Flood Management in Scotland

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Structure

- The flooding problem
- Politico-legal ‘solutions’
- Land management as sustainable flood management: examples
- An agenda for the future

The Perth to Inverness Railway at Dalguise, River Tay in flood January 2005

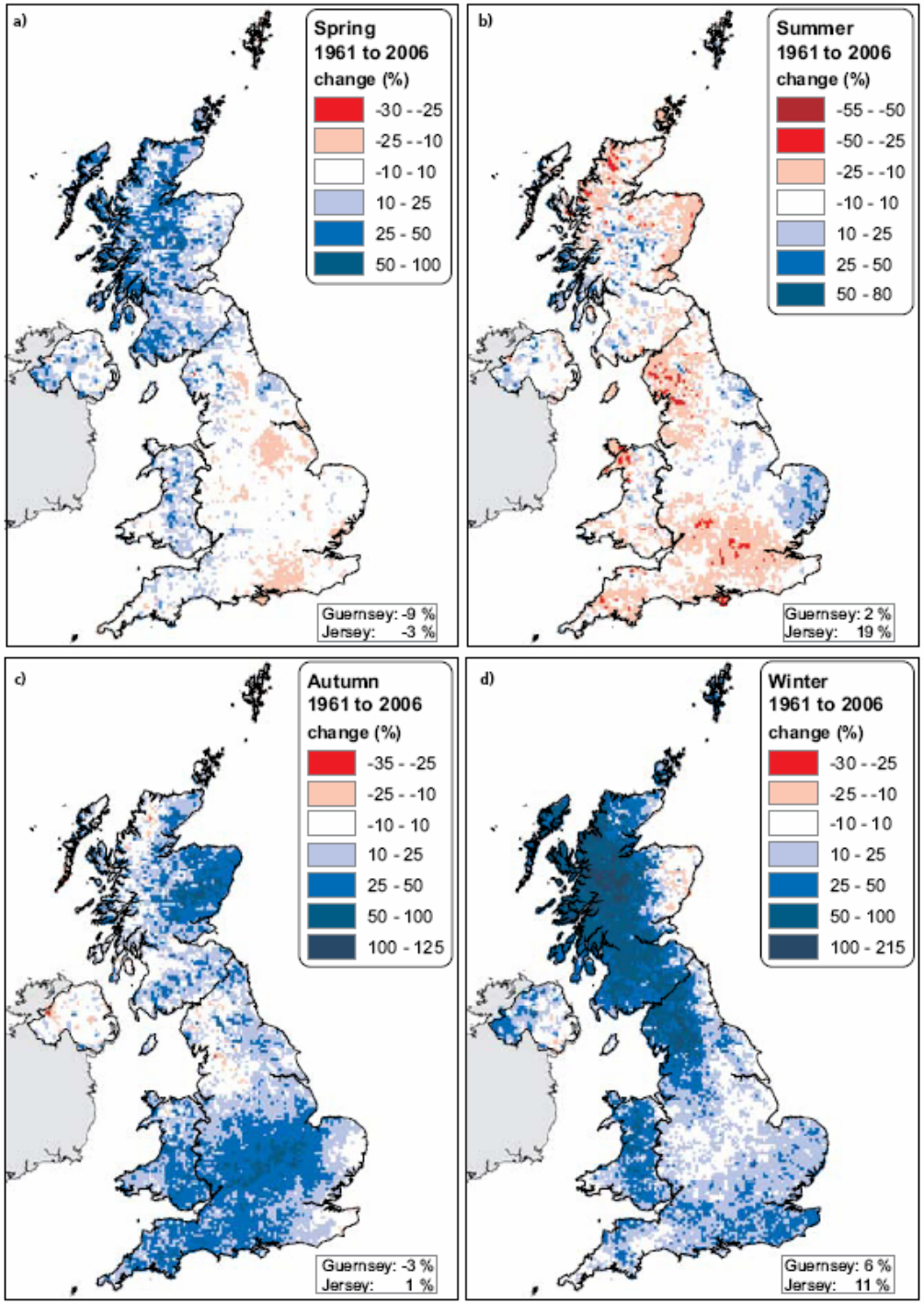
The scale of the problem

- ~ 200 000 homes at risk of coastal/ fluvial flood in Scotland
- Average insurance claim for a one metre depth summer flood: £22,000 for buildings and £13,000 for contents (many much higher)

In Scotland…

- River flow peaks are measurably higher compared to 30 years ago, especially in the West (Werritty et al. 2002)
- 8 of 16 largest rivers had maximum recorded flood in 8 years prior to 2002
- Many large flood events since 2000 (Edinburgh, Glasgow, Elgin)
- No conclusive proof of a link to climate change, but in line with model predictions

Seasonal Precipitation changes 1961-2006



UK Climate Impacts Programme 2008

Water flows in major Scottish Rivers

River	Drainage area (km^2)	Record begins	Maximum flood to 1988 (m^3s^{-1}) + date		New maximum from 1989 (m^3s^{-1}) + date	
Tay	**4587**	**1948**	**1890**	**2/1950**	**2268**	**1/1993**
Tweed	4390	1962	1556	1/1982		
Spey	2861	1952	1594	8/1970		
Ness	**1839**	***1930*/73**	**594**	**?/1937**	**669**	**2/1989**
Clyde	**1704**	**1958**	**670**	**9/1985**	**830**	**12/1994**
Dee	1370	1934	1134	1/1937		
Don	**1273**	**1969**	**286**	**8/1970**	**313**	**9/1995**
Deveron	954	1960	521	5/1968		
Annan	925	1967	473	10/1977		
Nith	799	1957	986	1/1962		
Leven	**784**	**1963**	**151**	**1/1974**	**197**	**3/1990**
Findhorn	782	1958	2410	8/1970		
Earn	**591**	**1951**	**305**	**2/1948**	**358**	**1/1993**
Helmsdale	**551**	**1975**	**273**	**12/1985**	**287**	**10/1993**
Teith	**518**	**1963**	**247**	**1/1975**	**374**	**1/1992**
Whiteadder	503	1969	280	11/1984		

Table shows data for gauging stations at outfall of all Scottish catchments with area >500km^2 and continuous peaks-over-threshold records 1975-1997

GOOD NEWS!

FOLLOWED BY
BAD NEWS!

Flood Risk Management (Scotland) Act 2009

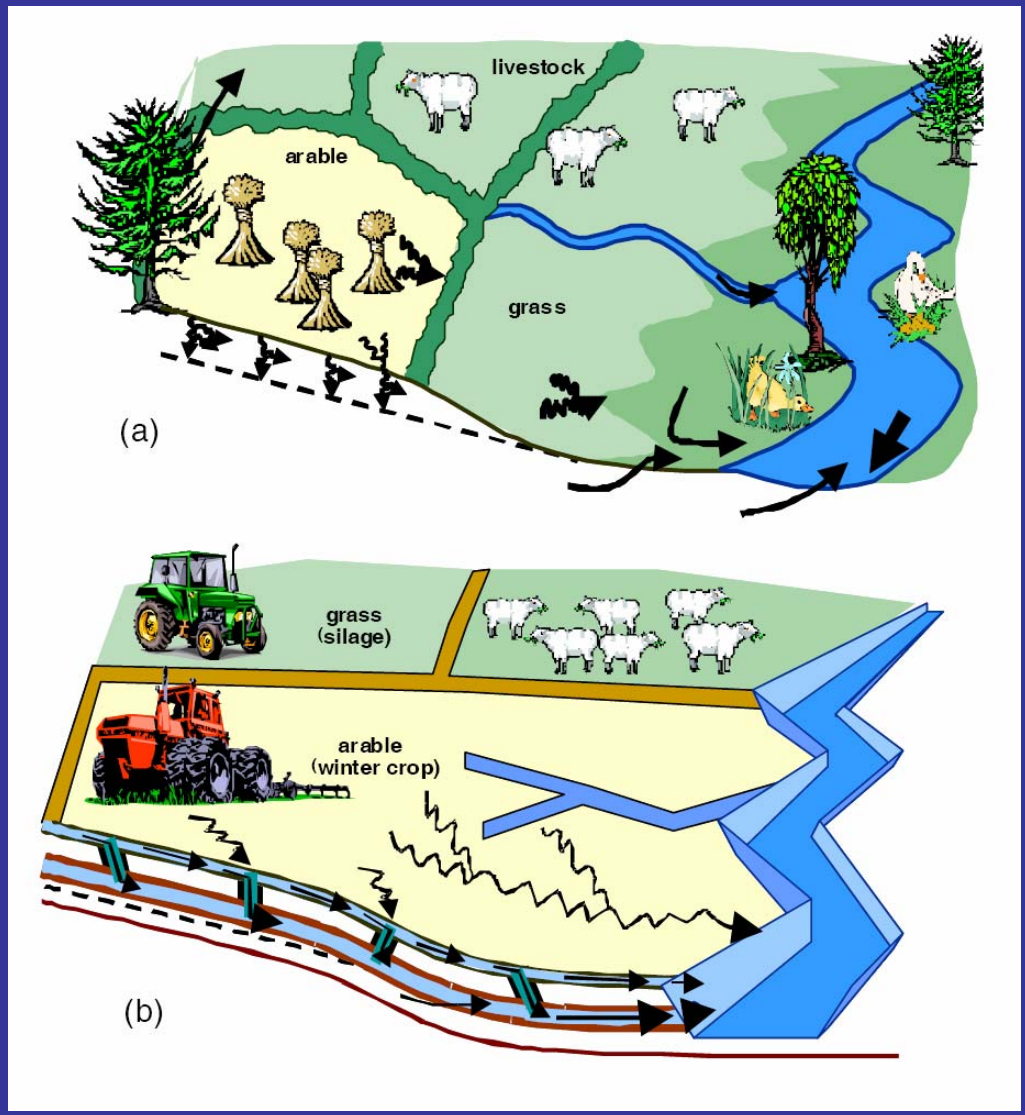
SECTION 20

SEPA to assess possible contribution of alteration etc. of natural features

(1) SEPA must, by 22nd December 2013 or such other date as the Scottish Ministers may direct, assess whether alteration (including enhancement) or restoration of natural features and characteristics of any river basin or coastal area in a flood risk management district could contribute to the management of flood risk for the district.

– more priority to land management?

A link between rural land use change and flooding?



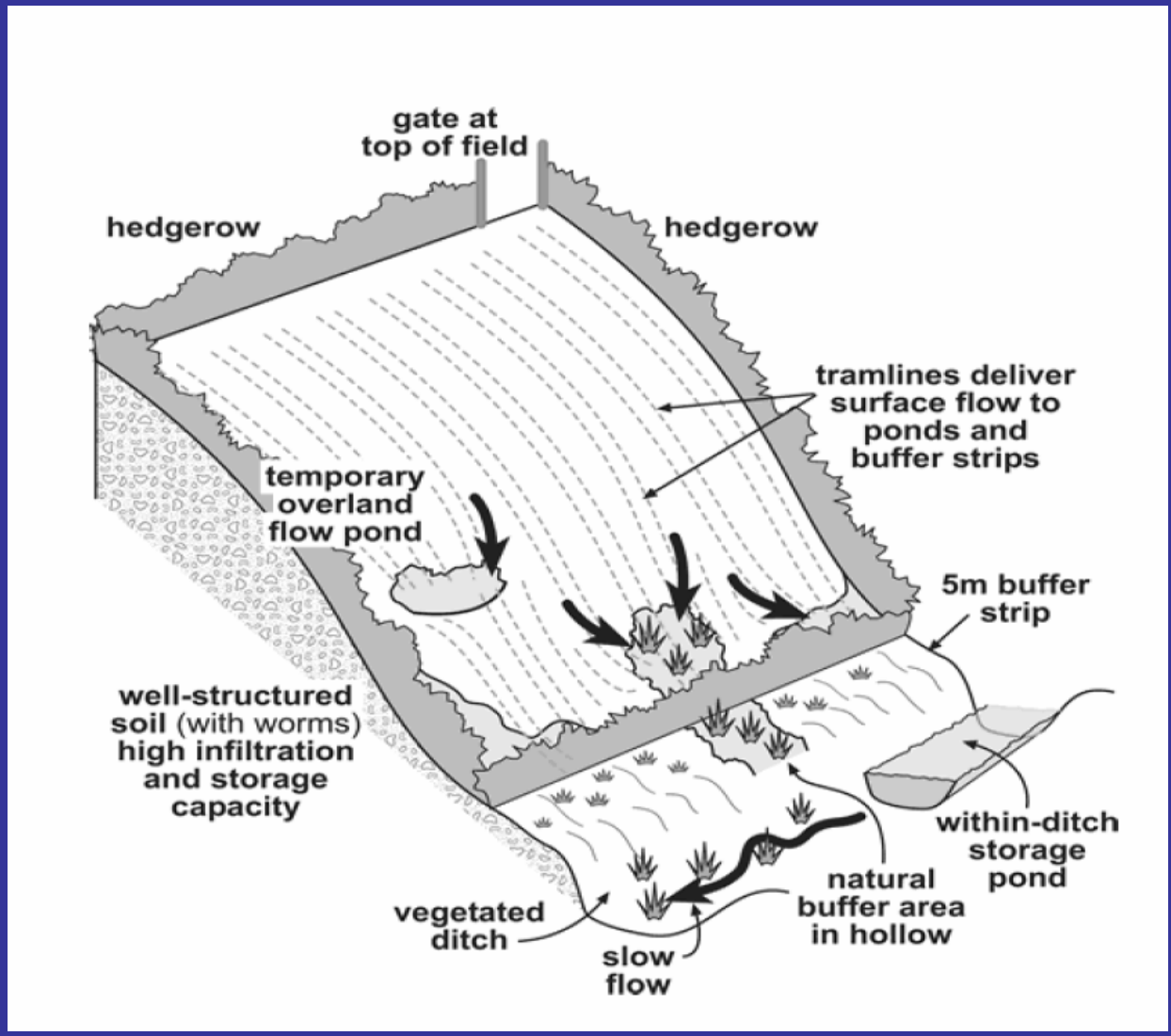
Pre-war (1930s and before)

Recent

O'Connell E et al. (2007) Hydrol Earth Syst Sci 11:96-107

O’Connell et al 2006 - conclusions

- Substantial evidence in the UK of increased surface runoff generation resulting from modern land use practices (and that they *can be mitigated or avoided by a range of surface runoff control measures*)
- “what hydrologists want is to be able to tell flood risk pratitioners that their predictions use a method that has been tested and found to be reliable”
- → need to validate rainfall-runoff models – scaling DOWN to process UP to catchment
  - Aggregation and propagation
  - Exchange with groundwater
  - Flow through confluences


gate at top of field
hedgerow
hedgerow
tramlines deliver surface flow to ponds and buffer strips
temporary overland flow pond
5m buffer strip
well-structured soil (with worms) high infiltration and storage capacity
within-ditch storage pond
natural buffer area in hollow
vegetated ditch
slow flow

Upland management

Floodplain wetlands


Plantation forests

Gully woodlands


Large woody debris

Summary of hillslope hydrology processes operating in the Coed y Brenin forest

Forestry

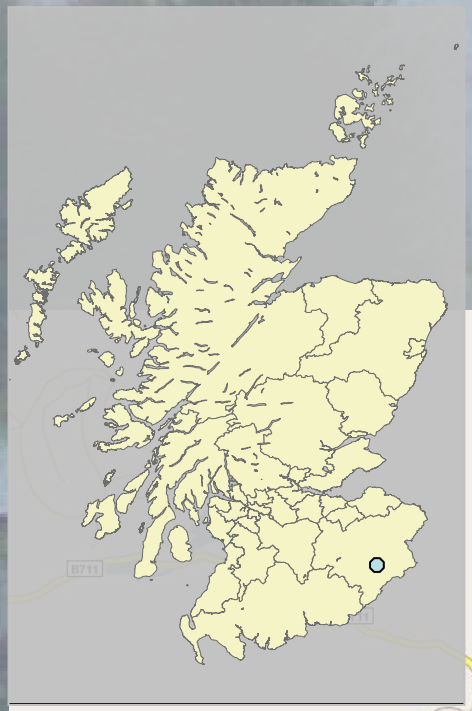
Hall GH and and Cratchley R (2005)

45th Congress of the European Regional Science Association, Amsterdam, August 2005

Possible flood reduction strategies for upland catchments (Hall and Cratchley, 2005)

- Continuous cover forestry practices should be employed, to avoid soil erosion from clear felled hillslopes. Trees need to grow beyond normal commercial maturity to ensure the open canopy conditions favourable for high productivity of ground vegetation.
- Riparian zones in the steep upland valleys should be planted with oak/birch to help ithe stabilisation of the thick deposits of glacial and periglacial sands, gravels and clays forming the river banks.

Operationalising Sustainable Flood Management: Hawick

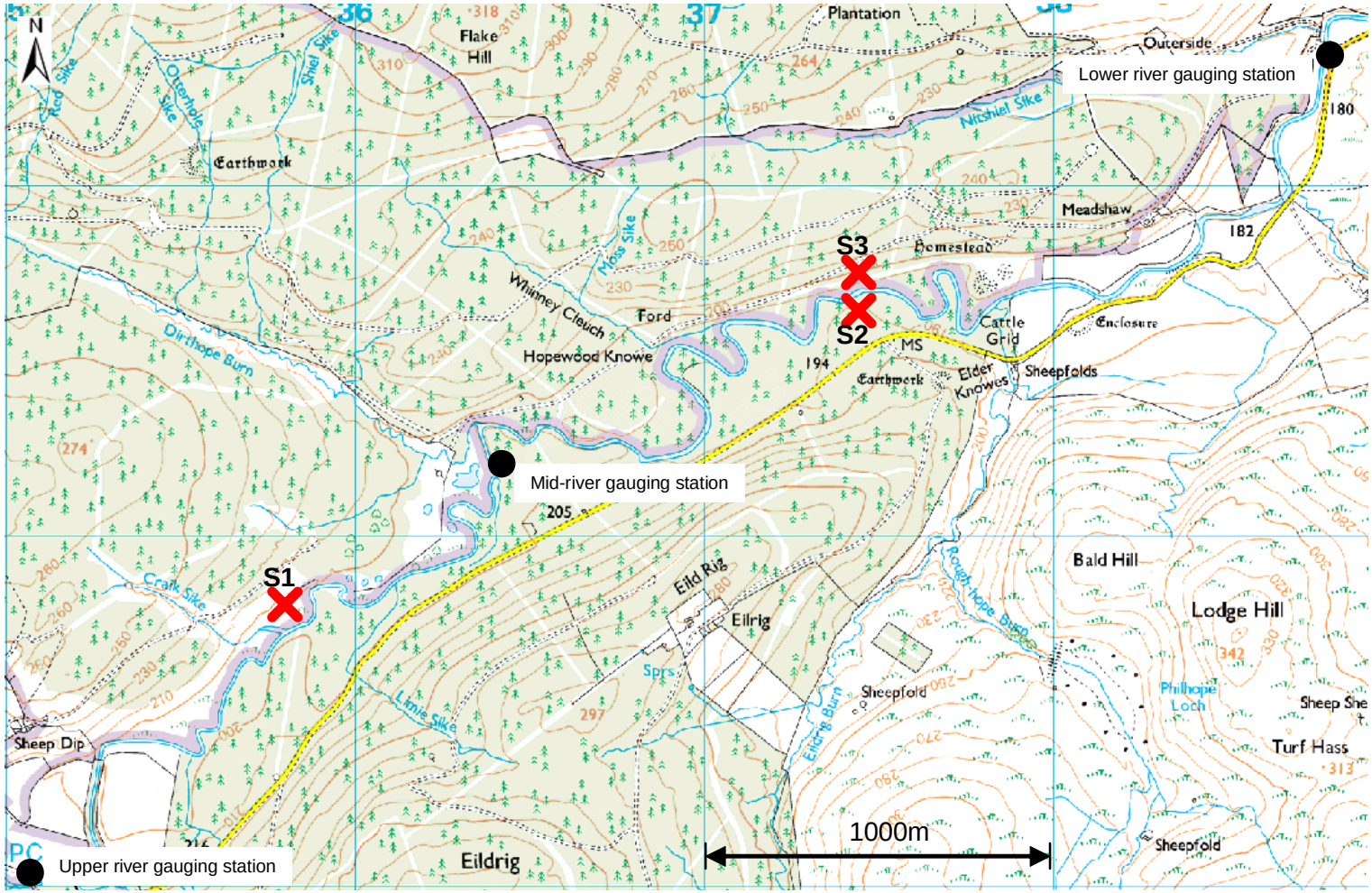


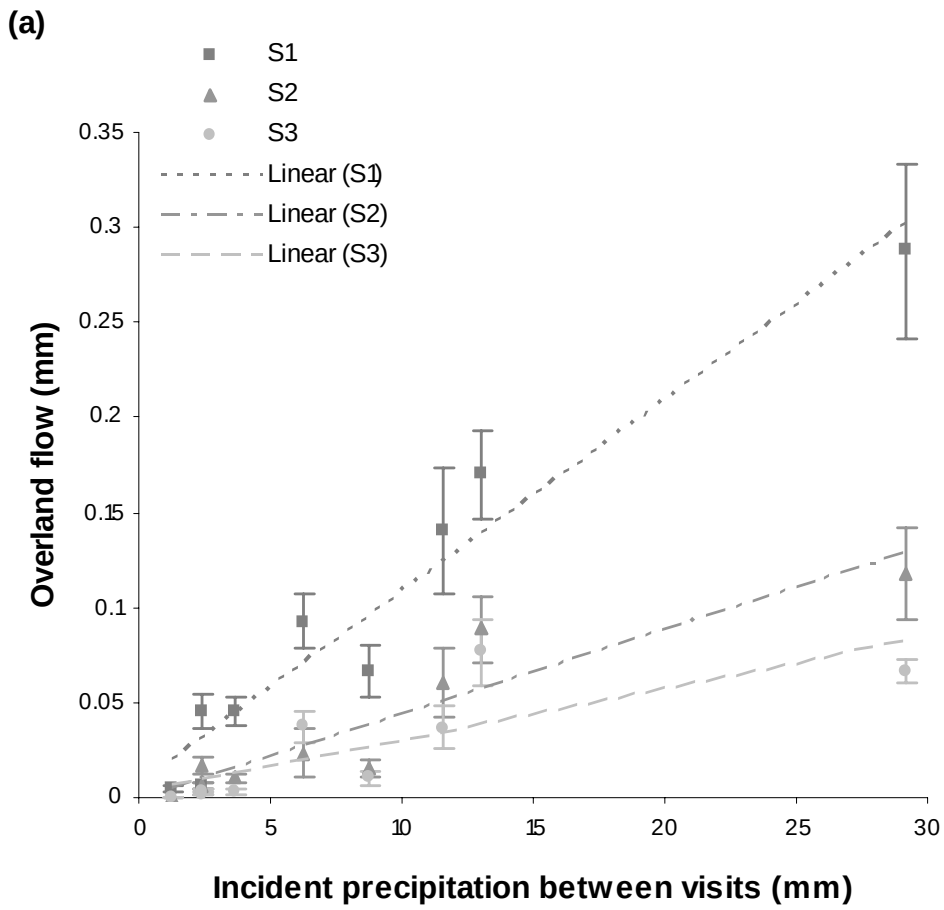
Ian Bell

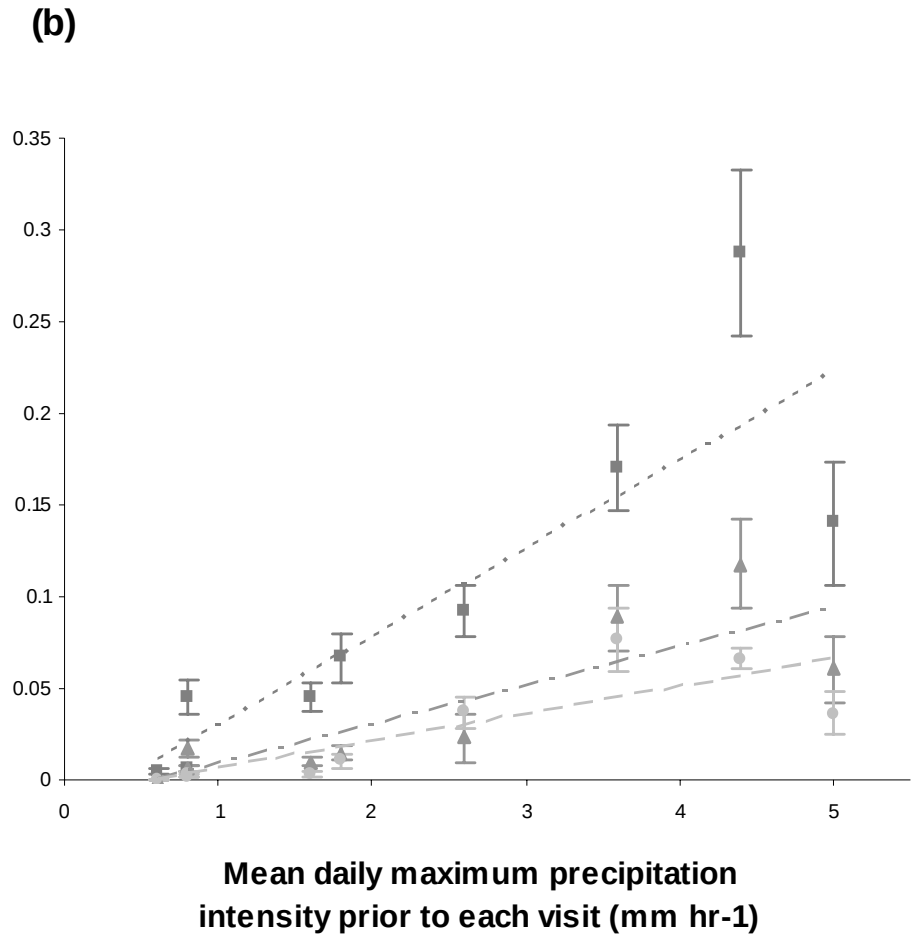

Craik forest, Scottish Borders


15 14:01


Existing river path with new plantings
Old path of river marked out by infilling cut-off meanders, ponds and riparian trees
Michael Bonell
15 14:15


N
Lower river gauging station
Mid-river gauging station
Upper river gauging station
S1
S2
S3
1000m
Flake Hill
Plantation
Outerside
Earthwork
Meadshaw
Homestead
Whinney Cleuch
Moss Sike
Ford
Hopewood Knowe
Dirthope Burn
Cattle Grid
Enclosure
Sheepfolds
Elder Knowes
Bald Hill
Lodge Hill
Philhope Loch
Turf Hass
Sheep Dip
Crank Sike
Eild Rig
Eilrig
Sheepfold
Eildrig
Rough Hope Burn
Eildrig Burn
Linnie Sike
Nitshiel Sike
Red Sike
Outerside Sike
Shiel Sike


(a)
S1
S2
S3
Linear (S1)
Linear (S2)
Linear (S3)
Overland flow (mm)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
5
10
15
20
25
30
Incident precipitation between visits (mm)


(b)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
1
2
3
4
5
Mean daily maximum precipitation intensity prior to each visit (mm hr-1)

Our ‘agenda’ for Flood Management Research

- Refine risk assessments through stakeholder-driven targeted hydrology
- Improve knowledge of constraints on delivery of measures, e.g. due to planning and policy
- Develop understanding and quantification of socioeconomic and environmental (multiple) benefits
- Disseminate/ interact with the key players including, most importantly
  - communities at risk
  - those who can make a difference -including landowners


Thanks!