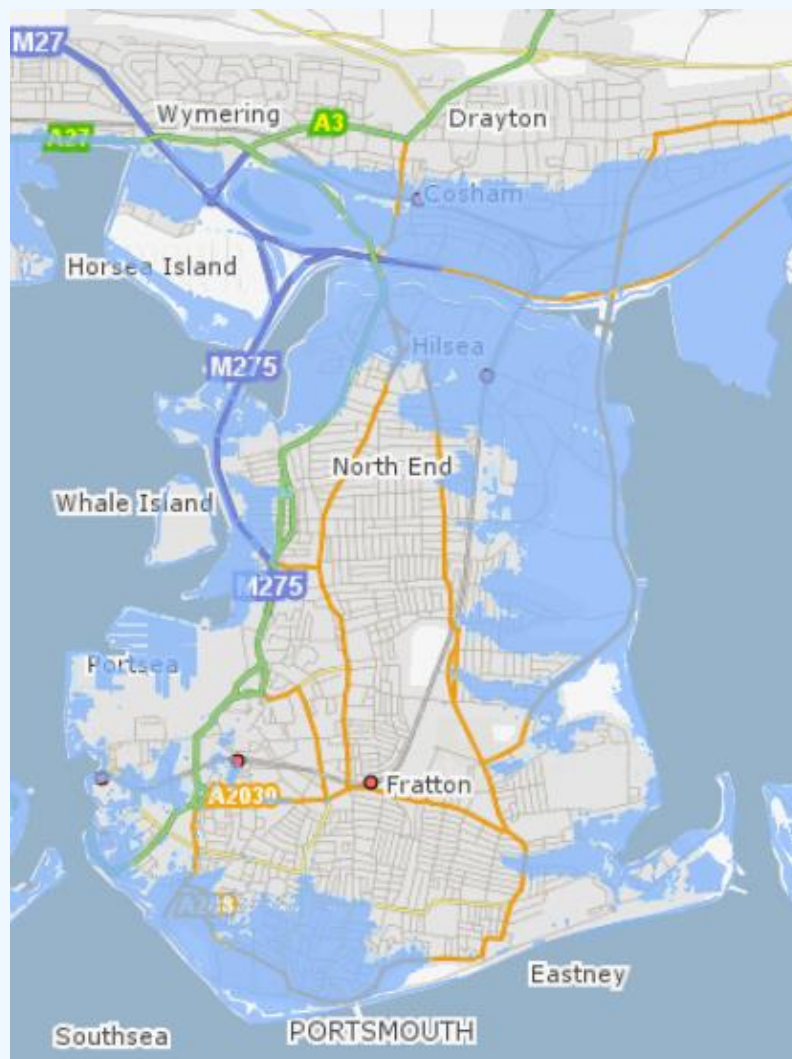


## 2.0 Built environment



## 2.1 Flooding

Portsmouth is the second most densely populated city in the UK; with 5,724 people per km<sup>2</sup>, 90,000 dwellings, 7,500 businesses and 65,000 sqm of employment space. As an island city we are limited in our ability to relocate away from areas at risk of flooding. Flooding will not only impact local people and businesses, the city is also home to major industries in aerospace, defence, maritime and tourism. There are numerous important assets concentrated on our small and exposed island city.



© Ordnance Survey - data derived from OS Premium.

**Figure 5** - Partnership for Urban South Hampshire: Projected flood risk zones for the year 2055<sup>15</sup>

As an island city the most noticeable risk to Portsmouth is the rising sea level. Since 1900 the mean sea level around the UK has risen by about 16cm. It is predicted that the sea level will rise by 0.37m to 0.6m<sup>16</sup> in the 2050s and by 1m in 100 years<sup>17</sup>. However, in a worst case scenario the sea level could rise by over 1.4m<sup>18</sup> in the 2080s, that is, if we take no action to tackle climate change and climate feedback loops intensify<sup>19</sup>. Similarly, extreme wave height is predicted to increase by 5% by 2050 and 10% by 2080. For this reason over £100 million is being spent improving the sea defences in Portsmouth. This is an ambitious and far reaching project which should be commended for its scope. However, while the sea defences

will significantly improve our resilience, their effectiveness will be undermined if we do not reduce our carbon emissions. If we continue to emit carbon at our current rate, the new sea defences surrounding Portsmouth could struggle to withstand the sea level height by 2080<sup>20</sup>.

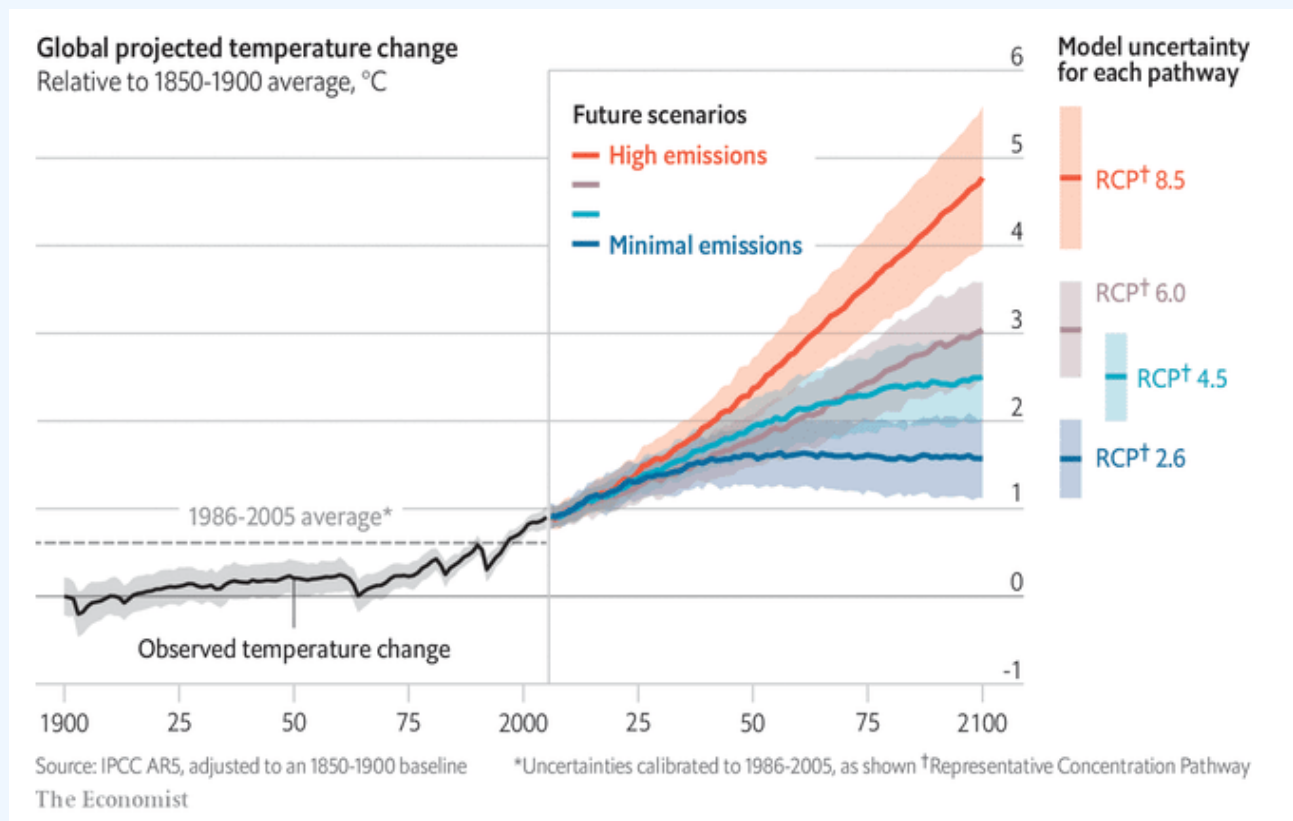
Our existing sea defences are prepared for a 1 in 100 year flood event, in which multiple factors coordinate to cause a surge in the water level; for example a high tide, strong winds and heavy rain. The 1 in 100 year terminology equates to a 1% chance of a major flood event happening in Portsmouth every year; however this does not mean that it is only likely to happen once in 100 years. Over 30 years there is an approximate 25% chance of a 1 in 100 year flood event occurring. For example, Somerset suffered a 1 in 100 year flood in both 2012 and 2014. The new sea defences in North Portsea are designed to withstand a 1 in 500 year flood event; the planned Southsea defences are designed to provide protection against a 1 in 200 year flood event until 2115<sup>21</sup>. Unfortunately, climate change makes flooding predictions incredibly difficult. Overtopping, heavy rain and storm events can cause even the most robust defences to fail. The US city of Houston has been hit by three 1 in 500 year flood events in three years<sup>22</sup>, while Ellicott City in Maryland has suffered from two 1 in 1000 year flood events in two years<sup>23</sup>. We are already seeing more frequent and powerful storms; the UK has experienced a major flood almost every year since 2007<sup>24</sup>. These intense storms could strike the UK with increasing frequency in the future, a 1 in 100 year flood event could become a 1 in 50 year flood event within the next century if we do not reduce our carbon emissions<sup>25</sup>.

While the rising sea level is one of the most noticeable threats, rainfall can cause similarly damaging flood events. Since 2010 both summers and winters in the UK are over 12% wetter; compared to the 1961-1990 period<sup>26</sup>. Because warmer air holds more water vapour the rainfall in Portsmouth will continue to increase; however, this will not be gradual or evenly distributed across the month. It is expected that shorter heavier events of rain will increase the risk of flash floods; by 2050 the intensity of rainfall is expected to increase by up to 20%. Despite the precautions and work implemented by Portsmouth City Council and Southern Water; the low topography of Portsmouth makes surface water flooding a particular issue. The south of the island was previously muddy marshland; also known as the Great Morass. This wet marshland was drained in 1886; however, the bowl like shape leaves a residual risk of flooding from rainfall (see figure 5). Portsea Island is also bounded by the sea, so flood water will not drain away easily.

## 2.2 Heat

The MET Office has reported that the UK's ten hottest years on record have all happened since 2002<sup>27</sup>. Days of extreme heat in South East England have also risen from once every 1000 days to as often as once every 200 days<sup>28</sup>. The increase in temperature is continuing, with 2019 recording both the highest summer temperature (38.7°C) and winter temperature (21.2°C) on record<sup>29</sup>. Portsmouth's dense urban environment is particularly susceptible to increased levels of heat, this is because of the urban heat island effect. The centre of a built urban area can be several degrees warmer than the surrounding rural areas. This additional heat is caused by a combination of human activity and the presence of buildings in close proximity. The lack of green space and canopy cover means that heat from the sun is more readily absorbed by the urban fabric; like concrete, tarmac and stone. These factors

combined contribute to the urban heat island effect and therefore increased temperatures in cities like Portsmouth.

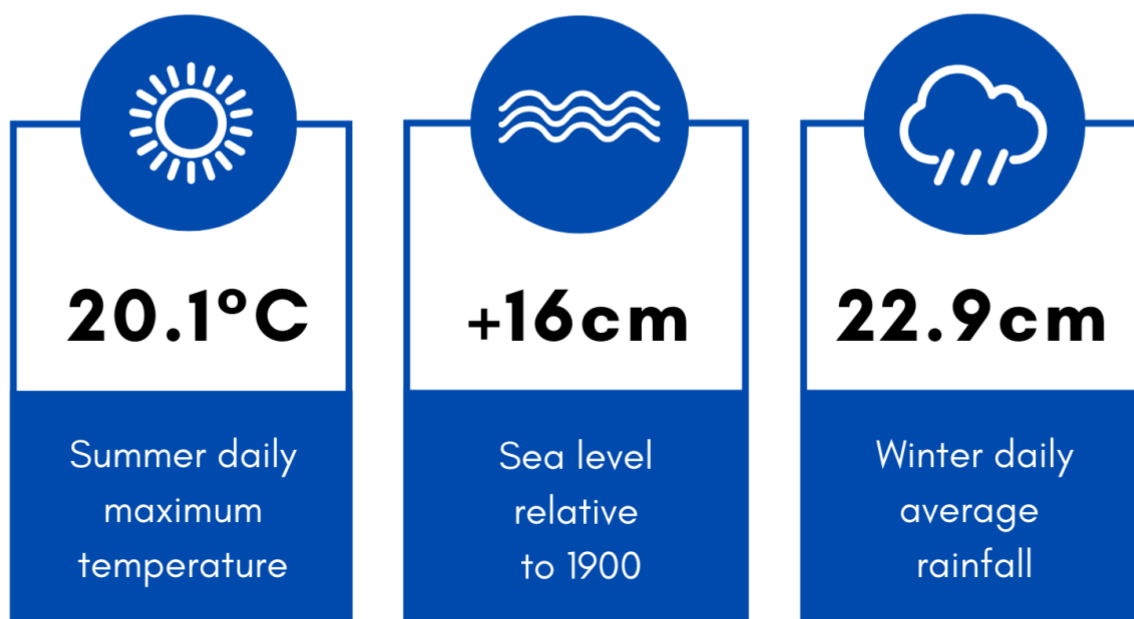


**Figure 6** - The Economist: Global projected temperature change under low (RCP\* 2.6), medium (RCP 4.5), high (RCP 6.0) and business as usual (RCP 8.5) emissions scenarios to 2100.

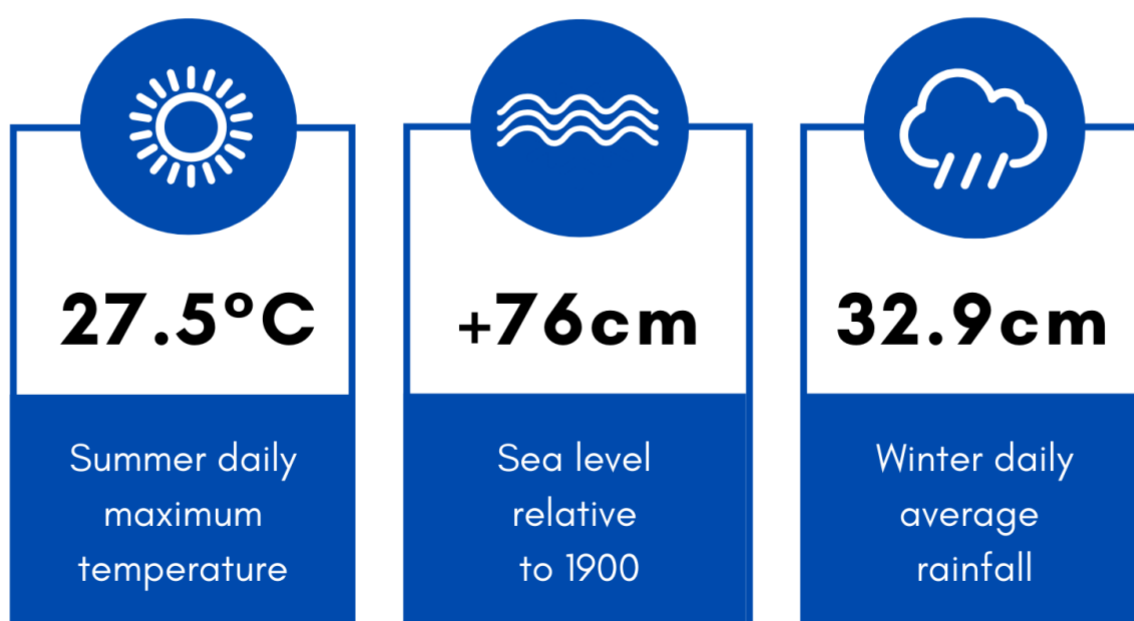
\*The Representative Concentration Pathways (RCP) show scenarios resulting from different atmospheric concentrations of CO<sub>2</sub>. The scenarios provide a standardised projection for future climate pathways to 2100. RCP 2.6 shows the projection if there is a major turnaround in climate policies within the next few years. RCP 4.5 assumes emissions will peak around 2050 and then stabilise. RCP 6.0 assumes that emissions will peak around 2080. RCP 8.5 shows a similar trajectory to our current pathway, that is, CO<sub>2</sub> emissions continue to grow and are not curtailed.

# UNCHECKED EMISSIONS WARMING TO 2050

## 2020



## 2050



**Figure 7** - Projections sourced from the Environment Agency: Climate Impacts Tool. These values show the national averages consistent with a 4°C rise in global mean temperature by 2100. \*The sea level relative to 1900 is an approximation.



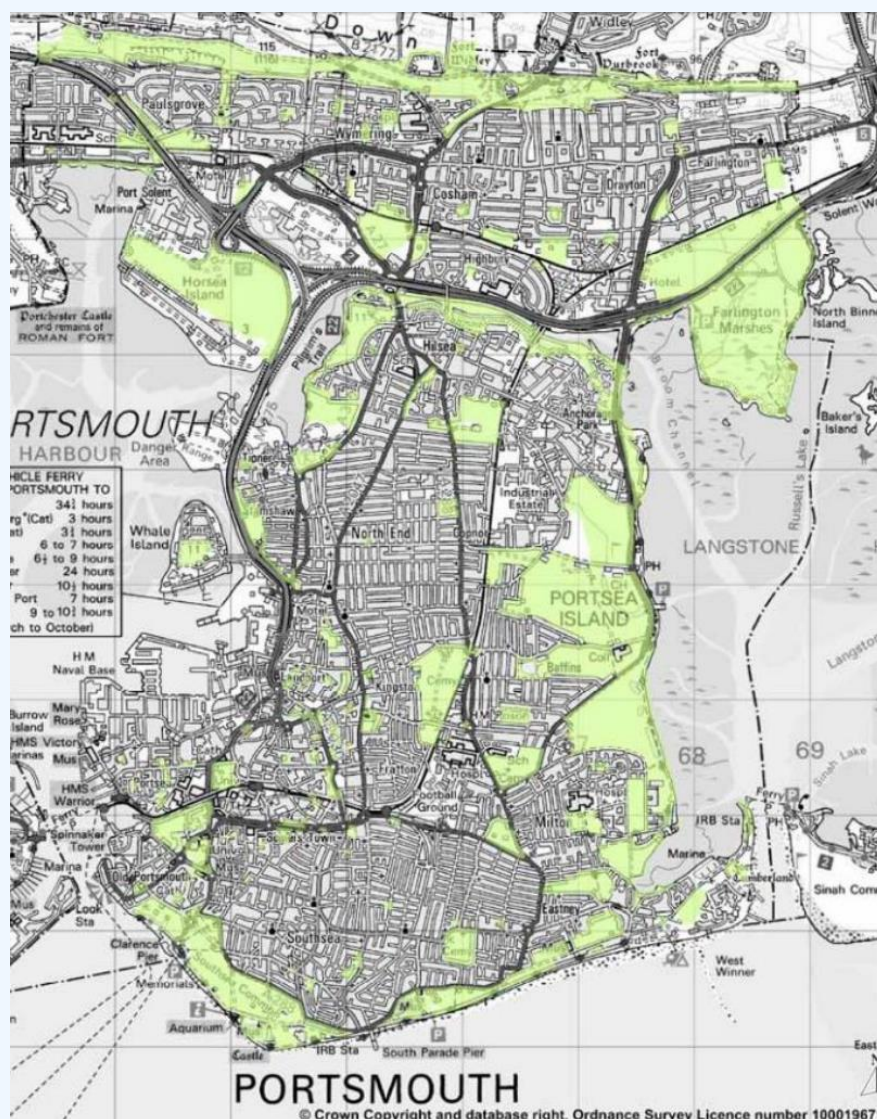
## 3.0 Natural environment



### 3.1 Green space

Trees and green space play an important role in cooling the urban environment and mitigating flood risk. Firstly, trees provide shade for people, buildings and surfaces. Secondly, trees and greenery reduce the air temperature through a process called evapotranspiration (evaporation and transpiration). When the sun's rays hit a tree's leaves it causes stored water to evaporate. Evapotranspiration therefore cools the plant and surrounding area, in a similar way to how sweating cools the human body. Thirdly, trees help to mitigate flooding; 1.3 million trees can 'catch' about 7 billion tonnes of rainwater<sup>30</sup>.

The current tree canopy cover in Portsmouth is 9.8%<sup>31</sup>; this is low relative to similar cities like Southampton (18.5%<sup>32</sup>), Plymouth (18%<sup>33</sup>) and London (21%<sup>34</sup>). Figure 8 shows the protected open spaces in the city; excluding cemeteries, there is sparse coverage in the centre of the island. There is also a general correlation between lower-income areas and an absence of green space. As mentioned, the lack of green space contributes to the urban heat island effect. This lack of greenery in lower-income areas could therefore exacerbate the impact of climate change on those least able to afford to mitigate it.



**Figure 8** - Portsmouth City Council: protected open spaces in Portsmouth<sup>35</sup>

Because of the minimal amount of farming taking place in the city, climate change is unlikely to have a significant impact on agriculture in Portsmouth. However, there could be impacts on national and global agriculture which could impact the availability of food<sup>36</sup>. Global transport routes are likely to become increasingly disrupted. This could lead to increases in food prices in Portsmouth, which will disproportionately impact those in lower-income groups.

### 3.2 Biodiversity

The milder winters, hotter summers and more extreme weather will have a direct impact on biodiversity in Portsmouth. Increased heat could lead to greater instances of drought and less water available for vegetation. This would lead to a shift in species composition as the local wildlife would need to adapt to less hospitable conditions. The change in species composition could also be affected by invasive species from continental Europe. Increased temperatures are already allowing more mosquitoes and ticks to enter the UK<sup>37</sup>. This also increases the risk of new vector-borne diseases entering the UK including Zika, dengue, West Nile fever and Chikungunya<sup>38</sup>. Portsmouth's geography, as one of the most southern points of the UK, means it could be at the forefront of species arriving from continental Europe. The climate is not the only factor that could increase the presence of mosquitos in Portsmouth. Shipping and the movement of goods provides an opportunity for mosquitoes to travel into Portsmouth through the international port<sup>39</sup>.

### 3.3 Water

The average Portsmouth Water customer consumes 140 litres of water a day<sup>40</sup>. Most of the water supply relies on groundwater, springs and rivers. A warming climate will impact these supplies by reducing the amount of groundwater through evaporation and reducing river flows. By 2079 rainfall in south east England could decrease by 40% during the summer months. Portsmouth has the cheapest water in England and Wales and most customers are not charged by the amount of water they use. As the water is cheap, and use of water meters low, there is no real incentive for residents to reduce their water usage. The warming climate will increase the demand for water from people, wildlife and the natural environment. The access to cheap water could therefore make it difficult to change resident's behaviour in response to a warming induced drought.



## 4.0 Residents



## 4.1 Health

In 2003 there were over 2000 heat related deaths across the UK in just 10 days, this is expected to more than double to 7000 deaths a year by 2050<sup>41</sup>. In recent years there has been a linear relationship between temperature and mortality rate; with an estimated 75 extra heat deaths a week for each degree of increased temperature<sup>42</sup>. By 2040 it is predicted that intense heat waves could strike every other year. If we continue emitting carbon dioxide at our current rate, by 2060-2079 summer temperatures could increase by 3-4°C. While this may seem like a small amount this will push far more days to exceed the heat wave threshold (32°C during the day and 18°C during the night). Residents over 65 (born before 1985), those living in poor health and the isolated will be most susceptible to heat deaths by 2050. However, part of this increased risk is attributable to increased air pollution and its effect on respiratory illnesses.

Southern England is predicted to be one of the regions most impacted by increased UV radiation. This increase will be exacerbated by climate change and could increase the rates of melanoma by 20% by 2080<sup>43</sup>. Children are the most at risk to UV radiation both in increased risk to skin cancer and damage to the cornea and lens of the eye<sup>44</sup>. Workers engaged in outdoor occupations are also likely to be at a greater risk of heat stress and UV exposure. This will therefore disproportionately impact lower income groups in the community.

A positive aspect of the higher temperatures will be warmer winters. Days which will require heating in the home (those below 18°C) in south England are projected to reduce by 50% in 2080 compared to the 1961-1990 period. This should reduce the amount of winter deaths and reduce the heating energy demand in the city. Likewise, the warmer weather could make physical activity more appealing, however this would likely be offset by increased air pollution, motor traffic and UV radiation<sup>45</sup>.

## 4.2 Wellbeing

The disruption and displacement caused by extreme weather events will have a significant and long-lasting impact on residents. This will range from the immediate psychological stress from the event and the ongoing stress from being displaced. Living in an area with an increased risk of flooding could also cause financial stress for residents. The risk of flooding could make the area less attractive for investment and residency; consequently the value of houses would decrease.

Since 2016 UK homeowners have been protected by the Flood Re insurance scheme. Flood Re was setup up in 2016 by the government to subsidise flooding insurance for properties in flood risk areas. While the scheme has helped to keep insurance affordable the scheme is due to be discontinued in 2039; at which time flooding insurance will be charged at the full market price. This could lead to economic hardship for thousands of people in Portsmouth if they cannot afford the higher insurance premiums. House prices could also decrease as more people recognise the threat posed by climate change and rising sea levels.

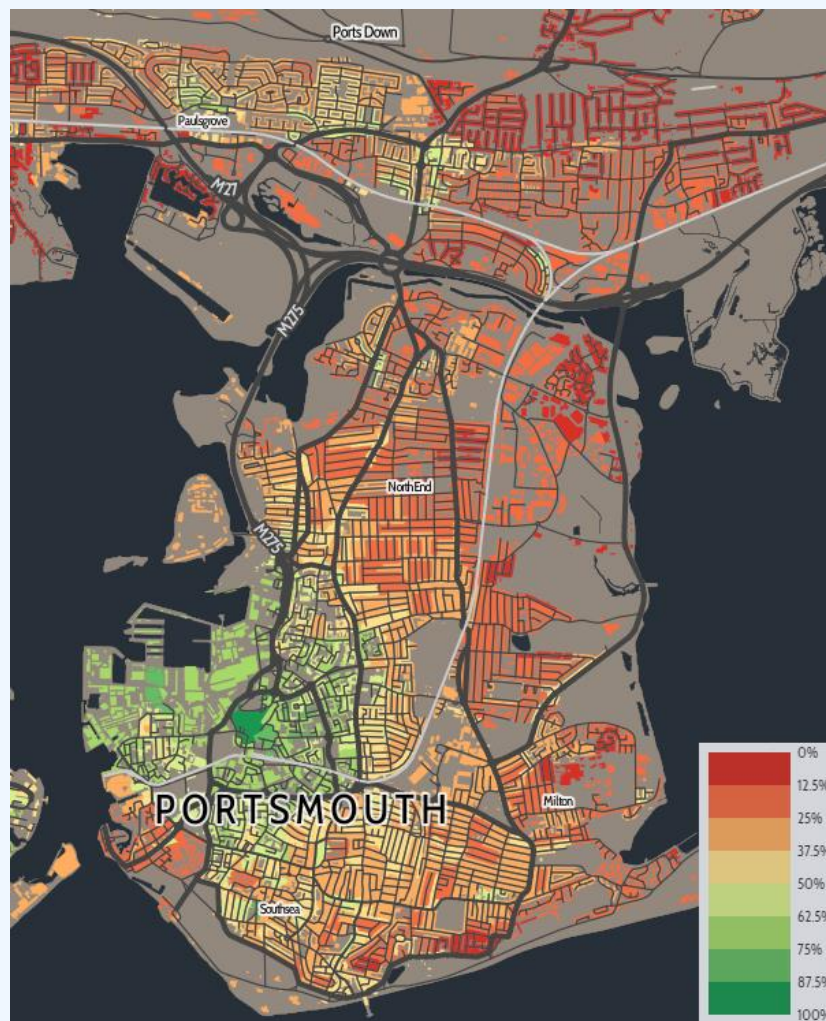
### 4.3 Air quality

Increased heat will worsen air pollution in the city. Heatwaves are typically accompanied by smog, which can lead to higher concentrations of nitrogen dioxide and particulate matter<sup>46</sup>. Similarly, heatwave conditions and sunlight increase the levels of ground-level ozone. While stratospheric ozone helps to protect the planet from UV rays; at the ground level reactions with pollutants make it damaging to human health<sup>47</sup>. The risk to those with health conditions in the city; like asthma, cardiovascular diseases, hay fever and other allergies, will therefore increase. This could lead to an increase in respiratory and cardiovascular mortality for residents in Portsmouth. Portsmouth already experiences higher incidence of several health conditions compared to the national average (see figure 9). Almost 100 deaths a year in Portsmouth can already be attributed to NO<sub>2</sub> air pollution alone. The impact of air pollution on mortality and morbidity is only likely to increase while the city's residents are reliant on motor vehicle transport.

Health condition	England average	Oxford	Brighton & Hove	Southampton	Portsmouth
Percentage of adults classified as overweight or obese (2018-2019)	62.3%	48.9%	50.5%	63.7%	66.5%
Fraction of mortality attributable to particulate air pollution (2018)	5.2%	5.9%	5.8%	6.1%	6.7%
Mortality rate for under 75s from all cardiovascular diseases (2016-2018)	71.7 per 100,000	66.9 per 100,000	71.7 per 100,000	80.3 per 100,000	85.1 per 100,000
Number of people killed or seriously injured on roads (2016-2018)	42.6 per 100,000	35.6 per 100,000	55.9 per 100,000	45.8 per 100,000	52.3 per 100,000
Number of people killed on roads while cycling (2018)	0.16 per 100,000	0 per 100,000	0 per 100,000	0 per 100,000	0.93 per 100,000
Percentage of people exposed to transport noise of 55 dB(A) or more during the night-time (2016)	8.5%	*not recorded	8.9%	10.7%	14.9%

**Figure 9** - Figures sourced from Public Health England<sup>48</sup>, the Department for Transport<sup>49</sup> and the Office for National Statistics<sup>50</sup>

While everyone in the city has to breathe the same air, air pollution and climate change will disproportionately impact lower-income communities. Figure 9 not only shows the health conditions that could worsen with increased heat, but also the issues of inequality in the city. While Portsmouth is geographically ideal for walking and cycling, figure 9 shows how dangerous the roads can be for vulnerable road users. Likewise, motor vehicle traffic is one of the main contributors to air pollution and disproportionately impacts lower-income areas. This is despite lower-income groups being significantly less likely to own a car than medium and higher income groups. Lower-income households are also less able to make adaptations to their homes structure or purchase additional devices, like air conditioning units, to alleviate extreme heat. Although transport noise will disrupt sleep and wellbeing; lower-income households are still more likely to open their windows to cool their homes, which could increase their exposure to air pollution<sup>51</sup>. Conversely the effect of higher income households installing air conditioning will increase the overall heat of the city. This is because the warm air exhausted by air-conditioning units will increase the air temperature, contributing to the urban heat island effect<sup>52</sup>.



Census data © Crown Copyright Office of National Statistics.

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**Figure 10:** Map showing areas by car or van ownership based on the 2011 census; green colouring shows areas where the majority of households do not own a car or van<sup>53</sup>.

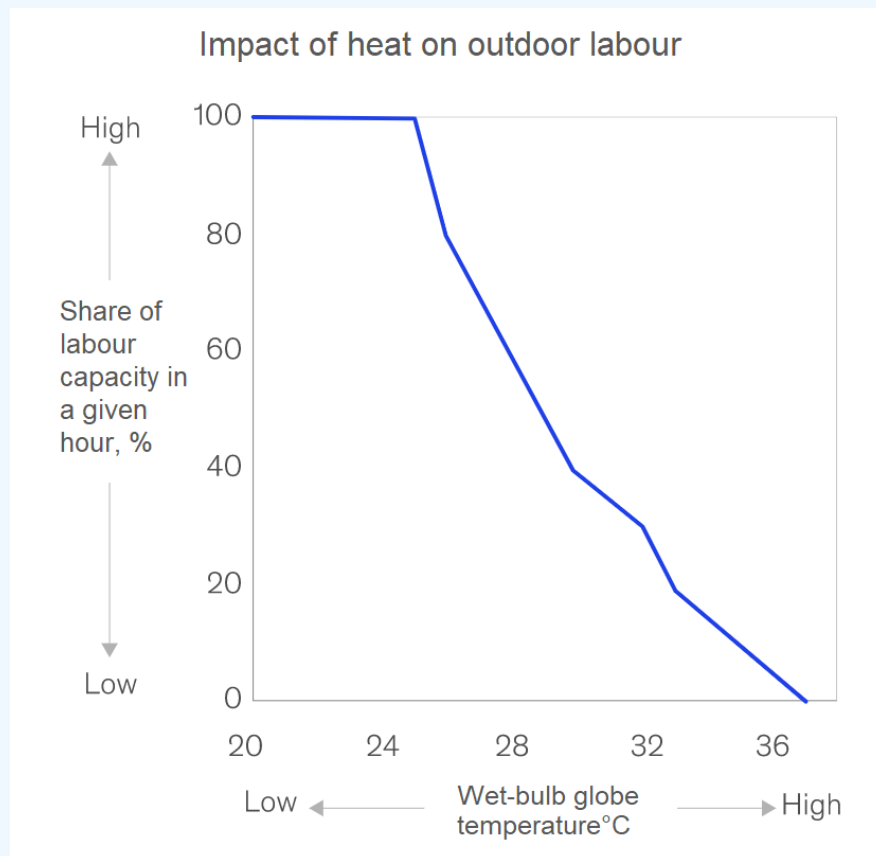


## 5.0 Economy



## 5.1 Productivity

One of the direct impacts on businesses in the city if temperatures increase is reduced productivity. Productivity in workers can decrease by 5% once temperatures reach 28°C, with higher temperatures further lowering output<sup>54</sup>. As well as decreased productivity higher temperatures increase absenteeism. A 1°C ten-day average increase in temperature can increase absenteeism by up to 5%<sup>55</sup>. While air conditioning could be utilised to mitigate some of these issues, it is an expensive and energy intensive utility. As mentioned, the emissions and heat caused by air conditioning units will further contribute to the urban heat island effect; and has a minimal impact on reducing absenteeism.



**Figure 11** - McKinsey & Company: The impact of heat on outdoor labour productivity. \*Wet-bulb temperature indicates the temperature felt when damp skin is exposed to the air.

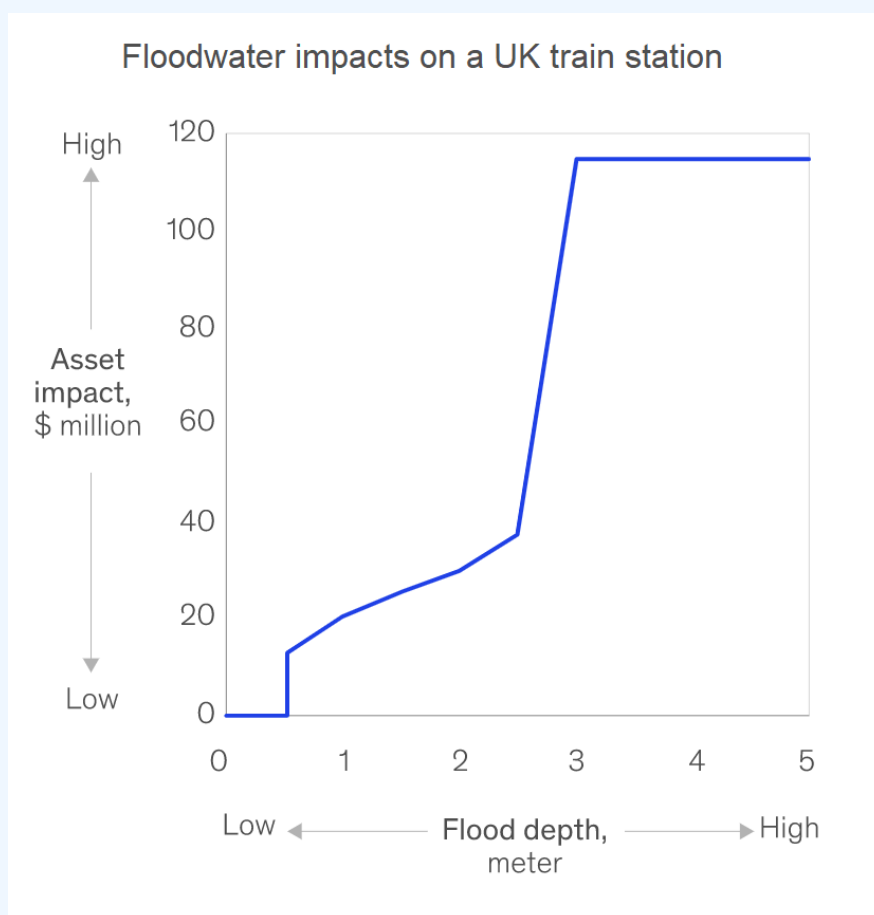
For the past 100 years Portsmouth has benefited from a relatively stable and temperate climate. There have been instances of storms and flooding, however these have not been frequent enough to cause catastrophic disruption. Therefore supply chains and business procedures are able to prioritise efficiency over resilience. While these efficient systems have benefitted the city they have not been optimised for high levels of strain. Consequently, climate change could cause widespread and frequent disruption<sup>56</sup>. This additional strain on supply chains will cause a range of knock-on effects throughout the local economy.

While larger companies are beginning to prepare for climate risks, most businesses in Portsmouth are small and medium-sized enterprises (SMEs); with 89% employing fewer than 10 employees<sup>57</sup>. SMEs are less likely to have produced a business continuity plan for an extreme weather event<sup>58</sup>. The most common reason is that the cost of producing a business continuity plan often outweighs the immediate benefit of conducting one<sup>59</sup>. Consequently,

SMEs frequently rely solely on their insurance cover<sup>60</sup>. However, the extent of cover for extreme weather events needs to be considered in detail to ensure the policy holder is fully protected.

## 5.2 Infrastructure and buildings

Like homes, businesses in Portsmouth will be affected by the increased cost of protecting their properties against flooding. It could become increasingly difficult to insure against flooding as policy costs increase and flooding becomes more frequent. Major shopping districts (like Palmerston Road, Albert Road and Gunwharf Quays), institutions and businesses (like the University of Portsmouth, Lakeside North Harbour, and Hilsea Industrial Estate) are likely to face a residual risk of flooding if carbon emissions continue to increase. Flooding could also cause damage and disruption to core infrastructure links; this could include railway stations like Portsmouth Harbour, Portsmouth & Southsea, Hilsea and Cosham. As an island city Portsmouth is at a particular risk to traffic and transport disruption. Two of the three main roads connecting the island to the mainland are located in flood zones. This could result in significant disruption to supply chains entering and leaving the city. This would include the restriction of access for commuters, businesses and residents, which averages approximately 90,000 trips a day into the city<sup>61</sup>.



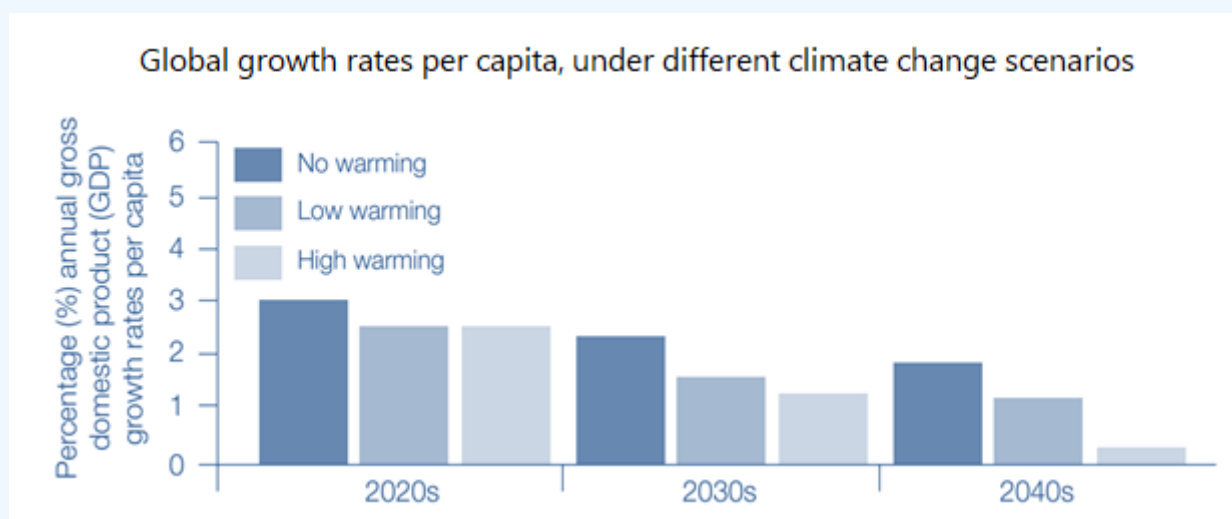
**Figure 12** - McKinsey & Company: The impact of floodwater on a UK train station, based on the average cost of a new-build train station. \*\$20 million equates to approximately £15 million.

### 5.3 Tourism

Portsmouth hosts hundreds of thousands of tourists each summer, the increased temperatures could therefore provide a short-term boost to this industry. However, this increased temperature will affect the whole of Europe; therefore it is difficult to predict the long term impact on tourism in the city. For example some models have predicted that by 2080 the south of England will have a reduced market share from both international and domestic tourists; while Scotland, Wales and northern England will increase their share<sup>62</sup>. The positive effects of warmer weather could also be counteracted by increased rainfall. Extreme weather events would become more frequent if the global temperatures increase; tourists may therefore become less willing to seek a long stay in the city.

### 5.4 Global supply

If carbon emissions continue at their current rate there will be a serious reduction in global economic growth and a possible decline by 2050. By 2030 the reduction in productivity from heat alone is predicted to cost the global economy over £1.5 trillion<sup>63</sup>. The economic impact will be felt in some regions of the world by 2030, parts of the developing world are already being affected now.



**Figure 13** - Ministry of Defence: The impact of different rates of warming on the global economy (data sourced from the International Climate Initiative)

Climate change will have far reaching, and difficult to predict, global consequences. Intense storms and rising sea levels could disrupt global shipping and transportation. Rising temperatures could lead to railway lines buckling and tarmac melting on roads. Flooding could affect the use of roads, tunnels and railway lines across the globe<sup>64</sup>. Further political upheaval could lead to a scarcity of resources and chokepoints on major trade routes, which will further disrupt supply chains. There are a range of businesses operating in Portsmouth and each will be affected differently by these global disruptions. From the local independent businesses struggling to insure their properties and attract custom, to global enterprises facing a shortage of parts in their supply chains. The knock-on effects could be similar to other economic shocks including a reduction in sales and custom, and an increase in unemployment.



## 6.0 Conclusion



## 6.1 COVID-19

While this report was being prepared the world was overwhelmed by a deadly pandemic. Millions of people have been infected with COVID-19 and hundreds of thousands of people have died. The UK has been one of the worst effected countries with over 100,000 deaths directly attributed to the virus<sup>65</sup>. By 30<sup>th</sup> July 2020 the UK recorded the third most deaths in the world, and the most deaths in Europe, as a direct result of COVID-19<sup>66</sup>. Although the UK has world class universities, cutting-edge research facilities, modern and efficient infrastructure and a stable government; the COVID-19 pandemic has caused widespread disruption.

The COVID-19 pandemic has shown that even a predictable event can devastate the most prepared and resilient countries. Less than six months before the outbreak of COVID-19 the UK was ranked as the second most prepared country in the world for a global pandemic<sup>67</sup>. At the end of March 2020 the government's Scientific Advisory Group for Emergencies (SAGE) stated that a reasonable worst-case scenario could see 50,000 deaths (caused as a direct result of COVID-19) between 30<sup>th</sup> March and September 2020<sup>68</sup>. It is therefore prudent to consider the worst-case scenario when preparing for a disaster, as opposed to focusing only on the most likely scenario.

The sudden impact of the COVID-19 pandemic, and the changes we were forced to adopt, demonstrate the difficulty in predicting future risks. In our interconnected and globalised society even the smallest changes can impact countries across the world. The complexity of nature means that we will continue to be exposed to unknowable threats. Likewise human, political and societal changes will change the trajectory of even the most thorough and accurate climate models. The changes made throughout the near-global lockdown may help to reduce global CO<sub>2</sub> emissions over the long-term. Conversely, the economic recovery, and the will of political leaders, may undo years of climate agreements and treaties.

COVID-19 in itself has caused a major health crisis, but it has also exposed numerous health inequalities across the UK. The elderly, vulnerable and those living in lower-income areas are most at risk from COVID-19<sup>69</sup>. As discussed throughout this report, those most at risk to COVID-19 are similarly at risk to the harmful effects of climate change. Action will need to be taken to improve health outcomes and wellbeing for all parts of the city. We cannot keep working to the status quo, the city will have to show leadership and prioritise actions which will benefit all residents of Portsmouth.

Climate change could have a similar impact as other natural disasters like pandemics, earthquakes and volcanic eruptions<sup>70</sup>. For thousands of years humans had to prepare for the worst, and hope for the best, when confronting these threats. However, climate change is different as we have direct control over its severity. We can make changes to the way we live our lives and the questions we ask of our leaders. The COVID-19 pandemic demonstrates the fragility of our society, but also our resilience and propensity to adapt. Despite the bleak outlook, and the challenges that lie ahead, the people of Portsmouth have shown that they can adapt to the most disruptive and challenging events.

## 6.2 Concluding remarks

This risk assessment has outlined some of the reasonable worst-case scenarios which could impact Portsmouth over the next few decades. By focusing on an intermediary between the most-likely scenario and the worst-case scenario, this assessment seeks to prompt action over deliberation. Too much faith in the most-likely scenario can lead to complacency and inaction. Whereas naïve uncertainty can lead to despair and inaction. Therefore the value of this risk assessment lies not in the accuracy of its forecast, but in the extent to which it provokes action and progress.

Throughout this assessment it has been made clear that the future is chaotic and unpredictable. There are no preordained pathways, the future is determined by the actions we all take each day; this is particularly true for climate change. The decisions and actions we take over the next decade will lay the foundations for all subsequent generations. It is for this reason that climate change is such a distinct threat. The IPCC has stated we need to halve our emissions by 2030 to prevent some of the most catastrophic climate impacts. While this is a relatively simple target, to achieve it will require changes across all parts of society. This will include each person making changes to their day to day lives; from using their cars less to heating their homes more efficiently. It will include employers and businesses accounting for their impact on the climate as well as their profit. Importantly, it will include decisions makers; who will need to lead by example and implement changes which will benefit not only today's society, but future generations as well.

A society grows great when old men plant trees under whose shade  
they know they will never sit.

**- Ancient Greek proverb**

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