

North Yorkshire County Council Climate Change Comprehensive Risk Assessment 2011



Contents	Page
1. Executive Summary	3
2. Methodology	3
3. Key risks to North Yorkshire County from a changing climate	4
4. LCLIP Evidence for North Yorkshire County	4
5. UKCP09 predictions for North Yorkshire County	5
6. Summary of key risks to North Yorkshire County Council from a changing Climate	6
7. North Yorkshire County Council Service Based Comprehensive Risk Assessment	9
8. North Yorkshire County Council Climate Adaptation Action Plan	20
9. Conclusion	27
Appendix 1 – Detailed Methodology	28
Appendix 2 – Acknowledgements	29

North Yorkshire County Council - NYCC

1. Executive Summary

Services throughout North Yorkshire County Council will be affected in the future by episodes of weather extremes and Regional Improvement and Efficiency Partnership (RIEP) funded two local government officers to come into North Yorkshire Authorities to interview key council department representatives to understand what can be done at a service level to adapt each individual Authority against future disruption which will cost time and money.

A weather extreme assessment examining the past five years was carried in 2010 by AECOM to understand past weather extreme events in North Yorkshire. This report indicates that the majority of impacts are caused snow and blizzards (60%) and excessive rainfall leading to flooding (29%).

Extreme weather events in Harrogate borough have impacts on service delivery and affect different services in both positive and negative ways. The challenge now is to proactively work to find solutions to enable services to run continually throughout the year and overall to consider climate change adaptation in the decision making process.

During the interview process several positive actions were generated by the individual services which indicates how North Yorkshire County Council can progress the weather extreme adaptation agenda in the near future to reduce the risk on business continuity and the time and cost constraints associated with a reduce or postponed service.

Disclaimer

All information and content provided in this report has been collected from services representatives of North Yorkshire

County Council as part of the RIEP funded work. All actions/ risks stated in the action plan were suggested by the service representative and are written only as a guide or suggestions of the types of actions that could be taken and therefore no liability is held with the author/s of this report.

2. Methodology

The sustainability officers group for York and North Yorkshire has drawn on Regional Improvement and Efficiency Partnership (RIEP) funding to employ two climate risk assessment project offices to undertake climate risk assessment work in the local authorities of York and North Yorkshire. The major risks and suggested actions required to address the risks have been assessed from interviews and discussions with Council staff across its key services whilst giving regard to the predicted future climatic conditions.

Interviews were conducted with representatives of key council departments that delivered services or that managed areas which were likely to be impacted by climate change. The officers were reminded of the key conclusion of the Local Climate Impact Profile (LCLIP) which showed current vulnerability – see table below. The officers were then taken through the likely changes in climate as identified from the regional Climate Change study and the United Kingdom Climate Impacts Programme (UKCIP) model – UKCP09 as highlighted in the Table below and discussions took place on the likely impacts on their services and work.

Future Climatic condition	2020	2050	2080
Increased summer temperature	+ 1.3°C	+ 2.3°C	+ 3.3°C
Decreased summer rainfall	- 8%	- 19%	- 23%
Increased winter temperature	+ 1.3°C	+ 1.9°C	+ 2.9°C
Increased winter rainfall	+ 4%	+ 11%	+ 15%
Increased storminess	Increase overtime		
Increased rainfall intensity	Increase overtime		
Rising sea level	22cm by 2050, 36cm by 2080*		

Table 1. Predicted climate change.

Source: Weathering the storm: Yorkshire and Humber regional adaptation study, 2009. * UKClimate Change Projections 2009.

For each service area the key risks were identified and the actions needed to deal with these risks were recorded – these might be changes to service plans, gathering further evidence or better working with partners.

The facilitator used the officer's comments on the likelihood and severity of the impact on their services and budget, to rank the risk according to the methodology as listed below. The risks and actions were those identified by officers being interviewed or provided in workshops and do not represent the views of the facilitator. The detailed methodology used on the day can be seen at Appendix 1 below.

3. Key Risks to North Yorkshire County from a Changing Climate

Key climate change risks are drawn from the previously produced LCLIP and from the UKCP09 predictions.

4. LCLIP Evidence for North Yorkshire County

North Yorkshire is already subject to severe weather events. The 5 year media trawl found over 200 weather events which led to more than 400 impacts of varying severity on Council and LSP partner services.

The media database indicates that a majority of incidents are caused by flooding (42%) and snow and blizzards (41%). Followed by a number of impacts being reported due to storms (10%).

Weather impacts in North Yorkshire are concentrated in Eastern areas, with Scarborough Borough suffered the greatest number of impacts (128 cases). North York Moors (80 cases) and Ryedale District (77 cases) were also heavily affected.

Scarborough Town suffered the most impacts at a single location. These were due to storms and high winds (40%), snow and blizzards (31%) and flooding (29%).

Excessive rainfall leading to flooding has caused the greatest impact on North Yorkshire County, with multiple flooding events being recorded in each of the last 5 years. Flooding events are most prevalent in Scarborough with a flash flooding a significant risk inland. Western areas suffered notably fewer impacts. Flooding events primarily cause damage to buildings (27%), increased disruption on the roads (19%) and they lead to reductions in the availability of Council services (such as school closures and refuse collection) (14%). Excluding the responses of Emergency Planning, flooding events have had the greatest impact on the services provided by

Highways. This has caused indirect impacts on a range of service areas including leisure and culture.

Snow and blizzards are regular winter events which have disrupted Council services in almost every year. The 'big freeze' of winter 2009/10 was one of the most significant events recorded. Snow events have more significant consequences for rural communities, as they can be cut off without access to Council services. Snow and blizzards appear to cause reductions in the availability of Council services such as school closures and refuse collection (54%), increased disruption on the roads (23%) and increased risk of injuries and accidents (8%). Snow and blizzards have had the greatest impact on service provision of Schools and the Highways Department. Impacts on the transport network have indirect impacts on all other service areas.

Media stories about storms and high winds focus on the coast line and in lowland regions through the centre of the County. Most storms and high winds result in impacts which are subjectively considered to have consequences of low or medium severity. Storms and high winds appear to increase the risk of injuries and accidents (32%), cause damage to buildings (23%) and result in disruption on the roads (21%). Storms and high winds cause problems for the transport network, tipping high sided vehicles and felling trees. Storms and high winds are often associated with flooding events. The impact of excessive rainfall is far greater and may suggest that not all damage due to high winds is reported.

Almost all impacts due to high temperatures and heatwaves occurred during a single period, June and July 2006. High temperatures appear to increase the risk of wildfires (47%), and injuries and death (16%). High temperatures have had the greatest impact on service provision of the National Park Authorities and the fire services because access to land must be closed.

The soft soil and geological character of the Scarborough Borough coast makes it susceptible to coastal erosion. Over the study period there have been many reports of land retreating, causing homes to be evacuated and buildings demolished.

The only occurrence of landslips outside Scarborough was at the A59 near Blubberhouse in Harrogate Borough. The road was closed for several weeks affecting local businesses and requiring significant investment in road improvement works.

No severe droughts have occurred in the past 5 years.

5. UKCP09 Predictions for North Yorkshire County

UKCIP conducted a piece of work in 2009 to project how the climate may change in 2020, 2050 and 2080 and below shows how they project the weather could change over the next 70 years in North Yorkshire.

2020 Yorkshire and Humber Climate Projections

The estimate of increase in **winter mean temperature** is 1.3°C.

The estimate of increase in **summer mean temperature** is between 1.3 – 1.4°C.

The estimate of increase in **summer mean daily maximum temperature** is 1.7 – 1.8°C.

The estimate of increase in **summer mean daily minimum temperature** is 1.5°C.

The estimate of change in **winter mean precipitation** is 5%.

The estimate of change in **summer mean precipitation** is 6% - 5%.

2050 Yorkshire and Humber Climate Projections

The estimate of increase in **winter mean temperature** is 1.9°C – 2.5°C.

The estimate of increase in **summer mean temperature** is 2.2°C – 2.6°C.

The estimate of increase in **summer mean daily maximum temperature** is 2.9°C – 3.5°C.

The estimate of increase in **summer mean daily minimum temperature** is 2.4°C – 2.9°C.

The estimate of change in **winter mean precipitation** is 9% - 12%.

The estimate of change in **summer mean precipitation** is –15% -18%.

2080 Yorkshire and Humber Climate Projections

The estimate of increase in **winter mean temperature** is 2.5°C – 3.6°C.

The estimate of increase in **summer mean temperature** is 2.5°C – 4.2°C.

The estimate of increase in **summer mean daily maximum temperature** is 3.4°C – 5.6°C.

The estimate of increase in **summer mean daily minimum temperature** is 2.8°C – 4.7°C.

The estimate of change in **winter mean precipitation** is 12% - 20%.

The estimate of change in **summer mean precipitation** is –17% -28%.

6. Summary of key risks to North Yorkshire County Council from a changing climate

Regional and local climate data has been collated to provide likely scenarios for key services (receptors) and is presented in table 2 below.

Severity and likelihood of incidents was scored by service representatives during the interviews and workshops and these have been multiplied to give the colour-coded level of risk. The table gives the service type, the likely impact and consequences of future climatic conditions and a risk rating for now, 2020, 2040 and 2080.

The risk of negative issues is quantified as follows:

1-9 = low (green)

10-15 = medium (amber)

16-25 = high (red)

The opportunity for positive outcomes is indicated as follows:

Pale blue indicates a low level of opportunity

Dark blue indicates a high level of opportunity

RECEPTOR	FUTURE CLIMATIC CONDITION	IMPACT	CONSEQUENCE	level of risk = severity x likelihood (see Appx 1 for explanation of scoring)			
				Now	2020	2040	2080
Built Infrastructure – all types of property	Increased winter rainfall	Flooding	buildings on low-lying areas at risk of flooding, increased property damage, threat to properties un aware of being in a flood risk zone due to surface water flooding	8	12	20	25
Transport	Increased winter rainfall	Flooding	Serious flooding of highway network leading to road closure and impacts accessibility for service delivery	8	12	20	25
Natural Environment	Hotter/Drier summers and increased rainfall intensity	Summer flash Flooding	Unpredictability of flood zones due to localised weather events leading to disruptions in service delivery.	4	9	12	20
Built Infrastructure – all types of property	Increased summer temperatures	Overheating	Reduced comfort in buildings for occupants – increased need for climate controlled environments. Impacts on the health, safety	6	9	16	20

			and wellbeing of the workforce and residents.				
Tourism and Economic Development	Increased winter rainfall, Increased rainfall intensity, increased storminess	Winter and summer flooding, storms	Loss of key outdoor events and attraction to the area.	4	9	16	25
Tourism	Increased summer temperature, increased winter temperature, decreased summer rainfall	Longer tourist season	Increased number of tourists leading to potential income opportunities for businesses.	1	4	9	16
Road network	Increased summer temperature/ decreased summer rainfall	Heatwaves – increased risk of melting road surfaces and damaged road structures	Restrictions to the road network and vehicle usage.	15	15	25	25

Table 2. Key risks to North Yorkshire County Council from a changing climate.

7. North Yorkshire County Council Service Based Comprehensive Risk Assessment

Service representatives were interviewed in 2011 using the methodology given in appendix 1. The following are the findings of this and include descriptions of climate adaptation work already being undertaken and suggested actions which have gone forward into the action plan (Table 3).

Waste

The household waste collection is the responsibility of District Councils. The disposal of waste and management of recycling points falls at County level.

The general view is that with increasing temperatures the risk to disposing of food waste stored in bins for two weeks is no greater, as this is not sufficiently long for adverse effects such as pest problems to develop.

A prolonged period of dry weather may impact on the amount of green waste needing to be disposed of (less), but this would require examination of contractual arrangements to prevent unnecessary collections. It is not clear if future disposal methods, see below, require a certain level of green waste to ensure the processes work correctly. This needs to be built into future planning.

Through recent snow and icy periods it had been possible to keep the Council's recycling points operational and provide flexibility for households to bring recycling. Although there were issues with some residents accessing these points due to the adverse weather but that would only require them to store material for a slightly longer period.

The current disposal of residual waste is through landfill at various sites across the county. Some of these are affected by windy weather which requires them to be closed, however, there is normally flexibility for waste to be diverted to other facilities. This may happen more frequently due to a changing climate so flexibility needs to be maintained.

Consideration needs to be given to whether former land fill sites are at risk if water tables rise in the future due to higher levels of rainfall. More recently closed sites should be well lined but inspection may be needed of older sites to ensure that contamination will not occur.

There is a major waste disposal facility planned for the whole of York and North Yorkshire, potentially near Knaresborough. This would involve a number of processes to dispose of the waste. It was not considered that these processes themselves would be impacted by lower rainfall, leading to less water availability, nor by increased temperatures. The site would need to be protected from flooding.

The waste would be transported to the facility after collection by York and the Districts and would be sent via transfer stations. The network would need to be sufficiently resilient to cope if transport disruptions cut off certain routes or impacted on a specific station. With widespread issues such as snow/ice or major flooding there may need to be storage capacity at the transfer stations. The facility would need to be able to deal with several days' waste from the stations at one time and some waste might have to be diverted elsewhere.

Actions

- Former landfill sites to be examined to ensure resilience to changing climate.

- Contracts and methods for disposal of green waste need to be flexible to deal with potential fluctuating amounts.
- The future waste disposal methods need to be sufficiently flexible to deal with impacts on transport networks and facilities, if increased levels of adverse weather such as floods and storms occur. The need to be able to store waste at transfer stations for short periods and the facility to deal with extra waste when connections are restored, need to be considered.

Estates Management

The team is responsible for sustainable management of the County Council's own properties, which includes schools. A Sustainable Design Policy for the Council's own estate has been developed which is valuable for building in resilience to climate change. It is also used by the Council's design contractors when planning work. The policy might usefully feed into wider policies, such as development of Local Development Frameworks (LDF) and Building Control work across the sub-region.

A key risk is hotter summers causing an extra demand for cooling in properties. This leads to extra energy demand and potentially fitting and upgrading of air conditioning which leads to expensive disposal of coolants which are high risk greenhouse gases. This could lead to a considerable cost, particularly with the large number of schools. These create a substantial energy demand on the Council already, although Display Energy Certificates are being used to identify the worse performing schools for action. These tend to be newer schools rather than older ones. Retaining tree cover for shading becomes important across the estate, particularly for provision of shaded outdoor areas for vulnerable people.

Developing renewable energy sources such as photo voltaic energy (PVE) could help generate energy for cooling and to meet heating demand in winter. More renewable energy could also bring income (through FIT/RHI) and greater resilience due to local supply in times of potential over demand on the grid supply. There could be a risk from storms in some areas to roof-fitted devices and this risk needs to be taken into account when equipment is being installed and in insurance cover. NYCC is looking at a joint procurement of the technology to reduce costs. Buildings and estates in general will need more maintenance to reduce storm damage if this is more prevalent in the future.

Another issue is water supply for buildings and for allotments and other planted areas if there is a decrease in summer rainfall. One way of countering this could be rainfall harvesting and storage areas. These would also reduce run-off in sites when there is higher rainfall intensity or excess winter rainfall. There is an issue with the large capital cost which is difficult to justify under current financial situation. There are drainage plans in places for major sites and open areas such as playing fields to ensure protection of nearby built areas from run-off after major rainfall events.

There are risks of cold weather and snow which create winter demand for energy and to counter this more efficient heating systems, insulation and better controls are being installed. There needs to be actions to ensure that water pipes are insulated to avoid burst pipes.

Some properties/assets may be at risk from coastal erosion and flooding. However these are generally on higher land and the facilities are more at risk from transport disruptions preventing access, which is dealt with under transport.

Actions

- Ensure use of sustainable design policy in the future and share this with the Council's partners in North Yorkshire and beyond.
- Implementation of renewable energy solutions to help deal with extra energy demand for summer cooling and energy security and maintain shade around properties.
- Ensure water supplies to allotments and other planted areas - consider using rainwater harvesting.
- Continue to prepare for cold spells with suitable insulation of buildings and pipes.

Flood Management

The county council leads on assessing and dealing with flood risk across the county. Environment Agency (EA) leads on protection against flooding from major rivers, with NYCC leading on the response to flooding from minor water courses and surface water flooding. The Council has new responsibilities under various Acts and Regulations and is preparing a flood risk map which looks at current vulnerabilities, maps of surface water risks and is linked to an asset register. In the future this will need to factor in the risk of increased winter rainfall and increased intensity of summer rainfall. A National Flood Risk Management Strategy was produced in October 2010, further guidance is expected for use at the local level in April 2011.

Across North Yorkshire there are different types of flood risk, which will be dealt in part by individual District Climate Change Risk Assessments. In upland areas there is rapid run off causing flash flooding, with more gradual build up from large rivers affecting low lying, larger settlements. Surface water flooding in low lying areas is generally more gradual from build up in dykes and ditches. Here Internal Drainage Boards have a key role to maintain drains to reduce the risk of flooding.

There are budgets for flood defences across North Yorkshire and also to defend against coastal erosion and flooding in Scarborough. However, the funding is limited and the threat predicted to increase due to climate change. Hard defences cannot always be deployed to address surface water flooding, which can happen across broad areas with intense rainfall.

It is important that the increasing social and economic importance of flood prevention is recognised in future partnership structures that develop in the sub-region, such as by the York and North Yorkshire Local Enterprise Partnership. In future budgets may not be ring-fenced, yet the risk of flooding needs to be recognised to protect future investment. Land use planning needs to take account of flood risk and planning gain may be useful to support localised flood prevention measures.

Leadership needs to be maintained at the strategic level, but increasing involvement of communities and businesses, particularly land owners, is needed to address the increasing risk. This is particularly so where flood defence structures may not be a priority and 'softer' measures such as tree planting and other land use management tools are used. There are important pilots in the county already, such as 'Slowing the Flow' around Pickering and the knowledge gained from these needs to be shared. A cross agency and business approach needs to be encouraged and supported.

Actions

- Flood risk mapping of various types needs to build in future climate predictions, to best determine future risk, this is particularly important when planning long term infra-structure.
- Flood prevention recognised as a key issue across the county and cross agency and partner working to be continued and developed. Funding for engineering and other methods continues to be prioritised.
- Information on flood prevention pilots to be shared in the sub-region and beyond to support future more widespread implementation.

Plans and Partnerships

The County Council leads on Emergency planning across North Yorkshire and provides support for District Councils through a Service Level Agreement. There are collaborative groups at different levels which support joint working across Councils and with partners at a strategic level. The risks from floods is described above, a detailed flood risk plan is in place to deal with emergencies that occur.

There are other plans in place to deal with other impacts which may grow worse due to climate change. There are potential water shortages with reduced rainfall. Yorkshire Water is responsible for provision of supplies and can provide water pallets but mechanisms are not currently in place to ensure vulnerable members of the public can access these. Co-ordinating roles will need to be agreed if conditions become more severe.

Plans are in place to deal with continuing snow and ice problems with key routes agreed for clearing snow and ice. This can leave some communities vulnerable on less important routes. For these and other issues community resilience is being promoted, where members of the farming community and others with suitable vehicles help others in the community. This puts agreements that often arise in an ad hoc fashion on a more formal basis. Training and support is also provided for more isolated communities at risk of flooding. In some cases temporary flood barriers can be deployed where major flood defences cannot be prioritised.

Action

- Continue to develop joint working on emergency planning across councils and with partners, as climate change makes some risks greater. Emergency plans and procedures are developed to deal with greater risks such as water shortage.
- Community reliance to be further promoted for more isolated communities at risk from a range of impacts.

Sub-regional Policy

The Regional and Spatial Policy Team deal with sub-regional planning and policies at the strategic level. Spatial planning is generally dealt with at the District/ National Park Authority level.

In general, policies and plans are subject to rigorous Strategic Environmental Assessment (SEA) which will include as assessment of how well they deal with the important climate change risks. Plans such as the Local Transport Plan are also subject to Strategic Flood Risk Assessment (SFRA). These use current vulnerabilities and take into account climate change increasing risk, but further data are useful to provide greater evidence.

It was considered that embedding action on issues such as adapting to climate change could be strengthened by promoting Environmental Management Systems across NYCC Directorates to ensure that necessary actions are taken. Training for County Council Members to understand and deal with the risks would also help with this work.

It was considered that the LCLIP process carried out across Y&NY was valuable for assessing vulnerability and should be maintained each year as weather related events are logged. This would provide a developing picture on vulnerability.

Actions

- Embed adapting to climate change across services using EMS systems. brief Members to increase understanding of the issues and responsibilities.
- Maintain mapping of vulnerability to extreme weather across North Yorkshire.

Natural Environment

Habitats and species have evolved over millennia and are tied to various climatic conditions (such as mean winter temperature, humidity, etc). For example the emergence of moth larvae in an oak woodland is linked to climate. If climatic conditions shift, ecology becomes out of sync, for example returning summer migrant birds may arrive in the UK but their food source, the moth larvae may not have emerged. Therefore as the climate changes, the species which make up ecosystems have to physically move to the zone with the appropriate climate. Species (e.g.: trees) spread very slowly and so are less able to keep to their preferred climate conditions in a rapidly changing climate. Further, if there are barriers such as mountain chains, a farmed landscape or motorways, habitats are not able to spread and isolation occurs. Habitat fragmentation prevents more mobile species from moving to preferred climatic zones.

The North Yorkshire sub-region holds some important species that are on the edge of their range, changing climatic conditions will lead to them becoming stranded. In the last ten years a number of species previously only known from the south of the county have become established (e.g.: the gatekeeper butterfly).

To enable the necessary expansion and shift of habitats a network of green corridors is desirable. An example is a national initiative known as 'bee lines' which will provide lines of species rich grassland running north-south and east-west, which will allow pollinating insects to move. Barriers such as major roads are an issue and in other countries 'green bridges' and 'green tunnels' (dedicated to wildlife) have been built.

It is difficult to convince non-specialists the priority of protecting wildlife and ecosystems compared to protecting human population and physical assets from climate change. Habitats and the natural environment have their own value to the economy, referred to as ecosystem services, which have been demonstrated to be worth millions of pounds. These services include reducing flooding, providing shade, filtering pollution, carbon storage, ensuring health and well-being, tourism, providing raw materials, conserving soil, pollinating crops, etc. The Ecosystem services approach provides a vehicle to justify nature conservation measures. It would be useful to quantify the cost benefits of protecting businesses from climate change. There are initiatives to evaluate the value of the green tourist industry to Yorkshire (millions of pounds to the tourism sector).

A high risk to natural habitats is a greater prevalence of invasive pests and diseases which are spreading into the area as the climate changes. These include some aggressive Phytophthora species that are damaging trees (alders and commercial larch plantations) and shrubs (see also trees below) and oak processionary moth which can also affect human health by irritating the skin. Increased flooding spreads non-native, river bank invasive species such as Himalayan balsam.

The risk of hotter, drier summers provides a risk of fire damage particularly to key upland habitats of peat and moorland which would do long term damage and fragment habitats and also release thousands of tonnes of stored carbon. Concerted awareness, risk management and action plans are needed by land owners and fires services to prevent fires. Closing areas to visitors during high risk periods can be used to reduce risk, but has the detrimental effect of damaging the visitor economy. There is a risk of soils being damaged by increased wetting and drying, which could impact upon hydrology, run-off, erosion and instability to foundations.

Erosion of key coastal habitats will worsen with a changing climate. This will squeeze coastal habitats between the sea and barriers inland. Such managed retreat has to be planned along with other coastal land uses such as sea defences. For some habitats, such as salt marsh, there is planned expansion as soft defence solutions allow new habitat creation.

There is also impact of a changing climate on fish stocks and fish species which needs to be better understood so that negative impacts can be avoided or mitigated.

Actions

- Work with landowners to create habitat corridors to allow key species to move to different areas as climatic conditions change.
- Understand the impact of new invasive and aggressive pests and diseases so these can be managed where possible.
- Protect vulnerable upland habitats against fire by working with key partners
- Understand other threats from climate change to natural environment, such as on soils and fish stocks so they can be managed or mitigated.
- Understand the value of Ecosystem services, including their role in mitigating to climate change and make the case for protecting them.

Arboriculture

Today's trees are at threat from a changing climate. They are key assets in providing shade and helping slow flows of water. Trees are long-lived and those which grace are County today may not be suitable species in a few years. Landscapers across the county should be aware that new species and strains will need to be selected for planting schemes.

The greatest risk is from increasing pest and disease risk, with new diseases occurring and others becoming worse possibly due to climate change. Horse Chestnut is an important tree in terms of town and park landscapes and is threatened by a recently arrived fungus. Storms damage trees and increasing wet and drying cycles over the seasons also have an adverse impact. Wind-blown trees on road networks are a problem and one solution is to select strains that are more resistant to wind blow and losing limbs.

Establishment costs will also increase with hotter, drier summers, requiring more investment. Planting is a long term investment with trees planted now, still being alive in 2080 when conditions may be different. There are limited budgets for tree planting but their importance needs to be recognised further as they bring benefits by buffering climate change and provide other environmental and social advantages. Joint working to realise such benefits needs to be carried out with Highways and school colleagues.

The Forestry Commission is carrying out research on the impact of a changing climate on trees. Sharing the results of this and development of a co-operative approach to action could be carried out by the Tree Officers Group across Yorkshire.

Actions

- A plan for understanding impacts, developing and protecting the tree stock of North Yorkshire should be developed across the sub-region through the Tree Officer Group working with the Forestry Commission.
- Partners need to work to ensure that the key role of trees is recognised in adapting to climate change.

Road Transport

North Yorkshire is a large area linked by a large number of A roads but also has a large number of minor roads which are important links for individual communities. NYCC (not individual district councils) deliver services across the county. The Council takes technical advice on the impacts of environmental issues (such as climate change) from its advisers Jacobs and its lead infrastructure contractor Balfour Beatty.

A new Local Transport Plan (LTP3) is under development, which has a specific Environment and Climate Change Appendix which deals with adapting to climate change as well as reducing carbon emissions. The key impacts of a changing climate are addressed in the policy and actions identified as shown in Table 3 below. It is important that these adaptive actions are implemented by NYCC and its partners.

Table 3. Key impacts of a changing climate taken from the NYCC Local Transport Plan.

Impact	Suggested adaptation
Surface melt of rural road surfaces and associated knock-on effects, such as disruption to travel	Use of alternative road surfacing materials in carriageway maintenance programmes to ensure higher melt resistance
Increased number of traffic accidents and delays on the principal transport routes through North Yorkshire caused by increased winter rainfall and winter average wind speeds	Weather and travel warnings issued to users of key road networks during storm events and anticipate increased resource requirements for emergency responses
Increased tourism and recreational activity, as other European resorts become too hot, putting increased pressure on local road networks	Plan for increased visitor numbers and consider appropriate interventions to manage additional traffic
Increased blockage of drains, culverts and gullies due to flooding and re-wetting after dry periods	Consider approach to inspection and clearance of drain, culvert and gully blockages
Increased frequency of flooding from	Consider improved sewer and drainage

drainage and sewer systems in urban areas	design capacity in scheme design
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Further adverse winter conditions could be seen. There have been major impacts in the last two winters. Major routes were cleared of snow and salted to prevent ice formation but this did not provide access to isolated communities on minor routes. There was general disruption to schools and businesses. One issue is the problem of supplying heating oil to homes and agricultural premises. If adverse winter conditions lessen over time then the providers of key services may become less well prepared. Contingency plans need to build in the possibility of severe winters still occurring. Community resilience and localised treatment of roads can be investigated. Renewable energy has the possibility to provide more robust local supplies of energy which can be sustained during such times, using localised supplies such as biomass.

Another impact of severe winters is more frequent salting due to marginal conditions, which together with more common freeze-thaw cycles, is causing damage to surfaces and making potholes a major problem. These will bring extra pressure on budgets for road repairs. More flexible road surfaces that can stand up to a range of conditions need to be developed. This is because there are also projected increasing summer temperatures which may cause melting of surfaces, which also needs to be mitigated for. In 2006, North Yorkshire had to grit roads in the summer to prevent melting of surfaces.

Bridges are pinch points in the transport network which could be threatened by increased winter rainfall and more intensive rainfall at any time. They may be damaged by increased and more frequent high water flow. There is a comprehensive inspection regime to check for damage and prioritise repairs. The county has a large number of heritage bridges which need sympathetic maintenance, although some older structures are more robust than newer ones. New bridges and drains will need to have sufficient capacity for the predicted future levels of water flow. Coastal routes are at risk from erosion and coastal flooding and these will need to be protected as part of Shoreline Management Plans. Inspection and building of bridges and other structures needs to take into account higher summer temperatures and possible buckling of structures of metal construction.

Increased storms can mean localised disruption via damage to trees and other structures. This needs to be managed effectively as it occurs. Roadside verges and trees are recognised as important for biodiversity and amenity and need to be managed effectively. Due to climate change leading to an increased growing season, the cutting of verges for safety reasons (view of traffic) will need to be reviewed and extended. High priority verges need to be maintained but others could be cut less often and become more naturalised, an approach which is being trialled in the National Parks.

In the higher areas of North Yorkshire where steep slopes occur, there could be increased subsidence due to increased rainfall and wetting and drying cycles. There are key points where major disruption to major routes can occur. As this risk increases further funding may be needed to protect vulnerable points. Similar impacts can be seen on rail infrastructure, so follow up discussions are needed with Network Rail.

Actions

- The adaptation actions in the LTP3 need to be implemented and increased risks identified in the UK Climate Projections need to be taken into account in building new structures and inspection and maintenance regimes.
- Flexible surfaces need to be developed for increasingly changeable conditions across the road network.

- Community resilience needs to be supported in more remote communities to help them protect locally important routes. Localised energy supplies will help develop resilience to disruption to transport.
- A regular inspection regime is needed for structures and trees to ensure that damage is detected at an early stage and surgery carried out.

Economic Development Policy

North Yorkshire covers a large area with a relatively small population. Changes to the climate would affect the economy, e.g.: any adverse impact on infrastructure will impact upon businesses and residents. Farming will be affected by changes to weather and the growing season. All types of businesses will suffer disruption if commuting is affected.

One of the county's key assets is its countryside which drives green tourism as well as making North Yorkshire a desirable place to live and work, i.e.: to set up a business. Warmer summers and a longer summer season are anticipated to provide further tourism opportunities.

Actions

- Ensure Climate Change Adaptation and mitigation is implemented as part of the York and North Yorkshire Local Enterprise Partnership.
- Assist in risk assessing extreme weather events on major businesses/ employers in North Yorkshire, e.g.: the impact on food processing at Leeming Bar.
- Raise awareness to businesses of the risk of climate change and how to adapt to projected weather extremes
- Promote local food to encourage business and reduce 'food miles'.
- Promote opportunities within specific sectors, e.g.: green tourism.

Public Rights of Way

The number of flash floods has been on the increase in North Yorkshire over the past ten years and the Public Rights of Way (PROW) Team has seen damage to the network throughout the year from flooding. A flooding event can cause disruption to the network by closing routes temporarily, e.g.: damage to bridges or permanently, e.g.: erosion of land with a footpath into the river or sea. Many routes (including National Trails) follow the coast or river banks and it is common for a flooding event to collapse a series of bridges along a stretch of the network leading to closures. Damage to the network leads to negotiations with the landowners regarding re-routing, which can be problematic as it impacts land, e.g.: by reducing land available for crops. In law, if a PROW is lost through erosion the landowner is not obliged to re-instate and this leads to a cost in officer time in negotiating, especially where the path affected is a national trail. When repairing paths, the PROW team utilise a relatively small budget to make the paths more sustainable where possible, e.g.: by moving the route away from unstable ground.

The service provides a reactive approach to climate change adaptation due to the immense size of the network and the limited resource available.

During the winter period staff can assist other services in keeping priority services operational.

The Rights of Way Team has noted longer growing seasons, with most main network routes needing two cuts a year rather than one in mid-summer.

The service has improved its ownership and hiring of plant and machinery to adapt to current ground conditions.

Actions

- Where practicable protect river banks and cliff top land from erosion.
- Look for funding opportunities for adapting Rights of Way.
- Investigate liability issues of gritting Public Rights of Way and create a policy based on the results of the investigation.
- Seek training opportunities for staff regarding adverse weather conditions, e.g.: driving in snowy conditions.
- Annually update a risk assessment for working in adverse/ extreme weather conditions.
- Monitor network route erosion and where possible link to weather extremes.
- When procuring the construction of infrastructures, include specifications for sustainable structures.

NYCC Historic Environment

The historic environment team hold historical data in several media types to advise on development impacts on archaeology and to assist agencies to conduct research.

Actions

- Future proof the current storage regime by either transferring to electronic format or have a disaster recovery plan for the safe storage of the current data storage methods.

NYCC – Passenger Transport

Responsible for transporting 22,000 school children across the county throughout the year, via local transport operators. The consequences of extreme weather lead to problems e.g.: fallen trees blocking roads, flooded routes and icy roads.

Actions

- Provide advice on adverse driving to North Yorkshire County Council 'grey fleet' drivers.
- Where possible provide 'driver training for adverse weather conditions' for minibus operatives and taxi drivers contracted by NYCC.
- Ensure voice contact communication is rolled out comprehensively throughout the county.
- Provide advice and guidance on heat stress and de-hydration to NYCC Council driving operatives.

NYCC – Highways (Highways Asset Manager)

Due to the Flood Act 2010 North Yorkshire County Council is now the lead authority in North Yorkshire on flooding. This has led to the production of an asset register and considerations given to surface flooding.

Weather extremes impact on all aspects of the highways service, with increase in rainfall, followed by storminess creating the biggest risks to the service and to service planning.

Localised intense rainfall causes road safety issues, especially on high speed roads. It also leads to flooding on to the highway from adjacent land, instability of land, landslides and over capacity of the drainage network. This risk has led to proactive work on an improved gully-cleaning programme and ditch-digging programme. Another solution investigated in some locations is the flooding of land adjacent to the highway to reduce standing water.

The unpredictability of damage from storms causes problems to the highways department and is costly to the service. A robust surveying of the highway network is carried out on a hierarchy basis depending upon several factors. This is to examine the condition of the highway and to identify remedial work required.

Cold winters in the future could cause problems for the highways service due to the freeze thaw process leading to road surface damage. These conditions would increase pothole development and generate added cost to the service in gritting and surface repairs. The mix or type of surface to be laid for each repair needs to be determined. The salt content from winter gritting damages road and verge infrastructure, by accelerating the deterioration of materials like concrete. To work effectively, grit requires vehicle activity post spreading which can be at low frequency in rural areas. Grit is less effective below -6°C and in the winter of 2010/11 the service had to deal with temperatures as low as -19°C, when the grit was ineffective at treating the road conditions.

Actions

- Proactively seek a solution for the service issues of freeze-thaw cycle.
- Consult document on adapting the highway section's work practices and adaptive infrastructure techniques.
- Continually seek improved binders and polymers when purchasing road materials, to ensure they resist water penetration during extreme weather conditions.
- Investigate protection of the road network infrastructure from accelerated deterioration caused by gritting.
- Ensure weather extremes are considered when tendering the construction of new highway infrastructures.
- Proactive approach to drainage gullies, establish and maintain frequent and leaner regime, especially in prone areas
- Investigate acquiring land to divert surface run-off, flood water to, to reduce standing water on the road network.
- Build a database of areas prone to flooding, so that officers are aware and can prioritise remedial works.

NYCC – Emergency Planning

Flooding and other extreme weather impacts pose a higher risk over a prolonged period. Surface water causes the most problems over the county. North Yorkshire County Council in the past was very reactive to flooding, but over the past few years is turning more proactive. This includes work with parish councils and other bodies to prepare for events such as flooding. Harrogate BC has employed a community officer for flooding which will increase awareness and preparedness in that district. Partnership working has increased over the past few years, to strengthen the preparedness and response to all types of flooding.

At times there has been pressure on water supply. This has been of concern where supply did not meet demand. This triggered regional teleconferences with appropriate officers and

agencies and led to the checking of vacant properties for water leaks. This has led to closer working with Yorkshire Water which has developed trigger points for action.

Actions

- Try and embed parish flood plans to all parishes prone to any type of flooding or on a flood plain.
- Raise awareness and publicise EA river and surface water flood maps.
- Better partnership working between emergency planning and flood management teams.
- Train and develop a network of on call North Yorkshire County Council employees to work in multiple, severe weather events.
- Develop and promote the availability of 4x4 vehicles throughout North Yorkshire.
- Develop a comprehensive contact list of employees, businesses, public sector and cross sector organisations, to maximise the number of organisations informed of forecasted, extreme weather events.
- Develop a water distribution plan with Yorkshire Water and promote issues around stop taps.
- Develop trigger points with CE electric and Yorkshire Water.

8. North Yorkshire County Council Climate Adaptation Action Plan

The actions from the interviews have been tabulated to give a 2011 climate adaptation action plan (Table 4).

Table 4 – North Yorkshire DC Climate Adaptation Action Plan 2011

ID	Action	Service	Action Plan	Service Plan	Risk Register
1	Former landfill sites to be examined to ensure resilient to changing climate.	Waste	X		
2	Contracts and methods for disposal of green waste need to be flexible to deal with potential fluctuating amounts.	Waste	x		
3	The future waste disposal methods need to be sufficiently flexible to deal with impacts on transport networks and facilities, if increased levels of adverse weather such as floods and storms occur. The need to be able to store waste at transfer stations for short periods and the facility to deal with extra waste when	Waste	x		

	connections are restored, need to be considered.				
4	Ensure use of sustainable design policy in the future and share this with the Council's partners in North Yorkshire and beyond.	Estates Management	x		
5	Implementation of renewable energy solutions to help deal with extra energy demand for summer cooling and energy security and maintain shade around properties.	Estates Management	x		
6	Ensure water supplies to allotments and other planted areas - consider using rainwater harvesting.	Estates Management	x		
7	Continue to prepare for cold spells with suitable insulation of buildings and pipes.	Estates Management	x		
8	Flood risk mapping of various types needs to build in future climate predictions, to best determine future risk, this is particularly important when planning long term infra-structure.	Flood Management			x
9	Flood prevention recognised as a key issue across the county and cross agency and partner working to be continued and developed. Funding for engineering and other methods continues to be prioritised.	Flood Management			x
10	Information on flood prevention pilots to be shared in the sub-region and beyond to support future more widespread implementation	Flood Management	x		

11	Continue to develop joint working on emergency planning across councils and with partners, as climate change makes some risks greater. Emergency plans and procedures are developed to deal with greater risks such as water shortage.	Partnership working	x		
12	Community reliance to be further promoted for more isolated communities at risk from a range of impacts.	Partnership working	x		
13	Embed adapting to climate change across services using EMS systems. Brief Members to increase understanding of the issues and responsibilities.	Sub-regional Policy	x		
14	Maintain mapping of vulnerability to extreme weather across North Yorkshire.	Sub-regional Policy	x		
15	Work with landowners to create habitat corridors to allow key species to move to different areas as climatic conditions change.	Natural Environment	x		
16	Understand the impact of new invasive and aggressive pests and diseases so these can be managed where possible.	Natural Environment	x		
17	Protect vulnerable upland habitats against fire by working with key partners.	Natural Environment	x		
18	Understand other threats from climate change to natural environment, such as on soils and fish stocks so they can be managed or mitigated.	Natural Environment	X		
19	Understand the value of Ecosystem services, including their role in mitigating to climate	Natural Environment	X		

	change and make the case for protecting them.				
20	A plan for understanding impacts, developing and protecting the tree stock of North Yorkshire should be developed across the sub-region through the Tree Officer Group working with the Forestry Commission	Arboriculture	X		
21	Partners need to work to ensure that the key role of trees is recognised in adapting to climate change.	Arboriculture	X		
22	Use of alternative road surfacing materials in carriageway maintenance programmes to ensure higher melt resistance	Road Transport	X		
23	Weather and travel warnings issued to users of key road networks during storm events and anticipate increased resource requirements for emergency responses	Road Transport	X		
24	Plan for increased visitor numbers and consider appropriate interventions to manage additional traffic	Road Transport	X		
25	Consider approach to inspection and clearance of drain, culvert and gully blockages	Road Transport		X	
26	Consider improved sewer and drainage design capacity in scheme	Road Transport	X		
27	The adaptation actions in the LTP3 need to be implemented and increased risks identified in the UK Climate Projections need to be taken into account in building new structures and inspection and maintenance regimes.	Road Transport	X		

28	Flexible surfaces need to be developed for increasingly changeable conditions across the road network.	Road Transport	X		
29	Community resilience needs to be supported in more remote communities to help them protect locally important routes. Localised energy supplies will help develop resilience to disruption to transport.	Road Transport	X		
30	A regular inspection regime is needed for structures and trees to ensure that damage is detected at an early stage and surgery carried out.	Road Transport		X	
31	Ensure Climate Change Adaptation and mitigation is implemented as part of the York and North Yorkshire Local Enterprise Partnership.	Economic development policy	X		
32	Assist in risk assessing extreme weather events on major businesses/ employers in North Yorkshire, e.g.: the impact on food processing at Leeming Bar.	Economic development policy	X		
33	Raise awareness to businesses of the risk of climate change and how to adapt to projected weather extremes.	Economic development policy	X		
34	Promote local food to encourage business and reduce 'food miles'.	Economic development policy	X		
35	Promote opportunities within specific sectors, e.g.: green tourism.	Economic development policy	X		
36	Where practicable protect river banks and cliff top land from erosion.	Public Rights of Way	X		

37	Look for funding opportunities for adapting Rights of Way.	Public Rights of Way	X		
38	Investigate liability issues of gritting Public Rights of Way and create a policy based on the results of the investigation.	Public Rights of Way	X		
39	Seek training opportunities for staff regarding adverse weather conditions, e.g.: driving in snowy conditions.	Public Rights of Way	X		
40	Annually update a risk assessment for working in adverse/ extreme weather conditions.	NYCC Public Rights of Way			X
41	Monitor network route erosion and where possible link to weather extremes.	NYCC Public Rights of Way	X		
42	When procuring the construction of infrastructures, include specifications for sustainable structures.	Public Rights of Way	X		
43	Future proof the current storage regime by either transferring to electronic format or have a disaster recovery plan for the safe storage of the current data storage methods.	Historic Environment			X
44	Provide advice on adverse driving to North Yorkshire County Council 'grey fleet' drivers.	Passenger Transport	X		
45	Where possible provide 'driver training for adverse weather conditions' for minibus operatives and taxi drivers contracted by NYCC.	Passenger Transport	X		
46	Ensure voice contact communication is rolled out comprehensively throughout the county.	Passenger Transport			X

47	Provide advice and guidance on heat stress and de-hydration to NYCC Council driving operatives.	Passenger Transport	X		
48	Proactively seek a solution for the service issues of freeze-thaw cycle.	Highways	X		
49	Consult document on adapting the highway section's work practices and adaptive infrastructure techniques.	Highways	X		
50	Continually seek improved binders and polymers when purchasing road materials, to ensure they resist water penetration during extreme weather conditions.	Highways	X		
51	Investigate protection of the road network infrastructure from accelerated deterioration caused by gritting.	Highways	X		
52	Ensure weather extremes are considered when tendering the construction of new highway infrastructures.	Highways	X		
53	Proactive approach to drainage gullies, establish and maintain frequent and leaner regime, especially in prone areas.	Highways		X	
54	Investigate acquiring land to divert surface run-off, flood water to, to reduce standing water on the road network.	Highways	X		
55	Build a database of areas prone to flooding, so that officers are aware and can prioritise remedial works.	Highways		X	
56	Try and embed parish flood plans to all parishes prone to any type of flooding or on a flood	Emergency Planning	X		

	plain.				
57	Raise awareness and publicise EA river and surface water flood maps.	Emergency Planning	X		
58	Better partnership working between emergency planning and flood management teams.	Emergency Planning		X	
59	Train and develop a network of on call North Yorkshire County Council employees to work in multiple, severe weather events.	Emergency Planning	X		
60	Develop and promote the availability of 4x4 vehicles throughout North Yorkshire.	Emergency Planning	X		
61	Develop a comprehensive contact list of employees, businesses, public sector and cross sector organisations, to maximise the number of organisations informed of forecasted, extreme weather events.	Emergency Planning	X		
62	Develop a water distribution plan with Yorkshire Water and promote issues around stop taps.	Emergency Planning	X		
63	Develop trigger points with CE electric and Yorkshire Water.	Emergency Planning	X		

6. Conclusion

This piece of work was funded by RIEP and the intention is for the North Yorkshire CC sustainable development officer to work across the service areas to implement the results and in particular the action plan. Action at an early stage is likely to save considerable resources in the future as the climate changes and climate adaptation measures are needed.

APPENDIX 1 – Detailed Methodology

The risk assessment was conducted by meeting with individuals or groups of staff and following the method outlined below.

Key activities at risk:

Please consider the key activities that your service/work area currently have responsibility for and consider the major impacts that a changing climate might have on your work. A matrix has already been partly completed by pulling out actions from a similar exercise in West Yorkshire and based on the work City of York Council did at the Tackling Climate event in 2009 and through the local impact assessment for York 2010.

Future climatic conditions affecting activities:

Please use the menu below to select the individual climatic condition relevant to the chosen activity. The table below outlines these future climatic conditions:

Future Climatic condition	2020	2050	2080
Increased summer temperature	+ 1.3°C	+ 2.3°C	+ 3.3°C
Decreased summer rainfall	- 8%	- 19%	- 23%
Increased winter temperature	+ 1.3°C	+ 1.9°C	+ 2.9°C
Increased winter rainfall	+ 4%	+ 11%	+ 15%
Increased storminess	Increase overtime		
Increased rainfall intensity	Increase overtime		

Table 4. Future climatic conditions. Source: Weathering the storm: Yorkshire and Humber regional adaptation study, 2009

Impact:

Please list the key impacts that the different climatic conditions (above) would have on the activities e.g. flooding or heatwave.

Consequence:

What are the results of the impacts? Who or what is impacted? Please list positive & negative consequences e.g.: Increased tourism (+) or road closed (-). If the consequence is positive, then highlight in blue.

How severe is the impact:

Please rank using the following scores:

- 1 = Insignificant
- 2 = Minor
- 3 = Moderate
- 4 = Major
- 5 = Catastrophic

How likely is the risk:

Please rank using the following scores:

- 1 = Low
- 2 = Fairly low
- 3 = Medium
- 4 = Fairly high
- 5 = High

Level of risk:

This is an automatic calculation (severity x likelihood = risk).

We have followed normal risks assessment protocol by selected scores of:

1-9 to be green
10-15 to be amber
16+ to be red

Taking each red risk

Please list any actions that are currently in place or will soon be out in place to address the risk. If there are none, please propose what would be necessary to deal with the risk. Each action should be colour-coded to represent whether the action is needed, planned or done.

Red = needed
Amber = planned
Green = done

Cost of action

Score low, medium or high. Monetary values were not used as the cost will be relative to each service or sector and should not be used as a comparable measure.

APPENDIX 2 - Acknowledgements

The Regional Improvement and Efficiency Programme would like to thank the following individuals and organisations in their support in the creation of this document.

West Yorkshire Comprehensive Risk Assessment
East Midlands Comprehensive Risk Assessment

And the following North Yorkshire County Council Officers:

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Sub-regional policy - Carl Bunnage, Team Leader Regional and Spatial Policy
Natural environment – Graham Megson, Team Leader, Natural Environment Team
Arboriculture – Dennis Gregson, Arboricultural Officer
Road transport – James Gilroy, Engineer Local Transport Plan
Economic development policy - Rita Lawson, Senior Economic Development Officer
Public Rights of Way - Aidan Rayner, Team Leader Public Rights of Way
NYCC Historic Environment - Gail Falkingham, Team Leader Historic Environment Team
Passenger Transport - Andrew Bainbridge, Team Leader Local Transport Plan
Highways - Doug Huzzard, Highways Asset Manager
Emergency Planning - Mark Wilkinson, Emergency Planning Manager