

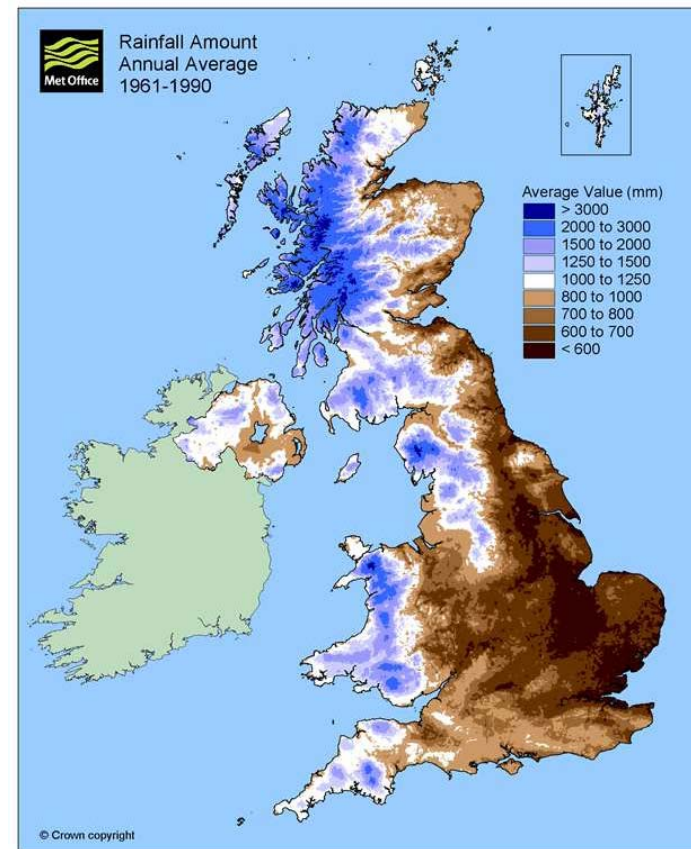
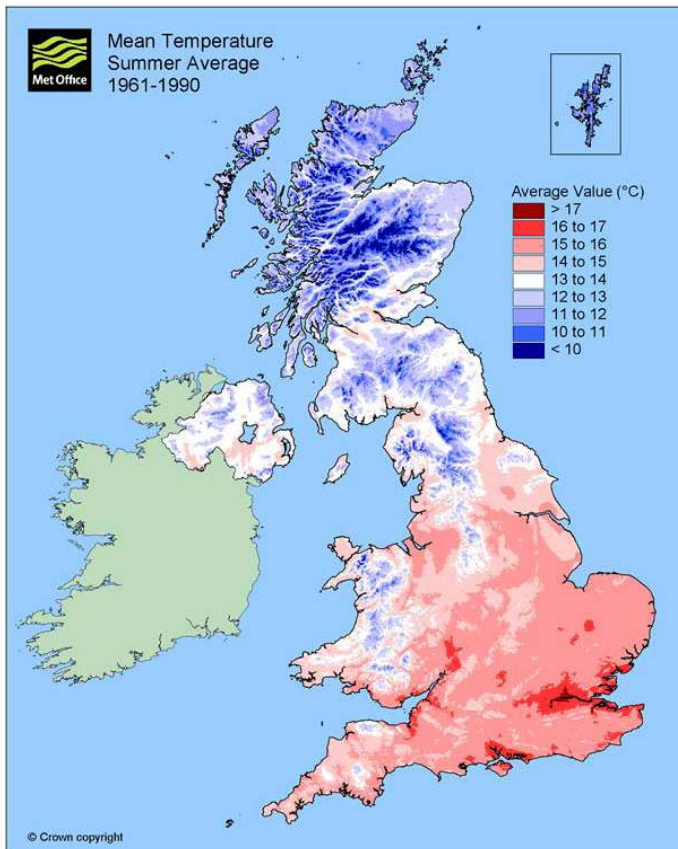
Climate Change Impacts on the Scottish Transport Network

**Graham Edmond
Head of Network Maintenance**

- Outline of Climate Change policy in Scotland
- Scottish Road Climate Change Study
- Adaptation Plan and Risk Assessment



TRANSPORT
SCOTLAND





HIGH WINDS



FLOODING

COASTAL EROSION



HIGH TEMPERATURES ?

LANDSLIDES



A83 Cairndow



A9 Dunkeld



A85 Glen Ogle

Climate Change Factors

- Occurrence of extreme high temperatures
- Occurrence of freezing conditions
- Length of growing season
- Extreme storm event rainfall
- River and stream flooding
- Groundwater
- Soil and sub-soil water content
- Occurrence of snow
- Extreme wind
- Occurrence of fog
- Coastal flooding

Rain

- Road drainage design
- River flood plains
- Areas of known flooding
- Channel Scour
- Earthworks –
Landslides



Wind

- Extreme wind events affecting vehicles and infrastructure



Temperature

High Temperatures

- Pavement
- Growing season

Snow and Ice

- Winter maintenance arrangements
- Freeze-thaw: durability aspects



Summary

- Climate Change is likely to result in greater impacts on the road network, through:
 - Higher temperatures
 - less freezing (freeze/thaw cycle change uncertain)
 - less snow
 - more rain
 - probably higher wind speeds
 - longer growing season
 - more river, stream and coastal flooding
- Uncertainty in predictions has to be recognised
- 28 recommendations for adaptation

Update on Recommendations

Priority Recommendations

- 6 priority recommendations
- 5 relate primarily to rain
- This is an area where changes are already being observed



Update on Recommendations

Priority Recommendations

Rain, recommendations 1 & 2

Design

- Revise surface water design storm event parameters
 - HD33/06 updated to include sensitivity test for 20% increase in design storm intensity
- Revise water course structure design storm event parameters
 - Follows above guidance although documents not yet revised



Update on Recommendations

Priority Recommendations



Rain, recommendations 3, 4 & 5

Operations

- Identify flooding locations and consider solutions
 - Number of individual schemes progressed but no consolidated schedule of locations, development of asset management programme will assist completion.
- Pre-emptively clear watercourses in flood risk areas
 - Requirement of term contractors managing the trunk road network

Research

- Further research into catchment runoff parameters
 - Research under way at present

Update on Recommendations

Priority Recommendations

Severe Weather Events, recommendation 6

Policy

- Severe weather information on VMS Network
- Weather warnings on network supported by information on Traffic Scotland web-site



Update on Recommendations

Other Recommendations – Short Term

Summary

- 10 recommendations for implementation in the short term
- cover temperature, rain, wind, coastal flooding and general issues



Update on Recommendations

Other Recommendations – Short Term

Temperature, recommendations 7& 8

Design

- Review local experience of surface dressing durability
 - update to Road Note 39, assessed on scheme specific basis
- Consider implications of extended growing season
 - to be addressed in next revision of Cost Effective Landscaping guidance



Update on Recommendations

Other Recommendations – Short Term



Rain, recommendations 9,10 & 11

Design

- Design drainage systems with additional storage capacity
 - Current practice is to encourage this approach
- Introduce surface/sub-surface drainage during maintenance work
 - Current practice is to encourage implementation of this recommendation on individual schemes

Operations

- Clarify scour inspection requirements
 - Requirements clarified in term maintenance contract documents

Update on Recommendations

Other Recommendations – Short Term



Wind, recommendations 12, 13, 14

Design

- Consider wind barriers in new designs
 - To be implemented on individual projects as appropriate

Operations

- Continue development of high winds strategy
 - Strategy at final review stage for issue shortly

Research

- Undertake further research into predicted changes in wind
 - To be addressed following issue of next UKCIP datasets

Update on Recommendations

Other Recommendations – Short Term



Coastal Flooding, recommendation 15

Design

- Consider coastal flooding risks in new designs
 - To be implemented on individual projects as appropriate

General Issues, recommendation 16

Research

- Update assessment following publication of next UKCIP reports
 - To be addressed following issue of next UKCIP datasets

Update on Recommendations

Other Recommendations – Long Term

Summary

- 12 recommendations for implementation in the long term
- cover temperature, rain, wind, coastal flooding, winter conditions and severe weather events



Current Work

- Update to report using UKCP09 data
- Ongoing work on
 - Landslide/Rock Slopes
 - High Winds
 - Durability of Pavements
 - Sustainability – carbon reduction



TRANSPORT
SCOTLAND







TRANSPORT
SCOTLAND





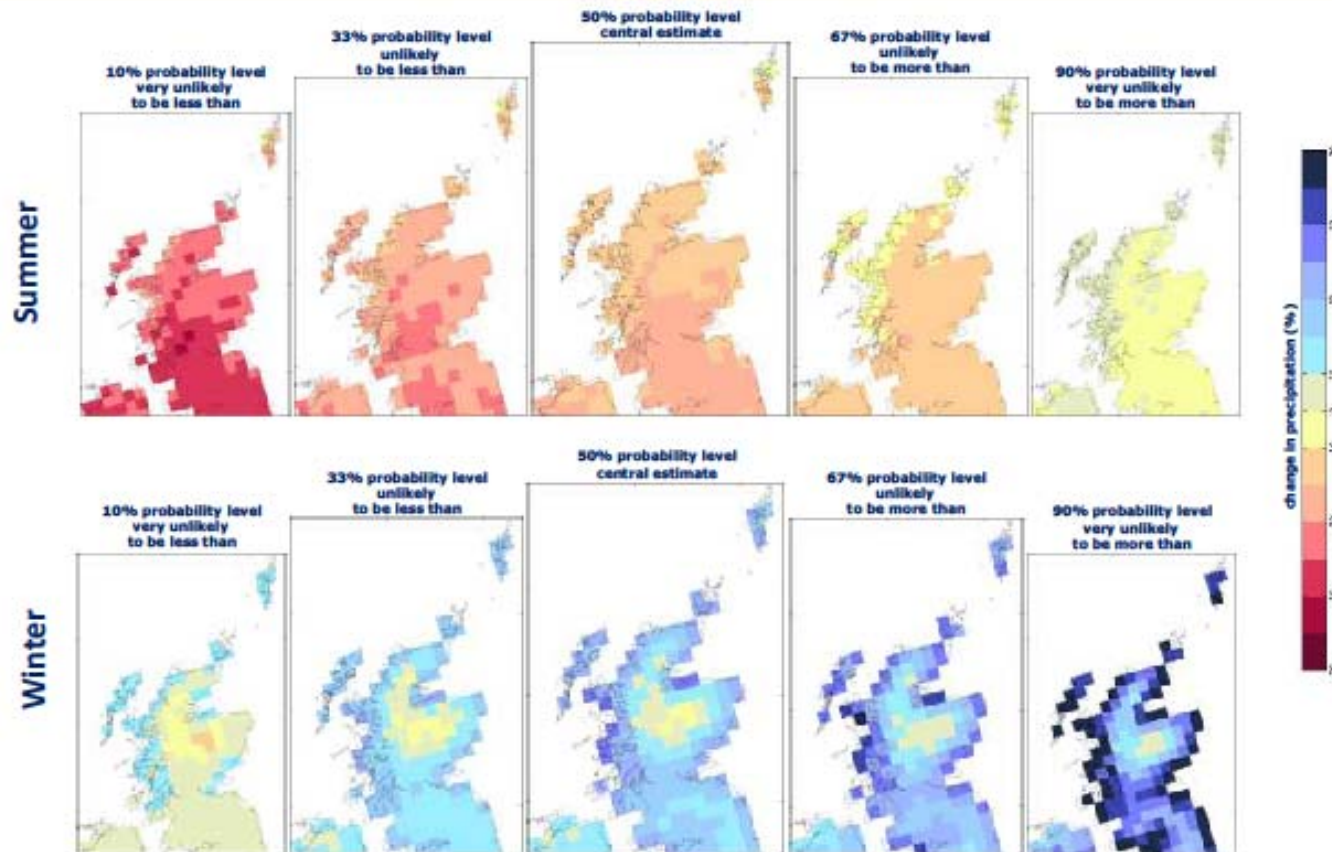
TRANSPORT
SCOTLAND





TRANSPORT
SCOTLAND

2080s High Emissions Scenario – Change in Mean Precipitation



SCCIP

Scotland's climate change
in response to the 2015 climate change act

UK
CLIMATE
PROJECTIONS

- Climate Change Adaption Plan – Update

• UK Risk Assessment

• Flooding Disruption	1	1
• Subsidence	2	7
• Energy Demands	2	7
• Thermal Loading on Hard Surfaces	4	14
• Hear Stress on Rail Infrastructure	4	7
• Cold Weather Working	6	14
• Erosion/Landslides	12	2
• Wind/Storm Damage	10	3
• Wind/Storm Disruption	20	4
• Insurance Cover	10	4
• Leaf Fall	19	-
• Disruption to Road Repairs	14	-

• UK Risk Assessment

• Flooding Disruption	1	1
• Subsidence	2	7
• Energy Demands	2	7
• Thermal Loading on Hard Surfaces	4	14
• Hear Stress on Rail Infrastructure	4	7
• Cold Weather Working	6	14
• Erosion/Landslides	12	2
• Wind/Storm Damage	10	3
• Wind/Storm Disruption	20	4
• Insurance Cover	10	4
• Leaf Fall	19	-
• Disruption to Road Repairs	14	-

- Biggest risk ?



Graham.Edmond@Transportscotland.gsi.gov.uk

www.transportscotland.gov.uk