


British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Applied geoscience for our changing Earth

Rural Flooding

from hydrology to hydrogeology




Dr Alan MacDonald amm@bgs.ac.uk

© NERC All rights reserved

Why Flood Science Matters ?

Public / government want effective solutions
Flood defences - effectiveness, cost...



© NERC All rights reserved

...and Natural Flood Management

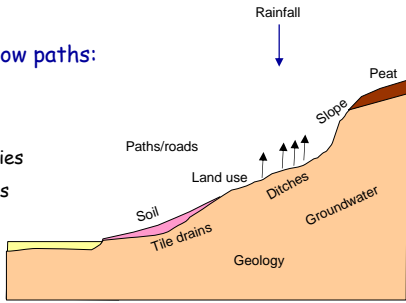
" holistic approach to reducing flood risk by restoring and enhancing natural processes which slow down the generation and conveyance of runoff through the catchment system, and deliver environmental and wider socioeconomic benefits "

© NERC All rights reserved

What affects how a hillslope responds to rainfall ?

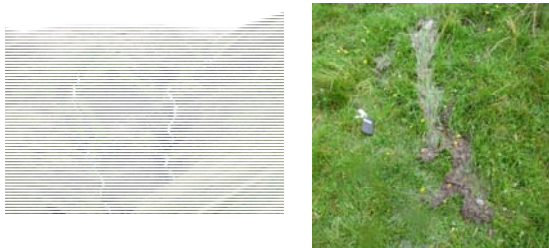
Different flow paths:

- Soil
- Overland flow
- Small tributaries
- Drains, Ditches
- Groundwater



© NERC All rights reserved

Examples from the Tweed 20/8/09



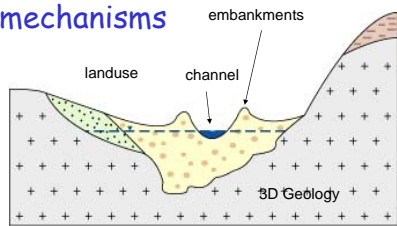
© NERC All rights reserved

Examples from the Tweed 20/8/09



© NERC All rights reserved

Flood Plain mechanisms



Examples from Tweed



© NERC All rights reserved



© NERC All rights reserved



Looking deeper

Groundwater in the flood plain

Characterising hydrogeology of upland catchments



Groundwater and the River Findhorn



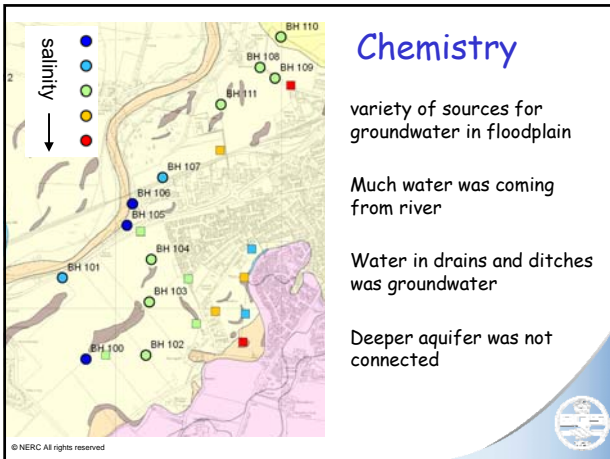
Large part of the town flooded 1997, 2001
Muckle Spate of 1829
New flood alleviation schemes

© NERC All rights reserved



© NERC All rights reserved





Chemistry

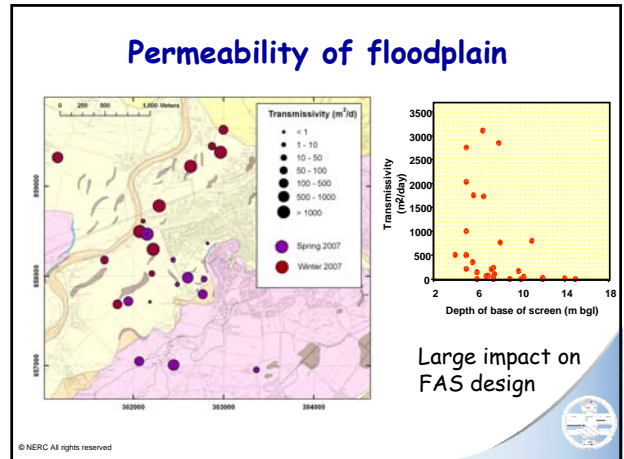
variety of sources for groundwater in floodplain

Much water was coming from river

Water in drains and ditches was groundwater

Deeper aquifer was not connected

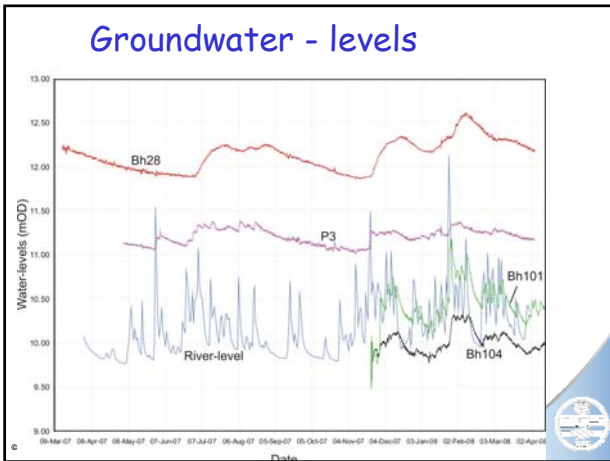
© NERC All rights reserved



Permeability of floodplain

Large impact on FAS design

© NERC All rights reserved



Groundwater - levels

© NERC All rights reserved

Summary: groundwater in the floodplain

Significant surface water - groundwater interaction

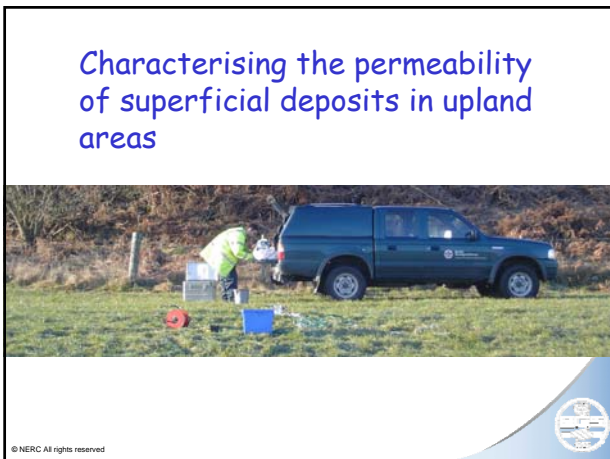
Large volume of storage - regularly used

Different timescale of response

Complex geology giving large changes in permeability

Groundwater integral to functioning of floodplain

© NERC All rights reserved



Characterising the permeability of superficial deposits in upland areas

© NERC All rights reserved

Interdisciplinary studies in Moray

Geologist - tell us exactly what unit we are in, build models

Engineers- do standard tests and descriptions

Hydrogeologists - test permeability

© NERC All rights reserved

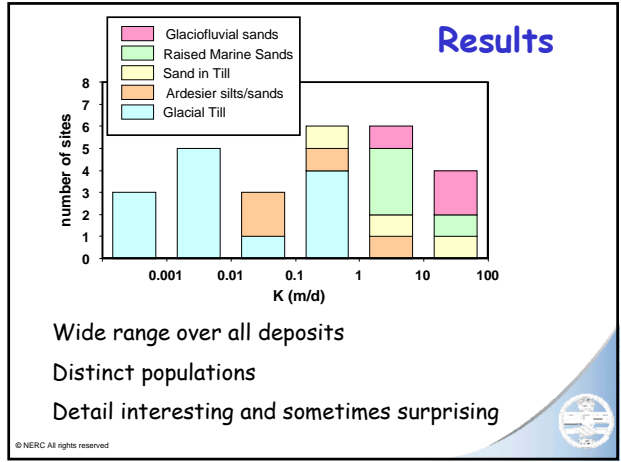


Measuring permeability

Guelph permeameter

Calibrated by comparing with 20 pumping tests in known deposits

© NERC All rights reserved

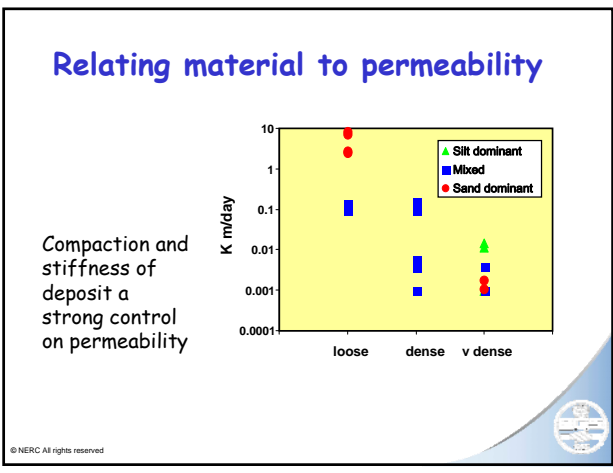


Wide range over all deposits

Distinct populations

Detail interesting and sometimes surprising

© NERC All rights reserved



Compaction and stiffness of deposit a strong control on permeability

© NERC All rights reserved



Summary - groundwater in uplands

1. Groundwater more significant in upland hydrology than conventionally thought
2. Very early days of understanding groundwater
3. Developing appropriate investigatory tools and models

© NERC All rights reserved



Conclusion

1. Flooding is highly complex and requires interdisciplinary thinking
2. Catchment solutions to flooding require a deeper understanding of processes
3. There is no substitute for instrumenting catchments and carrying out observational science
4. Don't forget groundwater