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Field methods for testing the theory of small scale riparian hydrology: implications for flood risk management

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The James Hutton Institute

EPSRC
Pioneering research and skills

Supervisors:
Dr. Lindsay Beevers

Prof. Garry Pender

Dr. Mark Wilkinson (James Hutton Institute)

WHY RESEARCH RIPARIAN BUFFERS FOR FLOOD MANAGEMENT?

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The Scottish Government

DIRECTIVES

DIRECTIVE 2007/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 23 October 2007
on the assessment and management of flood risks

Flood Risk Management (Scotland) Act 2009
2009 asp 6

deecatchment partnership

Flood and Water Management Act 2010

WHY RESEARCH RIPARIAN BUFFERS FOR FLOOD MANAGEMENT?

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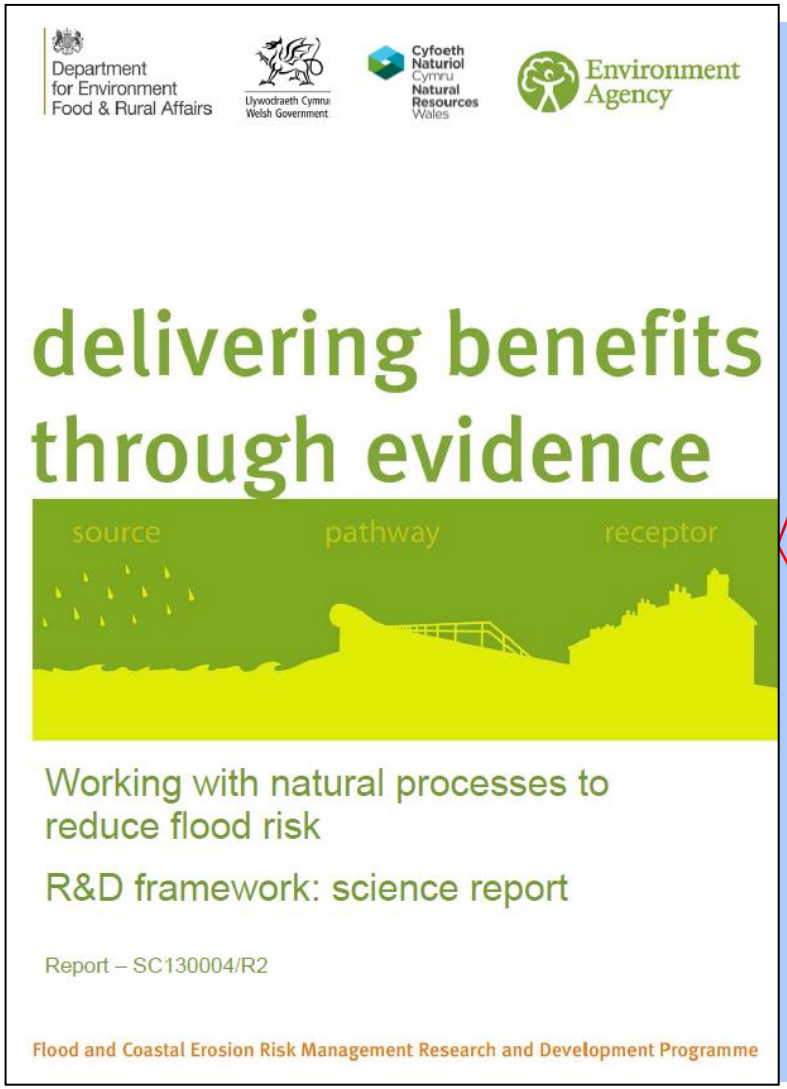
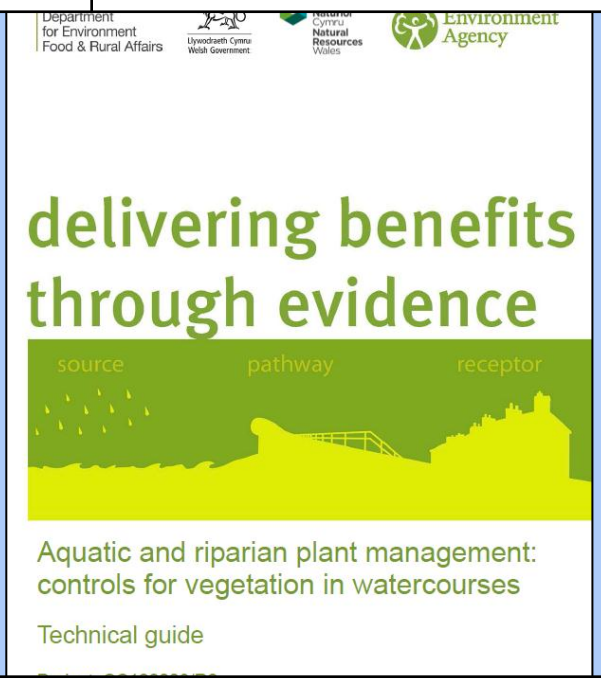


Research Gaps	
Gap 5	New studies to improve evidence base
Gap 7	Experimental studies of WWNP



Lack of research on riparian buffers that directly look at hydrology and the implications for flooding

TARLAND CATCHMENT

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RIPARIAN HYDROLOGY EXPERIMENT SITE (August 2014)

- 76km^2
- Tributary to River Dee in Rural Aberdeenshire
- Dominated by agriculture, forestry and heathland
- Most recent high flow event: 28/01/2014

RESEARCH OBJECTIVE & QUESTIONS

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1. OBJECTIVE
Establish and compare riparian hydrological behaviour types and key event characteristics

2. QUESTION
During hydrological events, is surface runoff *out-with* a riparian buffer higher than surface runoff *within* an established riparian buffer?

INRIP | OUT-RIP

SURFACE RUNOFF
Vs.
SURFACE RUNOFF

3. QUESTION
During hydrological events, is there a lag-time between *soil moisture* peak and *surface runoff* peak

INRIP | OUT-RIP

LAG-TIME
SOIL MOISTURE
Vs.
SURFACE RUNOFF

EXPERIMENT DESIGN

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PRELIMINARY RESULTS
JANUARY 2014 EVENT

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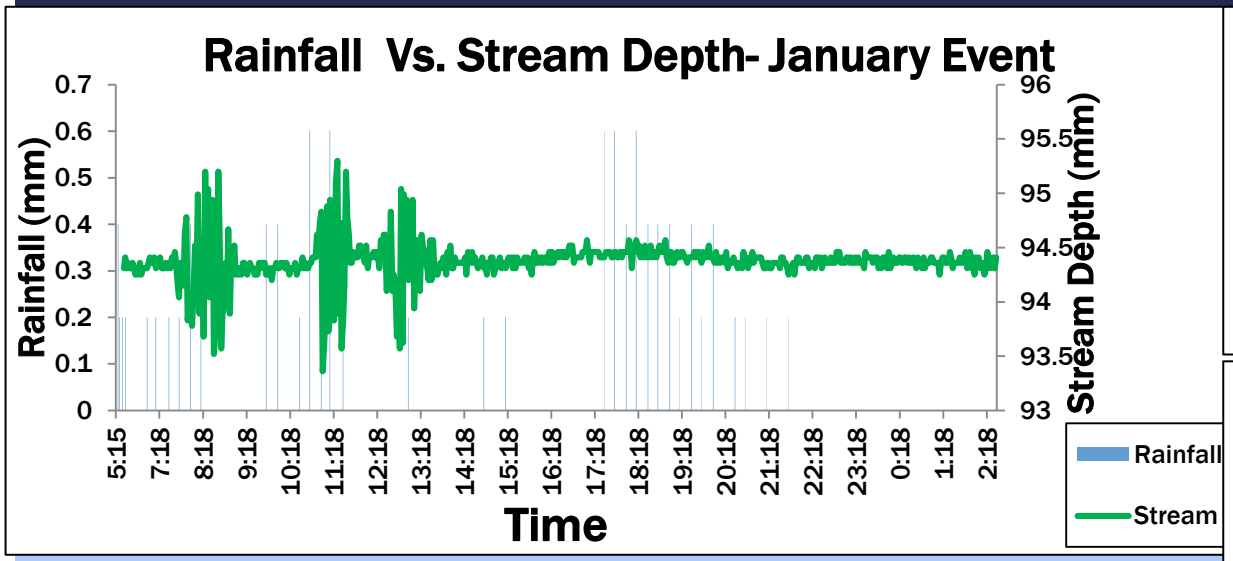

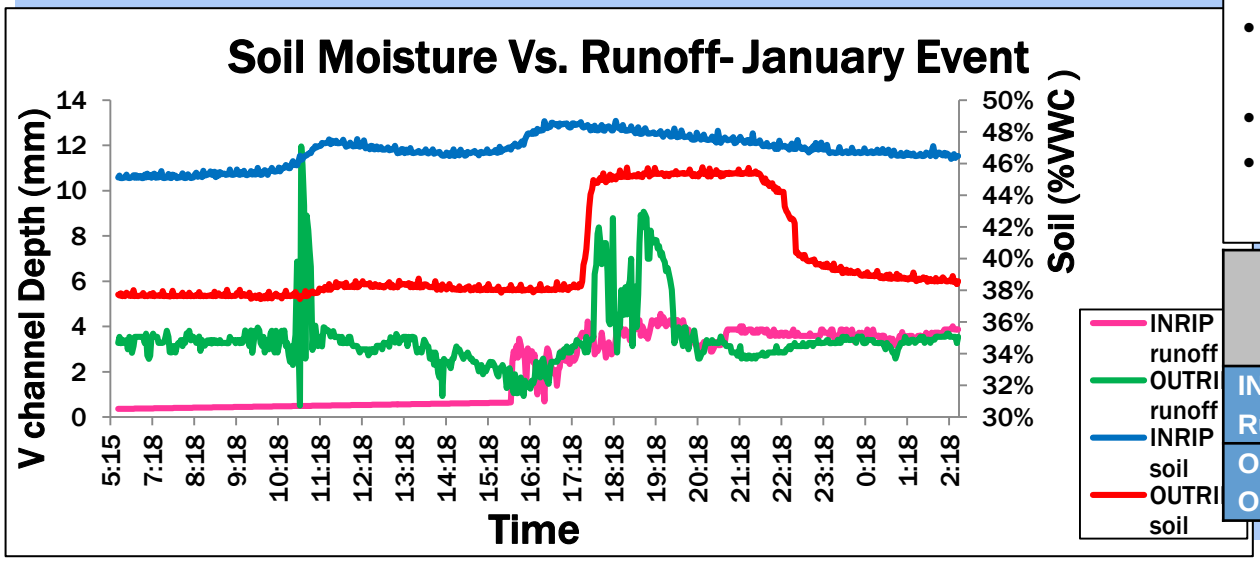

KEY CHARACTERISTICS:

- Limited vegetation growth
- Wet antecedent conditions
- Elevated stable stream depth
- Likely elevated GW
- No crop in adjacent sloping field
- Rainfall: 2hr 15m heavy

RIPARIAN BEHAVIOUR:

- Runoff higher OUTRIP
- INRIP soil sustained high- little variance
- OUTRIP soil responds to rainfall faster & plateaus
- Stream is not affected
- BUFFER PERFORMS AS EXPECTED

JAN 2014	Time between:	
	Peak	Time to Peak
INRIP Soil Vs. INRIP Runoff	1hr 14min	1hr 10min
OUTRIP Soil Vs. OUTRIP Runoff	24min	1hr

PRELIMINARY RESULTS
FEBRUARY 2014 EVENT

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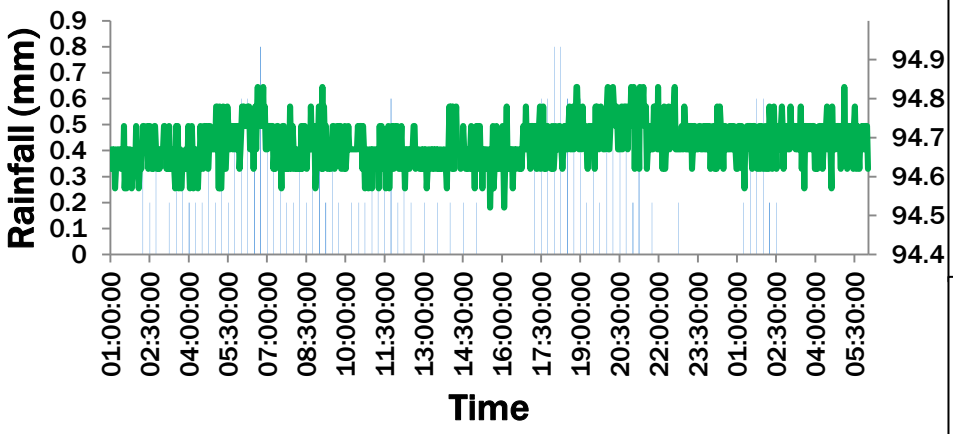

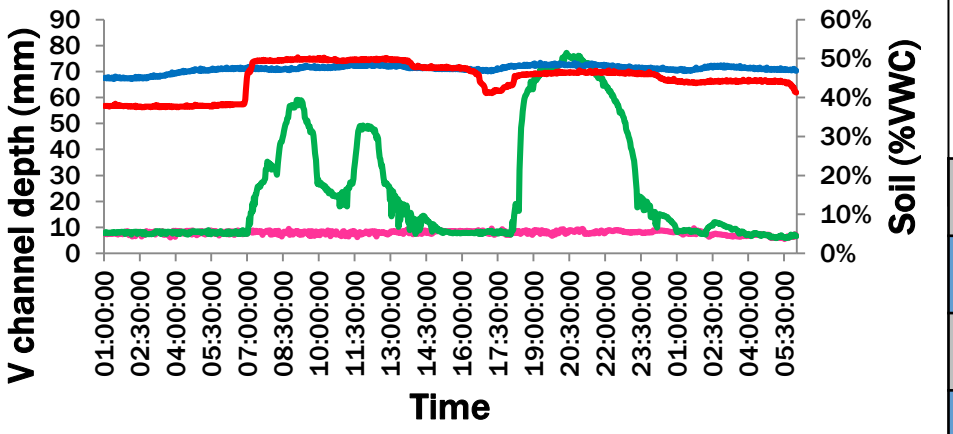

KEY CHARACTERISTICS:

- Limited vegetation growth
- Wet antecedent conditions
- Elevated stable stream depth
- Likely elevated GW
- No crop in adjacent sloping field
- **First Rainfall: 12hr 45m prolonged heavy**
- **Second Rainfall: 4hr 30m heavy**

RIPARIAN BEHAVIOUR:

- Runoff higher OUTRIP
- INRIP soil sustained high- little variance
- OUTRIP soil responds to rainfall & plateaus
- Stream- very little increase
- BUFFER PERFORMS AS EXPECTED

- OUTRIP soil peak after OUTRIP runoff: GW influence?

FEB (a) 2014	Time between:	
	Peak	Time to Peak
OUTRIP Soil Vs. OUTRIP Runoff	0min	10min
FEB (b) 2014	**Time between:**	
	Peak	**Time to Peak**
OUTRIP Soil Vs. OUTRIP Runoff	SOIL 32min AFTER runoff	1hr 2min

PRELIMINARY RESULTS MARCH 2014 EVENT- CONFLICTING EVENT

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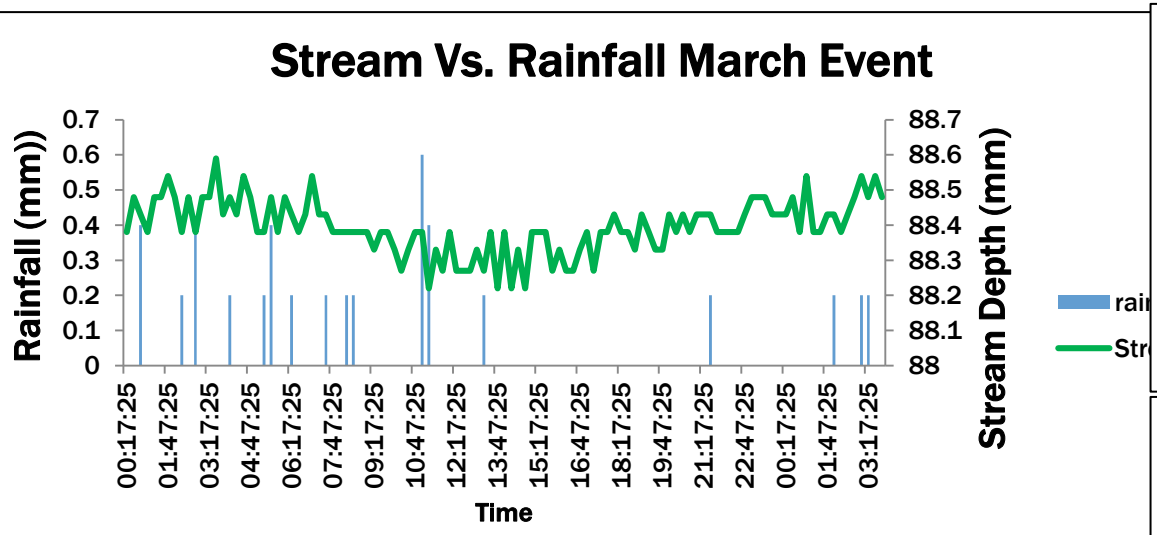

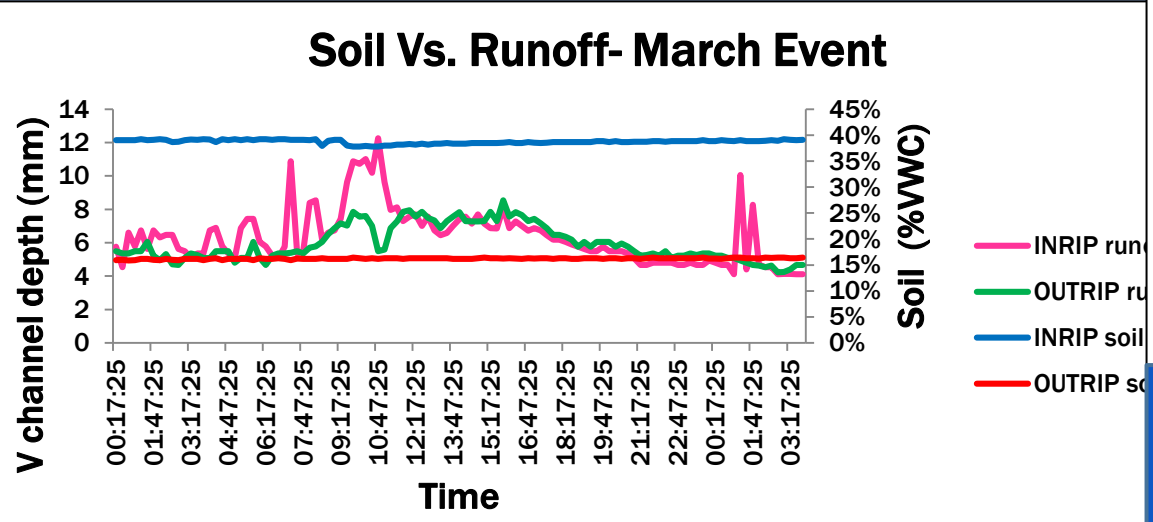

KEY CHARACTERISTICS:

- Limited spring vegetation growth
- Drier antecedent conditions than JAN/FEB
- Stable & lower stream depth
- GW likely to be low
- No crop in adjacent field
- **Sporadic short rainfall events**

RIPARIAN BEHAVIOUR:

- Runoff higher INRIP
- INRIP & OUTRIP soil sustained- no change
- INRIP soil consistently 23% wetter than OUTRIP soil
- Stream- insignificant increase
- Both runoffs react to rainfall: INRIP more reactive
- **BUFFER DID NOT PERFORM AS EXPECTED**

Lag-time could not be determined- soil does not react to the event

PRELIMINARY CONCLUSIONS

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CONCLUSIONS:

- In January and February
  - the buffer behaved as expected and attenuates runoff (OUTRIP runoff is higher)
  - Lag-time requires further analysis
- In March
  - the buffer did not behave as expected and did not attenuate runoff
  - Lag-time could not be calculated: soil did not react to event

- Remains inconclusive how effective buffers are at attenuating runoff and reducing flood risk

- Requires extensive further research & long-term datasets

FURTHER WORK:

- Establish seasonal range of Key Characteristics & typical riparian behaviour (10 months more data collection)

- Statistically analyse these behaviours & determine any thresholds for effectiveness

- Utilise further data from GW and time-lapse camera

- Model (using SWAT) the catchment wide implementation of buffers and the effect on FR

- Use field data to calibrate model

THANK YOU

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Any questions, comments or suggestions will be greatly welcomed and appreciated