9 Climate Change

9.1 Overview

The impact of climate change on the resilience of the highways network should not be underestimated. The pattern of more intense rainfall events, extreme high and low temperatures and freeze/thaw cycles is likely to continue.

The Met Office's August 2022 UK Climate projections note that winter precipitation is expected to increase significantly with a significant decrease in summer. However, when it rains in summer there may be more intense storms. The future resilience of the roads, structures and drainage systems will become more challenging and fragile assets will be more susceptible to accelerated deterioration and damage.

In 2024 the UK Government published its 'Fit for a Changing Climate? Adapting the UK's transport system' report. This document highlights challenges the UK faces in maintaining its transport system in the face of a changing climate. As part of the consultation on this document, the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) put forward the following climate risks on highways assets:

- Review drainage infrastructure to ensure it is not overloaded.
- Consider the impact of rising sea levels on highway assets.
- Consider of the impacts of increased summer temperatures on highway assets.
- Monitor ongoing patterns of severe weather (snow / freezing / flood / wind) on highway assets.
- Consider the emergency response to severe weather events and whether there are any changes the Local Authority can make to lessen the causes of effect on the highway network.
- Create a resilient road network which receives more attention compared to the rest of the highway assets.

9.2 Impact of climate change in Gloucestershire

The impacts of climate change include:

- Increased flood risk in urban areas, requiring more use of sustainable urban drainage and other flood risk management measures in construction practices. New developments in flood plains will also need to be avoided, which may be a challenge given the ongoing need for extra housing.
- Increased flood risk to property in some areas. This may lead to increased insurance premiums, or difficulty in obtaining insurance cover in the future.
- More heavy rainfall will increase the risk of landslips, soil erosion and run-off from agricultural land, which could in turn increase local flood risk and harm water quality.

- Drainage systems will be put under increasing pressure by heavy rainfall, requiring design standards to be re-appraised for both new and engineering structures.
- Potential increase in storm damage, light-degradation, rain damage, fungal and beetle damage to historic buildings and structures, e.g. bridges.
- Some towns, cities and transport routes are susceptible to periodic flooding, causing major disruption to road transport, and the potential for flash flooding increasing the frequency of these events.
- Increased temperatures may result in deformation of asphalt, failure of expansion joints, road surfaces melting etc.
- Changes in tidal levels - with the Severn running through the centre of the county, tidal ranges will certainly be affected, as well as storm surges where the Severn Estuary is expected to see the largest change.
- Increased risk of flooding from increased rainfall
- Improvements and higher specification required for flood defences and urban drainage and rainwater disposal systems.
- Improved road and rail infrastructure to provide alternative and diversionary routes in case of extreme climate events.
- Expansion of sustainable urban drainage systems
- Commercial opportunities in flood defence and flood management
- Opportunity to integrate flood defences.
- Increased scope for walking and cycling for everyday travel and tourists.
- Less frost damage to roads from winter cold, less need for road salting
- Fewer ice/snow related accidents on roads and footpaths, and points failures on railways.
- More extremes – heavy rainfall events, high winds, very hot spells – trees falling, vulnerability of some routes to storm damage, snow events, increase in vegetation growth affecting the structural asset and obstructing users.
- Increased subsidence due to drying out of substrata (especially in clay areas).

9.3 Building Resilience

Extreme weather often restricts capacity, such as flooding on roads, causing significant disruption to users. Maintaining infrastructure becomes more challenging without further inconveniencing users. Achieving total physical resilience is difficult and prohibitively expensive, so an economically rational approach is necessary. It's important to note that maintenance expenditure, rather than capital expenditure, primarily determines the network's resilience. For the county's local network, this includes costs for maintaining grass verges, managing tree stock, maintaining embankments, gully emptying, and grip cutting.

Often, a road network offers multiple routes for diversion if one section is disrupted. However, it's crucial to analyse potential single points of failure, especially on strategic networks, which would have significant impacts if they failed. Local knowledge frequently enhances the ranking of these vulnerabilities. When analysing the network, it's also important to consider end-to-end journeys and how the network integrates with the Highways Agency strategic network, rail, and air terminals. For Gloucestershire, this is particularly pertinent regarding the M5 and M50 motorways, the A417, the A40, and the A46 strategic network, as well as various transport hubs across the county.

Flooding events involve many different bodies in planning and mitigation actions, creating a complex picture. The highway authority needs to understand network vulnerabilities in addition to the usual focus on property flooding. In Gloucestershire, certain locations such as the A417 at Maisemore and sections of the A48 during high tidal events are known flooding issues.

Maintenance by neighbouring property owners significantly affects the network's resilience. For example, trees on private land that could fall onto the highway or the upkeep of ditches for surface water drainage can have a major impact. Gloucestershire has a good record of focusing on landowner responsibilities (such as the use of materials to lengthen lifespan and protect against the effects of climate change such as Fibre Reinforced Polymer (FRP) bridges in PROW), and this must continue going forward.

9.4 What Next?

The approach involves:

- Identifying a strategic network to focus on resilience harnessing and using key local knowledge.
- Identifying the potential impacts on highway network assets.
- Identify any potential single points of failure.
- Applying a risk based approach to the network, network assets and service delivery to prioritise areas for further action.
- Taking a more specific look at particular parts of the network, resulting in an action plan for understanding vulnerabilities.
- Reviewing priorities for conserving and protecting threatened historical and natural heritage, taking into account sites that are vulnerable to climate change impacts. E.g. historic bridges.

Gloucestershire County Council intends to adopt the toolkit to develop a better understanding of network resilience over the coming years.