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Creating and Managing Resilient Local Highways

A resource for practitioners attending Climate UK "Local Highways and Climate Change" events in July 2013

Delivered by Climate Change Northwest

In partnership with



Climate UK is a not-for-profit Community of Interest Company working with Climate Change Partnerships across England, Wales, Scotland and Northern Ireland to help the UK limit climate change and be resilient to its effects. By bringing together local knowledge and technical expertise from a range of sectors we aim to investigate, inform and advise on risks and opportunities presented by climate change; and coordinate and support integrated, sustainable and effective responses.

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For more information on this publication please contact info@climate.uk.net

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1. Introduction

1.1 Purpose

Our climate in the UK is projected to change, bringing increasingly extreme weather, including heavier rain, more flooding and heat waves. Whatever we do now to reduce emissions of greenhouse gases, some of these future changes will be unavoidable due to our earlier emissions.

Many infrastructure improvements require long-term planning, making it even more essential for local transport planning and highway authorities (metropolitan, unitary and county councils) to start planning now for future climate change.

This resource sets out the current national policy support and local authority responsibilities around adapting local highways. It will help you think about the vulnerabilities of local highways and measures you can take to improve resilience.

1.2 Local Authority Responsibilities

Under localism, given their statutory duties and powers, local authorities and the new Local Enterprise Partnerships (LEPs) have an important role in helping communities prepare for climate change, using planning and other policy levers to ensure that buildings and infrastructure are resilient to increased risk of flooding and heat stress. The strategic approaches they adopt will be strongly influenced by national policy.

Other Local Authority responsibilities include managing and extending natural resources to promote biodiversity and reduce flood risk, increasing the resilience of local spaces, minimising economic risks whilst maximising any economic opportunities associated with the impacts of climate change as well as protecting the local population from the health impacts of a changing climate through their role as community leader.

The Adaptation Sub Committee report 'How local authorities' can reduce emissions and manage climate risk' has identified the main opportunities local authorities have to increase the resilience of major infrastructure in their localities to climate change is described below;

Providing infrastructure

Local authorities can ensure that infrastructure they are responsible for is resilient to changing climatic conditions and extreme weather. Examples include:

Resilient roads - As the highway authority, local authorities are responsible for the construction and maintenance of non-trunk roads (representing 98% of all roads), cycle ways, street lighting, bridges and structures and other highway assets. Increasing resilience to extreme weather and climate change should be part of their capital and maintenance programmes where this is cost effective.



Flood defence infrastructure - In their role of Lead Local Flood Authority, the Flood and Water Management Act 2010 provides local authorities with powers to carry out works to manage flood risk from surface runoff and groundwater, lessening the impact of excess water on the highway network. District, unitary authorities or internal drainage boards have powers to carry out works to prevent flooding from ordinary watercourses.

Land use planning

From an adaptation perspective, land use planning is one of the most important functions delivered by local government and often cross over into highways planning issues. This decisions can directly help to increase resilience to climate risks or lock future generations into increased vulnerability. Highways stakeholders should look at where they can assist with;

Minimising flood risk - Avoiding inappropriate development in areas at risk of flooding and reducing the risk from coastal change.

Deliver green infrastructure - Green infrastructure is important because it can help to keep cities cool in the summer, provide drainage routes for surface water and provide pathways through the urban environment for biodiversity to migrate as the climate changes.

Deliver Sustainable Urban Drainage Systems (SuDS) - SuDS such as permeable surfaces, swales, wetlands and ponds can play an important role in managing local flood risk in urban areas since they replicate natural surface water drainage systems.

1.3 Why Should Action Be Taken?

Most highways infrastructure improvements require long-term planning, significant financial investment and are expected to operate decades into the future. It is essential for local transport planning and highway authorities to build climate change considerations into the decision making process for major schemes and routine maintenance activities. Reasons to act now are:

- **Economic growth** – a resilient and reliable transport network is essential for local economy and future growth.
- **Cost saving** – money can be saved by reducing the need for expensive future maintenance.
- **Reputation** – maintain or enhance the council's reputation and avoid adverse publicity through infrastructure failure.
- **Duty** – the Local Transport Act 2008 placed a duty on Local Transport Authorities to have regard to the Government's adaptation policies in their Local Transport Plans.

The very cold UK winters experienced over the past few years and the periods of prolonged rainfall and extreme weather events have illustrated local transport's vulnerability to severe weather, and the need for proactive preparation and planning.

2. National Policy

The National Adaptation Framework

The UK is one of the only countries to have addressed climate change adaptation in a systemic way through legislation. The Climate Change Act 2008 established a statutory framework for adaptation and set in place a five-year cycle which includes a climate change risk assessment, a national adaptation programme and the Adaptation Reporting Power.

National Climate Change Risk Assessment

In 2012 the first national [Climate Change Risk Assessment \(CCRA\)](#) analysed 100 potential impacts of climate change to 11 sectors. For the transport sector the assessment identified flooding, landslides, heat damage and bridge scour as important climate change risks. It also pointed out that transport networks can be affected by failures of other types of infrastructure, such as electricity networks.



National Adaptation Programme

The Government released the first [National Adaptation Programme](#) in July 2013. It contains actions to tackle risks identified in the CCRA.

Adaptation Reporting Power

The Adaptation Reporting Power allows the Government to direct certain organisations to submit a report on their climate risks. This power was used in 2010, though the Government decided not to direct local authorities to report. The Highways Agency and Transport for London did submit reports which can be downloaded [here](#):

Adaptation Sub-Committee

The Climate Change Act set up the Committee on Climate Change to advise the Government on climate change policy, and the Adaptation Sub-Committee (ASC) to advise on adaptation. The ASC has identified infrastructure, including transport, as a priority for adaptation, and plans to release a report on infrastructure and adaptation in 2014.

Climate Ready

In 2012 the Government asked the Environment Agency to accept a new role on climate change adaptation. This has resulted in Climate Ready, a support service to help businesses and other organisations prepare for the changing climate. Climate Ready provides general information on climate change, as well as tailored support to certain sectors, including infrastructure.

3. Identifying, Appraising and Addressing Risk

This section outlines the key steps you should take to adapt local transport networks. For full information and guidance on these steps see [Preparing for climate change: adapting local transport](#), April 2011. UK Climate Impacts Programme, Oxford.

Getting Started

Before you start you should:

- Clearly describe your objectives.
- Confirm that senior managers support your objectives.
- Identify what involvement you will need from colleagues.



Carrying out a Risk Assessment

Identify risks

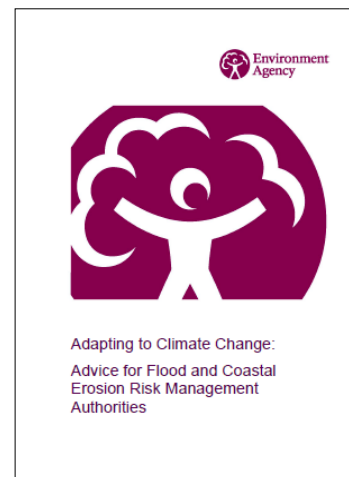
You need to establish how your transport assets and the operation of your transport network might be vulnerable to weather and climate change. To do this you should:

- Identify past occasions when weather affected transport in your area, or in other areas.
- Consider Table A below. Could these impacts affect your area?
- Explore how impacts could become more frequent or severe as the climate changes.



Projections are available for some expected changes to the climate e.g.

- Temperature and average precipitation – ukclimateprojections.defra.gov.uk
- Peak river flows, extreme rainfall and mean sea level – EA's [Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities](#).



The table below highlights potential direct and indirect risks.

Table A: Vulnerabilities of the Local Highway Network		
Change	Direct Impacts	Indirect Impacts
Increasing temperature	<ul style="list-style-type: none"> - Deformation of road asphalt & failure of expansion joints in concrete roads. - Hardcore underpinning cracking – subsidence & heave. - Heat affecting roadside equipment – e.g. signaling and telecoms equipment. - Traveler discomfort & safety due to overheating. - Vehicle break-downs due to overheating. 	<ul style="list-style-type: none"> - Changes in seasonal demand for transport and travel patterns, e.g. tourism. - Risk to workers’ functioning and safety.
More intense rainfall & flooding	<ul style="list-style-type: none"> - Intense rainfall overwhelming drainage systems. - Flooding of the highway network, depots and other routes (pedestrian, cycling, and vehicular). - Flood damage to roads surfaces, cycle ways and pavements. - Rising water tables flooding underground networks, e.g. tunnels & underpasses. - Scouring & weakening of bridge foundations. - Embankments vulnerable to landslips. - Flooding/failure of power sources and electrical equipment (road traffic management). - Reduced visibility. 	<ul style="list-style-type: none"> - Increased demand for car use. - Potential increase in accident rates. - Risks to travellers’ and workers’ safety.
Rising sea levels, increased coastal erosion and flooding	<ul style="list-style-type: none"> - Permanent loss of routes and infrastructure at coastal sites due to erosion. - Periodic flooding of coastal roads, pedestrian & cycling paths. 	<ul style="list-style-type: none"> - Risk to travellers’ and workers’ safety.
Increase in high winds, storms and storm surges	<ul style="list-style-type: none"> - High winds blow trees and other debris (signs, lights, equipment & street furniture) onto roads. - Operational constraints at exposed locations, e.g. bridges, for high sided vehicles. - High sided vehicles blown over. - Sea flooding coastal infrastructure. 	<ul style="list-style-type: none"> - Risk to travellers’ and workers’ safety.
Reference	Adapted from: Preparing for climate change: adapting local transport, UKCIP.	

Prioritise risks

Once you have a list of risks you should prioritise them. Aspects of a risk which affect its priority are:

- The severity of the potential impact on transport and other services.
- The likelihood of the impact occurring.
- The time it will take to adapt. Some assets (e.g. surface pavements) are replaced more frequently than others (e.g. bridges or drainage). It is particularly important that assets with long lives are designed to cope with future climate change.

You should incorporate the risks you intend to manage into your organisation's corporate risk register or other existing risk management processes.

Developing and Implementing Resilience Actions

Having identified the most significant climate risks faced by local transport, the next step is to decide how to address them.

Identify potential adaptation options

You should think about how similar risks are managed in your organisation (e.g. through business continuity or accident management plans) or by others (e.g. local transport authorities, Highways Agency). See Table B below for example responses to some common risks.

Bear in mind that resilience is achieved through a combination of activities or components. The Cabinet Office's guidance on natural hazards and infrastructure, *Keeping the Country Running*, describes the following four components to resilience:

- *Resistance* – preventing damage (e.g. a flood wall)
- *Reliability* – designing processes to operate under a range of conditions
- *Redundancy* – availability of backups or spare capacity
- *Recovery* – enabling a fast response to and recovery from disruptive events.

Try to include measures which are inexpensive and will be useful regardless of how the weather affects you in the future (e.g. developing a plan for what to do if a major road floods).

The table below provides examples of adaptation measures.

Table B: Example adaptation measures for four common risks.

Example Risk	Potential Action
Road drainage systems overwhelmed by torrential rain	<ul style="list-style-type: none">• Increase the capacity of all drainage.• Increase the capacity of drainage in areas that are most likely to flood.• Increase the capacity of drainage in areas where flooding will cause the most damage or delays.• Review the type of drainage and its maintenance regime. Determine ownership and maintenance responsibilities.• Improve the effectiveness of drainage by more frequent or targeted

	cleaning.
Bridges weakened or swept away by floods	<ul style="list-style-type: none"> • Strengthen all bridges. • Strengthen bridges crossing rivers that are most likely to flood. • Strengthen bridges that carry the most traffic. • Assess the bridges which are most at risk to scour. • Prepare contingency plans to communicate with drivers about alternative routes and close bridges that are most at risk when flooding is predicted.
Accidents (vehicles blown off course, debris) caused by high winds	<ul style="list-style-type: none"> • Remove possible sources of debris: • Improve the ability of trees, equipment etc. to withstand high winds: • Prepare contingency plans to communicate with drivers about alternative routes and close routes that are most at risk when high winds are predicted.
Reference	Adapted from: Preparing for climate change: adapting local transport, UKCIP.

Evaluate and select preferred options

Once you have listed potential options, you should decide which to implement. This will depend on:

- An option's effectiveness at managing the specified risk.
- Your organisation's ability to implement within relevant timescales.
- An option's cost and its alignment with investment priorities.

You should also consider whether a measure is flexible – whether it can be adjusted should unexpected change occur, such as more changes to the climate than expected. You might be able to avoid immediate implementation of some measures by building in the flexibility to respond later.

Implement options

- Plan how your measures will be implemented; who will do them and by when.
- Ensure they are incorporated into the relevant organisational plans.
- Plan how your organisation will monitor the risks and review the success of options.

Practical Examples

The two examples below show approaches from two different authorities.

3.1 Climate Change Risk Assessment Workshop – Cheshire West and Chester

The following example from Cheshire West and Chester Council demonstrates one way to identify risks and options using a workshop.

The workshop was attended by 20 people with representation from Highways, Street Lighting, Local Transport Plan team, Emergency Planning and Risk Management. In addition, external representation was provided by the Environment Agency and the Highways Agency.

The aims of the workshop were:

- To increase understanding of climate change risks, the risk management process and the adaptation actions required for Highways & Transport.
- To work through the process to reach a detailed risk assessment and management plan for the most significant risks.

The workshop was structured into 3 sessions:

- Session 1: Identifying and quantifying the risks.
- Session 2: Assessing existing risk management plans.
- Session 3: Identifying risk management options.

Session 1: Identifying and quantifying the risks

The first session aimed to consider the impact of each of the main climate change risks on Highways & Transport for CWAC, using a risk assessment matrix. These were logged onto an adapted matrix, which uses a '4x4' matrix, with scores for 'likelihood' and 'impact'.

Some of the higher risks identified included:

- Enhanced deterioration of highway/footway assets from extreme temperatures and hot-cold cycles.
- Snow/ice resulting in road closures causing an impact on general service delivery and access to essential goods and services.
- Increased risk of surface flooding affecting infrastructure, impact on all transport movements and access to services.
- Increased river flows resulting in accelerated scour/erosion of bridges/embankments.
- Risk of river and tidal flooding in low-lying areas causing flooding/severance of critical infrastructure (e.g. roads/rail).
- Impact on service delivery during extended 'cold weather' events.

- Erosion of coast causing a loss of infrastructure/amenity.
- Increased impact of interacting events, such as dry summer coupled with wet winter causing cumulative stress (ice/heat weakening road surfaces for example).

Session 2: Assessing existing risk management plans

Following identification of the major risks, the groups were then asked to identify how well existing plans and activities addressed the risks identified in the first session. The purpose of this exercise was to identify gaps in coverage of existing plans and help to assess what actions are required going forward.

Session 3: Identifying risk management options

The final stage of the workshop was to develop an action plan for taking forward the key gaps in coverage, with named responsibilities and a timescale for implementation.

A number of required actions were identified:

- Mapping assets against existing geotechnical maps to identify subsidence risks.
- Including a performance specification in maintenance regimes for urban areas.
- Mapping flood areas on assets.
- Mapping drains/culverts on GIS.
- Surface Water Management Plan will be required by 2011 with the new responsibilities of Flood and Water Management Act.

Taking Workshop Outputs Forwards

Following the Risk Assessment workshop, a 'mini-workshop' was held with key staff from Climate Change/Sustainability, Highways and Street Lighting. The purpose of this session was to complete the gaps in the risk register and identify ownership of the key actions identified.

Identified Next Steps

- Analysis of existing plans for their 'fitness for purpose' in relation to climate change adaptation.
- Identification and consideration of good practice from other authorities.
- Integration of climate change adaptation risk management into service planning.
- Identification of current and future budget implications.
- Preparation of business cases for short-/medium-/long-term investment that takes into account long-term changes in climate.
- Establishment of a 'Task and Finish' group to oversee this work.

3.2 Sequential Approach to Adaptation Risk - Dorset County Council

The following example from Dorset County Council demonstrates their sequential approach to assessing climate risk.

Expected changes in our climate are likely to have a significant impact on many of Dorset County Council's assets, responsibilities and functions. They wanted to ensure that future investment returns maximum value to the taxpayer and that the organisation's assets are resilient into the 21st century.

The stages below (and in Fig 1) describe Dorset's approach to building adaptation and resilience into their Highways Asset Management Plan.

Stage 1a (2009/10) Local Climate Impacts Profile (LCLIP)

An LCLIP was carried out across several Dorset County Council and Dorset District and Borough service areas. This highlighted how extreme weather events, such as extreme rainfall and high winds, had impacted the delivery of several key services including Grounds Maintenance, Highway Operations and Property Management between 2000 and 2009. Of the 102 severe weather impacts identified, the most common included flooding of carriageways and disruption to waste services and damage to property.

Stage 1b (2010) Highways Project; Identifying Climate Risks and Priorities for Adaptation.

Alongside the LCLIP, DCC Highways carried out a separate [study](#) to identify and prioritise the risks presented by climate change impacts on the highways asset. The study was carried out in partnership with the Met Office. Weather variables over three timescales, 2020s 2050s and 2080s, and highways specific knowledge were combined to produce a risk matrix against which the impacts were prioritised.

Stage 2 (2010/11) Comprehensive Climate Change Risk Assessment

Building on the findings of the LCLIP, a [Comprehensive Climate Change Risk assessment](#) was conducted providing a broad and shallow qualitative risk assessment of all Dorset local authority services. This sought to understand the impact of various (short term) weather and (longer term) climate variables over two timescales; the near term up to 2015 and the medium term up to 2050. It identified 6 priority areas for further investigation. These were; Highways, Health, Built environment, Green Infrastructure, Economy and Planning.

Stages 1 and 2 were both qualitative assessments and these helped reduce the perceived risks of climate change to lower priority services from further consideration enabling the focus of more costly qualitative investigations to be directed at high priority areas for adaptation. This should ensure that operational benefits are achieved in the short term and greater value for money in the longer term.

Stage 3a (2011/12) Highways Climate Change Detailed Risk Assessment.

The Highways Asset was prioritised for further quantitative study because of its importance supporting communities and the economy and the impact of its failure on the delivery of all other local government services. Dorset's Highways Asset Management Plan provided the basis for a structured approach to adaptation planning that also enables financial liabilities of climate impacts to be forecast once quantitative information is attained.

A risk management methodology and template was developed to capture, analyse and prioritise detailed climate impacts. The impacts were recorded for each of the 10 Highways Asset Groups and analysed under three areas of impact;

- **The *Physical Asset*** relates to risks that had a direct impact of the physical asset itself. For

example, Hotter, sunnier days leading to the melting of road surfaces on the minor road network or extreme rainfall leading to erosion of the roadway.

- **The Service Delivery** relates to risks that have an impact on the workforce or the way that it operates. For example, workers may have to avoid being out in direct sunlight during the hottest part of the day to avoid heat stress, sun burn and other heat related issues and so working hours may need to be adjusted to avoid these issues with earlier starts or later ends to the working day.
- **The End User** relates to risks that impact upon those persons who use the asset. For example this could be school transport services or local residents who are unable to use a particular part of the network due to failures of the asset

When the 10 different Highway Asset Groups identified by the Highway Asset Management Plan had been assessed, several high priorities or red risks were identified for quantitative investigation. These included the threat of high temperatures on the carriageway surface and structure and extreme precipitation impacts upon the highway drainage network and on bridges and structures.

Stage 3b (2012): Climate Threshold Investigation.

The production of the Highway Risk Register highlighted that the lack of Dorset specific weather and climate information was likely to provide a significant barrier in the development of a quantitative assessment of the risks to the highway infrastructure.

The Met Office was engaged to provide this Dorset specific weather threshold data, for high and low temperatures, precipitation and drought for each decade up to the 2080's. The thresholds were chosen were particularly relevant to highways assets and operations but will have similar significance for a range of local authority services, such as health and education as well as highways.

Stage 3c (2013): Highways Asset Climate Threshold Data Analysis.

The data provided by the Met Office is currently being analysed. As part of this analysis, methods will be identified to represent these changes spatially using GIS. The planned outcomes are to forecast the effect of impacts on the rate of deterioration and condition of highway assets and to provide a register of highways climate impacts; these will be achieved by adapting our carriageway asset management financial model.

Stage 4a (2012/13): Sector Specific Adaptation Plans.

Using the knowledge and understanding gained from stages 1 to 3 individual adaptation plans will be produced for the high risk impacts. The plans will include timescales for adaptation actions on vulnerable assets and the financial requirements to prepare asset or services for the future.

For example; The Highway adaptation plans may include detailing changes to maintenance practices or design specifications. Other actions may be the need to work with industry suppliers to develop new surface dressing bitumen's to cope with higher summer temperatures or investigate and adopt Mediterranean specifications if they prove appropriate.

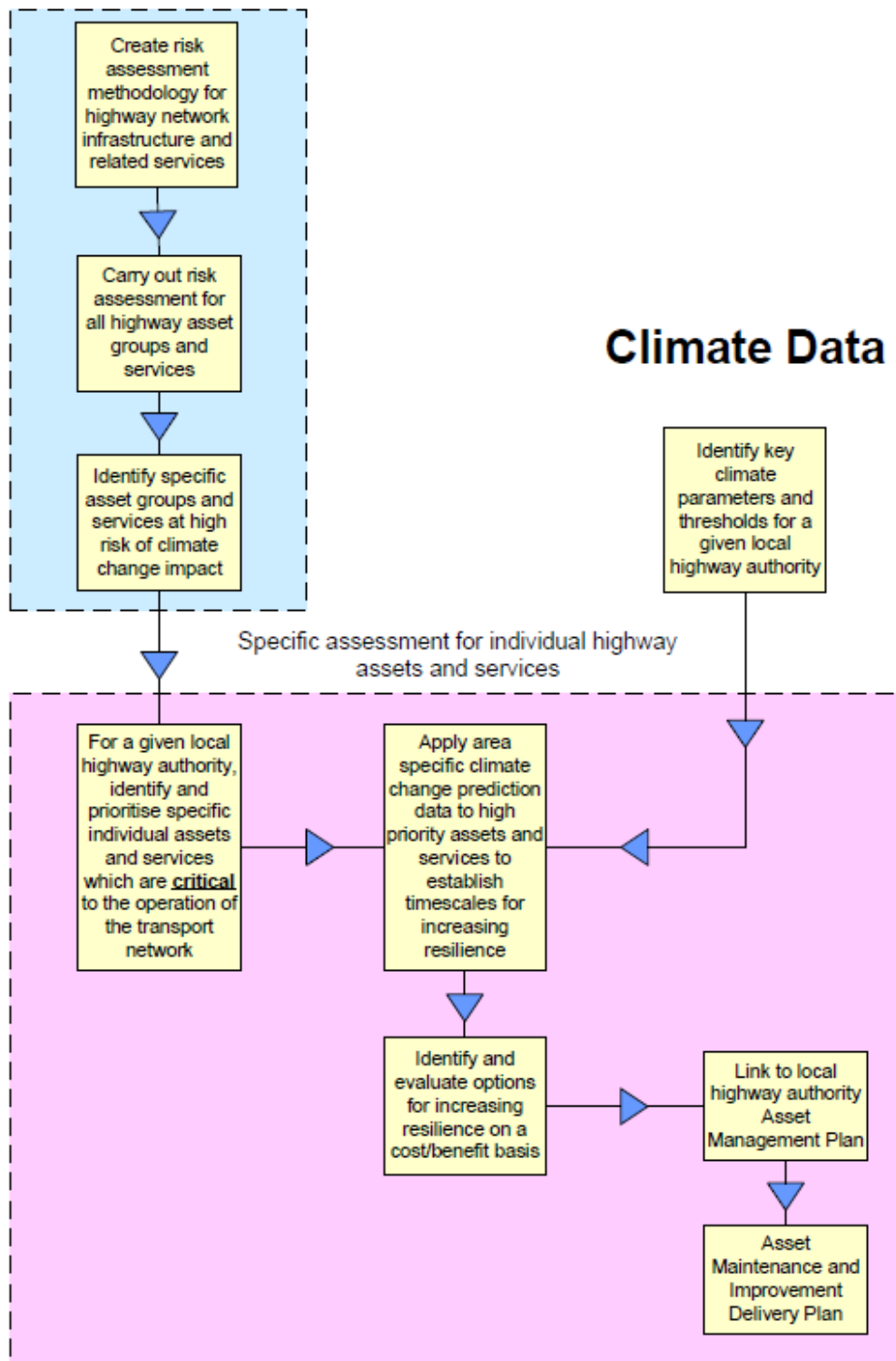
Stage 4b (2012/13): Highway Asset Management Plan.

The climate change impacts upon each highway asset group will be detailed under the relevant chapters of the Highway Asset Management Plan. This will be informed by both the climate change projections, the previous climate change risk assessments along with local knowledge.

Fig 1: Dorset County Council's Approach to embedding Climate Resilience.

Appraise Risk

Generic assessment of climate risk on highway infrastructure and services



4. Support from Professional Bodies

ADEPT

The Association of Directors of Environment, Economy, Planning & Transport (ADEPT) represents local authority county, unitary and metropolitan directors who manage some of the most pressing issues facing the UK today. ADEPT membership is drawn from all four corners of England. The expertise of ADEPT members, our vision and drive is fundamental in the handling of issues that affect all our lives. Operating at the strategic tier of local government, we are responsible for delivering public services that primarily relate to the physical environment and the economy, but which have a significant impact on all aspects of the nation's well-being. There are a number of boards and working groups within ADEPT that pick up on the specific issues raised in this workshop.

Engineering Board

The board deals principally with policy & operational matters associated with the highway engineering aspects of ADEPT's work, providing technical advice and expertise to the United Kingdom Roads Liaison Group (UKRLG) and its four supporting boards. The board is well represented on UKRLG as well as the Roads, Bridges and Lighting Boards. Increasingly, as the landscape of highway network management changes under the influence of both natural and financial changes, the board is looking to provide a focal point for local authority expertise and best practice in highway topic areas such as network condition and resilience, climate change impacts, procurement and sustainability.

Transport Board

The Transport Board is responsible for Transport Policy; Public Transport; Traffic Management; Accident and Road Safety, design standards; Intelligent Transport Systems; Traffic Signals and Rights of Way with emphasis on the practical and safe implementation of sustainable transport policies. The Transport Board has developed strong links with key decision makers and influencers across a wide spectrum on Transport Policy development delivery both in the Public and Private sector. It is one of the key points of contact on major Government consultations and is a regular adviser to the Government on a range of transport related topics.

Asset Management Group

The ADEPT TAG Asset Management Group is a formally constituted sub-group of UK Roads Board.

Bridges

The ADEPT Bridges Working Group is the focal point for a larger network of local authority bridge owners across the United Kingdom.

Highways Sustainability Working Group

The Sustainable Highways Group has a focus on sharing and developing best practice and case studies relating to sustainable highway maintenance products, processes and materials.

If you are interested in ADEPT membership and the above boards and working groups please visit www.adeptnet.org.uk or email adept@buckscc.gov.uk

Chartered Institution of Highways & Transportation

The Chartered Institution of Highways & Transportation (CIHT) is a membership organisation representing over 12,000 people who work in the highways and transportation sector.

CIHT members plan, design, build, operate and maintain best-in-class transport systems and infrastructure, while respecting the imperatives of improving safety, ensuring economic competitiveness and minimising environmental impact.

CIHT looks at the wider economic, social and environmental aspects of transport and how transport underpins what society wants and needs. CIHT has a Sustainable Transport Panel and this has been important for promoting Smarter Travel. The panel has been working with UK Government to ensure that planning and transport's critical role in adaptation and mitigation policy in the context of climate change is properly considered. CIHT want to ensure that authorities consider the transport system as a whole - including maintaining assets, working with partners including public transport providers, and encouraging walking and cycling - so as to ensure that there is access for all.

CIHT's manifesto calls for UK Governments to act to reduce the impact that the highways & transportation sector will have on the environment. UK Governments need to implement behavioural change policies, including Travel Planning and Smarter Choices, which will contribute to a reduction in an individual's carbon footprint.

The UK has seen transport carbon emissions increase while other sectors have managed to achieve significant reductions. UK figures have shown that any improvement in the fuel economy of new vehicles has been negated by the continual increase in road traffic levels.

CIHT believes that through the introduction of an incentive and reward approach that promotes a more efficient use of cars through the price of fuel, greater promotion of eco-driving and better enforcement of speed limits, significant carbon savings could be made.

CIHT's Climate Change & Sustainable Transport Report (2008) outlined areas where the impact of the transport sector on climate change should be addressed. These include:

- Managing Demand (Planning Policies, Impact of Retail and Freight Demand Management)
- Changing Behaviour (Use of Smarter Choices and Ways to Alter Travel Behaviour)
- Accessibility and Social Equity (Promoting Walking & Cycling, Making Use of the Current Asset, Public Transport Provision and Social Sustainability)
- Technology and Safety
- Alternative Fuels, Changes to Design Standards

CIHT runs a number of events, and recently hosted a seminar (available online at www.ciht.org.uk/hmepdrainage) on the Management of Drainage Assets based on guidance from the Highways Maintenance Efficiency Programme. CIHT also provides the Secretariat to the UK Roads Liaison Group and provided support to the review: Lessons from the Severe Weather February 2009.

www.ciht.org.uk

5. Case Studies

Case Study 1 – Maintaining Access on a Changing Coastline

Slapton Line Partnership – Living With a Changing Coastline

Slapton Line is a road in South Devon, on the A379, connecting the villages of Torcross and Strete. This road is on a shingle ridge which separates the sea at Slapton Sands and a fresh water lagoon, Slapton Ley. The road is already very susceptible to storms, particularly when easterly winds are blowing. In January 2001 a storm damaged the road and shingle ridge which meant that the road had to be closed for 3 months.



The vulnerability of the road has led Devon County Council to produce a contingency plan to deal with varying levels of damage to the road. This was done through the formation of a community partnership which worked with local people, businesses, parish councils and local authorities to develop an adaptation plan, to enable the local area to handle road closures and to promote the area for sustainable tourism and to ensure local businesses were not adversely affected. The eventual inevitable breaching of the road, due to tides and storms means the community and highways must be ready to adapt and these plans mean that they will be resilient and able to adapt.

Aims of the Project

- To ensure that the council and community are able to handle a major breach of the road.
- To put in place contingency plans and maintenance plans to manage while the road is closed and to reopen it as soon as possible.
- To continue to maintain Slapton Line as an attractive environment and promote it as a National Nature Reserve.

The Challenges Faced

The initial challenge was the 2000/01 storms that caused a loss of 5 m of shingle beachhead over a 1000 m length, with a 200 m section of the road being undermined by the sea and closed. Parts of the road were realigned 20 m inland, but it is only predicted to last 30 years and another breach is expected.

Budget – Devon County Council's budget is limited and it is dealing with other impacts, including the six consecutive worst storms ever experienced, all since July 2012, causing £20 million damage to bridges

and roads. This additional drain on resources puts even more pressure on decreasing budgets should a significant event occur on Slapton Line.

Adaptation Measures

Shingle bastions were put in place along the beach to prolong the life of the road. These are monitored and rebuilt by South Hams District Councils using beach material when necessary. If material is on the road, this is cleared by highways and returned to the bastions.

A monitoring system has been put in place, based on the coastguard and tide and weather forecasts, along with a plan to shut the road. This involves putting in place a diversion plan which has fold-down signage already in place diverting traffic onto agreed diversionary routes, and to clear the road if necessary.

A partnership with Plymouth University has been established, with time-lapse cameras in place to monitor beach behaviour and provide alerts if sections of beach are missing.

Key to all the above, the Slapton Line Partnership (formed of local people, adjoining parish councils and the Coleridge Association) worked together to agree the best diversion route to help residents and visitors maintain access in the event of road closures.

Resilient Results

- Contingency plans for road closures are in place and have been tested.
- Planning permission has been sought to realign the road further inland if funds are available.
- Devon County Council monitors tide/weather information for its on-call plan.
- There is ownership of the contingency plans and diversion routes by the local community, who helped develop the plans and routes, so everyone knows what to do.
- The local area is resilient to road closure, whether short term or longer term.

Learning Points

Getting everyone on board early was vital in ensuring everyone in the community understood the problem, was involved in the contingency planning, understood the reasons for what was happening, understood the finances, and understood that not everything was possible. This ensured that local expectations were managed, in terms of road maintenance and the fact that a future breach is likely. But it also enabled a strong partnership to be built, to promote businesses and the local nature reserve for the benefits of the community.

The bastions were well placed, and have not eroded; the district council of South Hams has moved material off the beach to maintain the bastions, but highways have not needed to clear material off the road itself. However, there are concerns that because the road has not been breached recently, the local partnership may lose momentum, because there have not been problems in recent years.

Contacts for Further Information

For information on highways: Jim Morrison, Devon County Council Highways
jim.s.morrison@devon.gov.uk

For information on the wider partnership: Alan Denbigh, Slapton Line Partnership
alan.denbigh@southhams.gov.uk

www.devon.gov.uk/slapton-line.htm www.slaptonline.org

www.oursouthwest.com/climate/registry/090700-case-study-Slapton-Line-Partnership.pdf

Case Study 2 – Planning for Climate Resilient Infrastructure

Worcestershire County Council - Building Information and Awareness

Worcestershire County Council, aware that its infrastructure is at risk, sought to provide information on climate risks to infrastructure across the county covering communications/telecoms, transport, water, energy and emergency services

The project used a combination of national climate data from UK CP09, locally provided data and information from a range of sources. The project mapped and interpreted this data to develop and test a methodology to help Worcestershire planners to incorporate climate issues into their infrastructure strategy.

Six risk alert maps were produced, for the north and south areas of the county for the hazards of drought, high temperatures and flooding. The methodology is available for other councils to use, and Staffordshire County Council are using it already, including climate risks to their waste sites and air quality management areas.

Aims of the Project

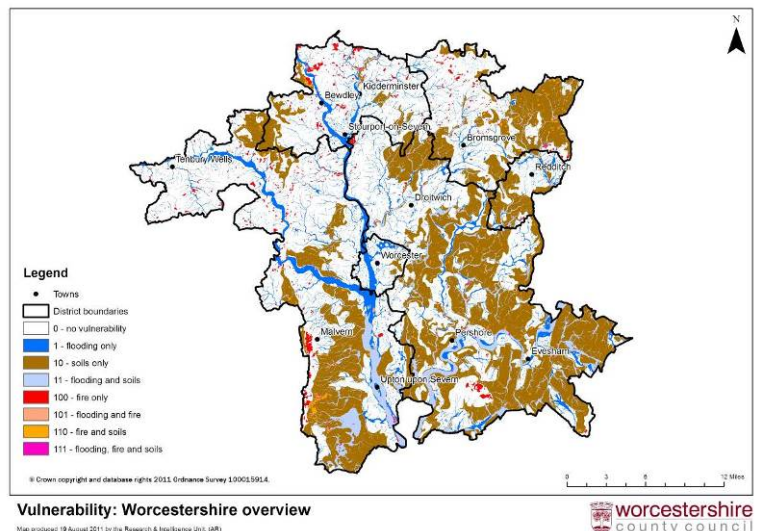
To discover how local authorities can integrate climate risks into infrastructure planning and develop a transferable methodology for use in other local authority areas.

The Challenges Faced

Accessing meaningful data was difficult. For example, while the main gas network provider gave information, part of the county was supplied by a different company that did not share information.

Thresholds were not always easy to discover – for example, at what temperature does a road surface melt? This is not a simple figure, but depends on several days' temperatures, whether the road is south-facing, exposed, and what type of road it is. The team had not anticipated these complexities.

Data licensing – the team had aimed to produce a composite map, layering areas with different risks, however data licences do not always allow data to be displayed cumulatively. Towards the end of the project a more accurate data set for soil was discovered but due to time constraints and data licence cost this was not used. These limits affected data on soil types, data from the Environment Agency and habitat data.



Adaptation Measures

The Research and Intelligence Unit (at Worcestershire County Council) created a system to enable mapping of climate hazards and existing infrastructure. The map is accompanied by risk profiles that provide more detail about risks to specific infrastructure.

A composite map was used for internal purposes, but separate mapping layers were used for the report due to data licensing restrictions on displaying data.

The team also looked at the main utilities climate adaptation reports which were produced for the Government, under the Climate Change Act's Adaptation Reporting Power.

Resilient Results

- A strategic alert map for the county.
- Risk profiles for north and south Worcestershire, highlighting potential risks associated with drought, high temperatures and flooding.
- Ability to drill down to specific sites to understand a more detailed assessment of the site.
- Transferable tool that is being used by other local authorities e.g. Staffordshire County Council.
- An Infrastructure Strategy that takes into account climate risks is being developed.

Learning Points

The project uncovered the dependencies between types of infrastructure which can lead to 'cascade failure'. For example, the dependence of everything on electricity – needed to deliver our emergency plans, our water (electricity for pumping), telecoms/communications, and acute hospital services.

It will be a challenge to keep the information up to date, because utility companies are not obliged to keep the council informed e.g. if a new substation is built.

The project cost around £9,000 of Defra funding, most of which was spent on data processing and on a person in the research unit to sort data and carry out mapping.

Each impact was considered separately. Now the interconnectedness of different infrastructure providers is being examined to understand these impacts for the council.

Contacts for Further Information

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http://www.sustainabilitywestmidlands.org.uk/media/resources/Planning_for_Climate_Resilient_Infrastructure_report_January_2012.pdf

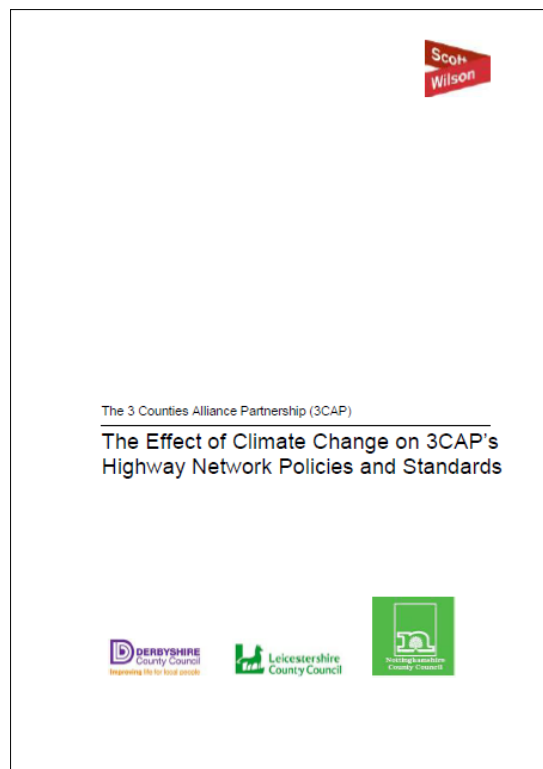
Case Study 3 – Understanding and addressing the effect of climate change on a local authority’s highway network

Nottinghamshire County Council - 3CAP: Practical Action for Adaptation

3CAP (3 Counties Alliance Partnership) is a partnership between the 3 Counties Alliance (Nottinghamshire, Derbyshire and Leicestershire County Councils – the 3CA) and business consultants, Scott Wilson.

3CAP’s project to understand and address the effect of climate change on the local authority’s highway network used an inclusive, action- focused approach working with Highways Managers. It identified the risks and assessed and prioritised adaptation responses which produced a plan for seven key policy areas:

- Bridges and other structures
- Drainage
- Grass cutting
- Materials
- Resurfacing
- Tree and hedge maintenance
- Winter service



Aims of the Project

To derive practical actions to implement adaptation in highways.

The Challenges Faced

- Focusing on adaptation without having to go through a climate debate and dispute about the extent of changes predicted to the climate – i.e. making adaptation relevant and important.
- Delivering adaptation within reducing budgets.
- Making resources available to develop and implement adaptations.

Adaptation Measures

- Adaptation was considered as a key element of highways network resilience rather than as a climate change issue.
- Adaptation actions were promoted as improving resilience with immediate and future benefits to make the issue relevant now.

- Adaptation was built into improvements to Highways Asset Management Plans, combining efficiencies and adaptation.
- Actions were developed with Highways Managers involved in day-to-day delivery of services through a workshop that examined previous impacts of hotter, drier summers, warmer wetter winters and more extreme weather events and arrived at practical, acceptable, affordable adaptation responses.

Resilient Results

The project delivered what it intended – practical actions for adaptation. These have been recognised nationally.

The actions for bridges and other structures – to carry out risk assessments to identify which structures are most at risk from climate change, with an increase of nature and frequency of inspection and maintenance regimes – have been taken forward by the National Bridges Group.

The drainage actions have given rise to experts from the 3 Counties Alliance Partnership writing the Guidance on the Management of Highway Drainage Assets (see links below) and involvement in the Department for Transport's Highway Maintenance Efficiency Programme including peer reviews.

The next annual condition survey will include an assessment of which roads are vulnerable to excessive heat so they can be given greater priority in maintenance programmes and included in contingency plans for heat wave conditions (e.g. proactive spreading of fine aggregate to stabilise road surfaces).



Learning Points

The approach to researching the effects of climate change on the highway network polices and standards has worked well. This was based on a high-level view of the climate forecasts: hotter drier summers, warmer wetter winters and more extreme weather events.

The key success factor was involving front-line staff and managers who manage the day-to-day aspects of highways including drainage, bridges & structures, grass cutting, resurfacing, tree and hedge maintenance and winter

services. A workshop was held to look at the impacts of the weather types, what happened in the past and how they could adapt to more frequent or extreme weather events.

Analysis of potential adaptations enabled managers to identify practical adaptations that were affordable and politically acceptable. Categorising adaptations in line with areas of responsibility meant actions could be easily aligned and embedded into business as usual. This meant the approach was sustainable, integrated and owned by those delivering the adaptations.

Contacts for Further Information

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http://www.leics.gov.uk/climate_change_adaptations.pdf

The main report, which covers the approach to the project as well as the adaptation outcomes.

<http://www.ukroadsliasongroup.org/en/UKRLG-and-boards/uk-bridges-board/index.cfm>

Information on the UK Bridges Board

Case Study 4 – Tackling surface water flooding

Drain London - Draining Away London's Flood Risk

The Mayor's Regional Flood Risk Appraisal identifies surface water flood risk as the most likely cause of flooding in London. With climate change, rainfall is expected to come in more intense storms, increasing peak rainfall rates by up to 40% creating a greater risk of surface flooding.

The Drain London Forum has been formed by the Greater London Authority and other agencies with drainage responsibilities in London. Its activity aims to increase understanding of surface water flooding in the capital and to equip each borough with a Surface Water Management Plan.

Aims of the Project

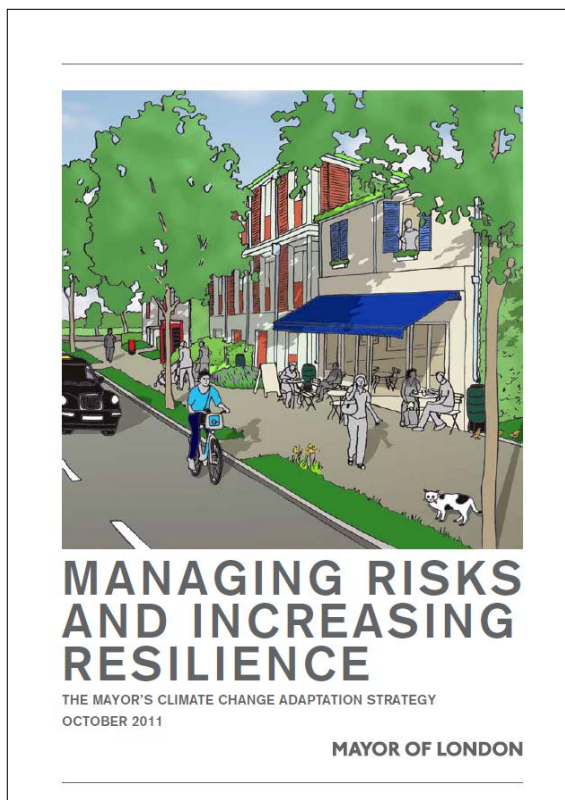
- Understand the nature and extent of surface water flood risk across London, and ensure London boroughs and Flood Risk Management authorities are aware of the risks and are working together.
- Equip each borough with a Surface Water Management Plan, and provide assistance and support for London boroughs in meeting their obligations under the Flood & Water Management Act (2010).

The Challenges Faced

- Lack of any consistent approach or record keeping of surface water flooding incidents.
- Lack of consistent approach and internal mechanisms in London boroughs to undertake their Flood & Water Management Act duties – each authority has different lead people, some have directors with members providing overview, others have highways engineers, while others did not have a named person.
- Funding – getting boroughs to allocate funds for works required to tackle flooding. Defra has allocated over £100k per year to boroughs to handle the additional burdens of the Act, however this has not been ringfenced. This funding is for 3 years from April 2011.

Adaptation Measures

To tackle the lack of consistent recording of surface water flooding Drain London supplied the same level of detail of flood risk to all boroughs with a Surface Water Management Plan and series of flood risk maps modelling five different return periods. They also developed a Flood Incident Reporting Template, which all boroughs now use, although some have amended the template for their own areas.



Drain London is providing detailed flood risk assessments for 12 hospitals, 20 schools and 20 residential/mixed development areas. This will be completed by March 2014.

Some boroughs needed a model to follow to identify someone to take responsibility for surface water flooding – Drain London brought in some of the more advanced boroughs which were already tackling the issue, and they shared their experiences of how they had taken action. Boroughs also recognised that flood risk affects several departments, and Drain London encouraged them to form cross departmental working groups to share knowledge.

In order to persuade boroughs to commit funding to the issue, Drain London raised awareness that funding had been allocated to local authorities; the type of projects they could or should spend it on, and also warned of the risks of inaction.

Resilient Results

All London boroughs are now in a better position to understand and manage the risks now and in the future. A good understanding has developed of surface water flood risk across London and a good understanding of the assets, utilities and infrastructure in risk areas.

40–50 people across London now have a deep understanding of surface water flood risk – before the project this was in single figures. They are aware of wider groups such as the London Drainage Engineers Group (LoDEG) and of sub-regional groups of boroughs who meet regularly.

The project created a strong emerging programme of defined investigations to understand what flood risk means to assets. For example detailed investigations are being funded into nine different parts of the transport and highways infrastructure in Hillingdon.

Drain London has also set up some communities to consider how they would cope in a flood event. This is slightly ad hoc, working with communities showing an interest – e.g. Purley in Croydon has produced a Community Flood Plan, while three other communities are developing one.

Learning Points

The project was helped by the Flood and Water Management Act coming into force. This requires boroughs to investigate and address flood risk problems and maintain a public register of Flood Risk Management assets. It also requires incident reporting which in part galvanised boroughs into action.

A big challenge will be how many of the additional staff with improved understanding of flood management issues are lost once Defra's extra funding ends (which is currently March 2014). Approximately half the people involved are funded by this Defra funding.

Drain London is still working to improve engagement with regional agencies such as Transport for London, Network Rail and the NHS. They are tackling this through the seven sub-regional groups who are easier for such agencies to deal with than 33 individual London boroughs.

Funding has been deployed over four years, which has given enough time to build partnerships and develop meaningful projects. To have spent the money more quickly would have resulted in less effective projects and poor value for money.

Drain London were not fixed in their ideas of what the project would be or what it would look like. This flexibility meant they could take on ideas and suggestions from boroughs.

Contacts for Further Information

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<http://www.london.gov.uk/drain-london>

Case Study 5 – Innovative partnership working

Southampton Highways Services Partnership

Southampton City Council and Balfour Beatty have formed the Living Places Highways Services Partnership. The Partnership aims to deal with climate impacts through existing budgets, mainstreaming responses on drainage into Capital Road Improvements and building resilience into the system.

Balfour Beatty Living Places manage, design and implement all capital maintenance schemes and the reactive repairs to the network. The latter is done on a fixed fee while the former is done through an agreed budget with the Highways Service Partnership Investment Manager.



Aims of the Partnership

- Tackle flooding hot spots.
- Improve water dispersal to avoid large areas of standing water (standing water causes damage to the road, leading to early deterioration of the road surface).
- Consider positive drainage systems and improve capacity to handle heavier and more prolonged rainfall.
- Deliver this within reducing budgets.

The Challenges Faced

The urban environment limits the possibility of using large scale SUDS (Sustainable Urban Drainage Systems).

Soakaways are difficult to install in an urban environment due to close proximity of buildings and lack of open space – they also require ongoing maintenance for cleaning and so add to costs.

Southern Water, who own the surface water mains to which gullies are connected, have to provide permission to connect. There is a growing issue with mains exceeding or nearly exceeding capacity which is likely to increase due to ongoing developments also connecting to these pipes.

Adaptation Measures

As part of the total roads infrastructure budget a small specific drainage allocation (£80k for the 2013/14 year) has been identified to help fund improvements through delivery of capital drainage schemes (this is in addition to the capital allowance for road schemes) and to fund works on known flooding hot spots – this small budget allows for proactive and reactive repairs.

Improvements to the existing drainage capacity are being considered during the design process for delivering maintenance schemes, with a view to improving the drainage capacity. The design should now focus on the addition of new mains/gullies to be piped into existing mains – if this is not possible, due to capacity issues or other factors, soakaways will be considered (if space permits).

Where the mains capacity is exceeded, gullies can be piped to each other, in essence forming additional catch pits that can then be directed along a road to discharge into another main that is not already up to capacity. This is very rare at this stage and not currently an issue.

New road surfacing considers *negative texture surfaces* (the texture is composed of voids below the plane of the road surface as opposed to particles protruding above the plane of the surface providing positive texture) to reduce noise, this also helps to reduce spray from vehicles and drain water from the surface. New surfaces also improve the camber and enables better use of gradients to improve water dispersal.

Resilient Results

Because drainage problems can cause early deterioration of the road structure, Southampton's Highways Services Partnership has been able to build resilience into the network by improving the drainage and will offset higher capital costs through reduced ongoing maintenance costs. The Partnership is building resilience into the network through resurfacing and considering drainage design at the same time.



Learning Points

Due to increased rainfall there has been a need to use known engineering solutions (Beanie Block kerbs, gullies, soakaways etc.) more actively in the design process.

The Partnership has learnt that it is essential to consider drainage design as part of a road improvement scheme to ensure future proofing. This also ensures that value for money is achieved as this process of investigation and design prior to construction will minimise the number of reactive visits following completion of the capital scheme to attend flooding issues.

The selection of roads to be treated within a year is determined by the Transport Asset Management Plan (TAMP). The TAMP assesses the structural integrity of a road and determines a priority ranking for delivery. As part of this a valued engineering approach is used to help calculate a road's priority and this takes into consideration amongst other issues any drainage problems such as isolated flooding, standing water, increased deterioration of the fabric of the road through water ingress etc.

Using this valued engineering approach should capture all other issues outside the structural need.

Contacts for Further Information

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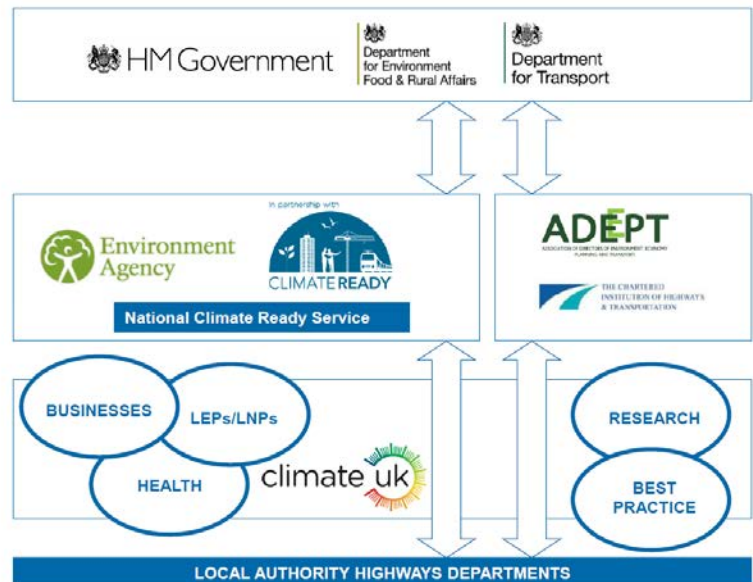
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6. Sources of Further Information

This diagram illustrates the interplay of key national and local agencies that can provide a range of support to local authority highways departments on this agenda.



Key agencies and websites are listed below.

ADEPT	http://www.adeptnet.org.uk
Bridges Forum	http://www.bridgeforum.org
Climate Ready	http://www.environment-agency.gov.uk/climateready
Climate UK & Climate Change Partnerships	http://climate.uk.net
Department for Transport	https://www.gov.uk/transport
Highways Agency	http://www.highways.gov.uk
Local Government Technical Advisors Group	http://www.lgtag.com
UK Climate Impacts Programme (UKCIP)	http://www.ukcip.org.uk

UK Climate Impacts Programme

The UK Climate Impacts Programme has produced a key briefing that guides you through key steps to assessing and mitigating climate risks to local infrastructure. It includes useful information such as:

- A list of commonly accepted transport vulnerabilities to severe weather.
- How to rank the risks to transport and decide on your priorities for action.
- The different types of adaptation measures that you might consider.

The briefing also contains many examples from local authorities and elsewhere, as well as links to further information. To access [“Preparing for climate change: adapting local transport, briefing for local authorities – UKCIP, April 2011”](#)



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