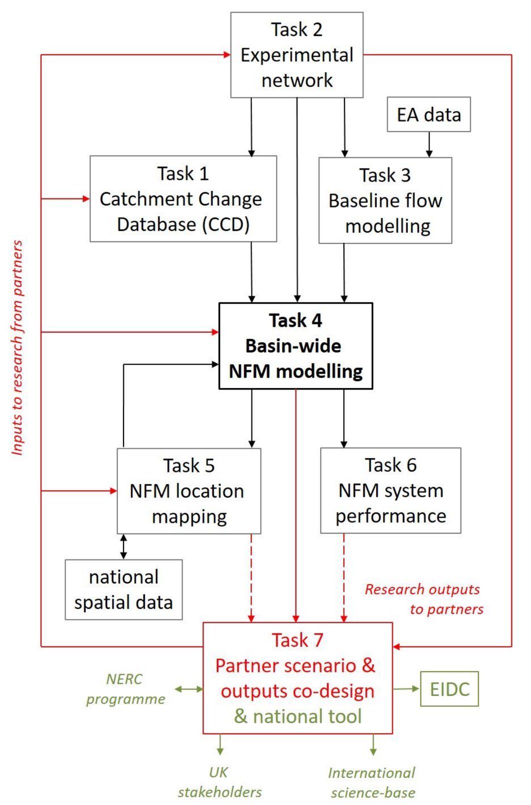
Q-NFM

NERC Quantifying the likely magnitude of nature-based flood mitigation effects across large catchments (Q-NFM)



How much can natural measures reduce flooding at large scales? To answer this question over the next three years the Q-NFM investigator team will work in three large Cumbrian catchments ('test basins'), the Eden, Derwent and Kent (see Task 3) with their partners who are delivering NFM interventions (see Task 7). The project has seven tasks that will build a scientifically credible, shared understanding of the role that Natural Flood Management (NFM) could play in reducing flood risk in the UK and locally in Cumbria (the test region). Task 7 relies on the expertise and experience gained by partner organisations and both informs Task 4-6 modelling and provides a means of sharing findings from across the project.

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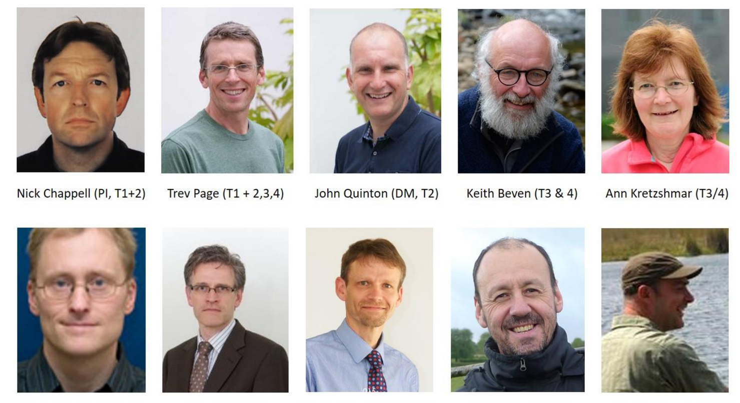
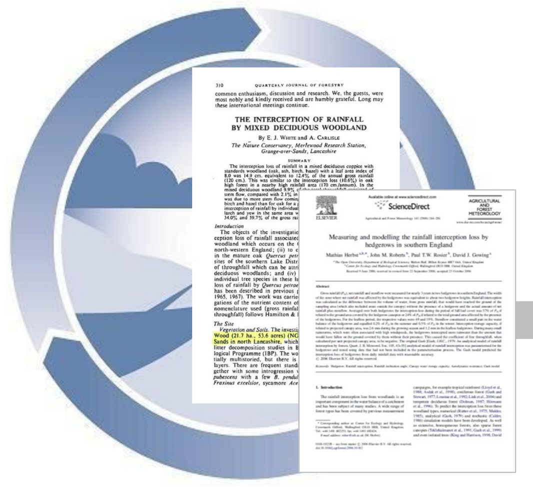


Nick Chappell (PI, T1+2) | Trev Page (T1 + 2,3,4) | John Quinton (DM, T2) | Keith Beven (T3 & 4) | Ann Kretzschmar (T3/4)

Barry Hankin (T5 + 6) | Rob Lamb (T6) | Steve Rose + JBA (T1, 5) | Phil Haygarth (T7) | David Johnson + RT (T7)

Task 1. Field observed scientific evidence from national and international research

A rigorous assessment of the available field-observed evidence is a pre-requisite for credible research. Within a 'Catchment Change Database (CCD)' this evidence will be 'weighted' based on its quality and local environmental relevance and will be used directly in the modelling and also provide a resource that can be used by NFM practitioners and other researchers across the UK.

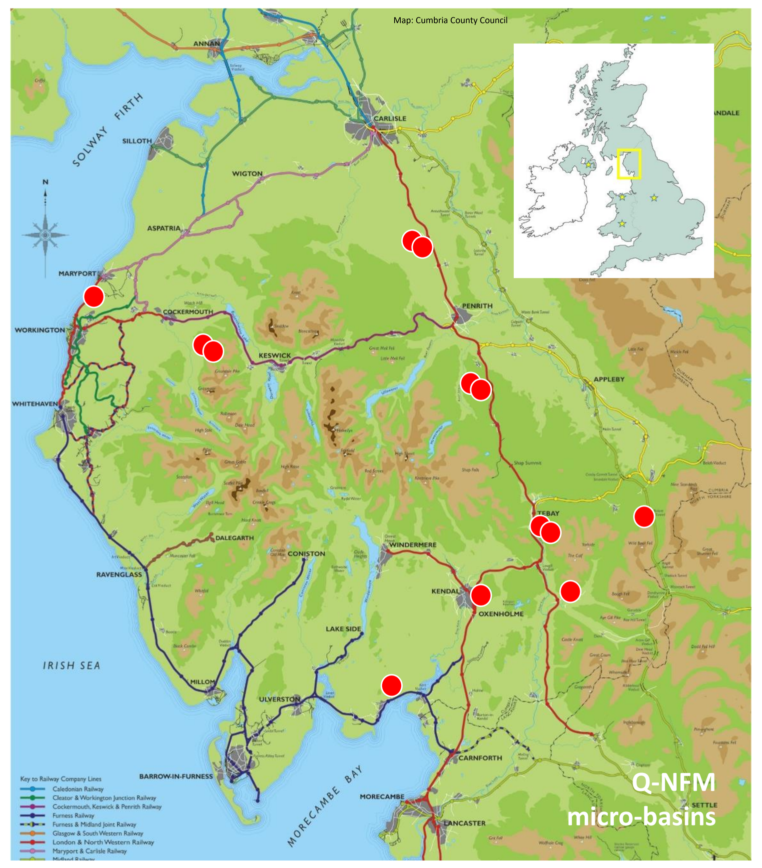


e.g., ΔE_{wc} workbook-based CCD: broadleaf trees spreadsheet (part of)

SUMMARY								
Reference (hyperlinked)	Herbst et al 2008	Carlisle et al	Reynolds &	Neal et al 1993	Staelens et al	Kramer and	Iroume & Huber	Iroume & Huber
Ewc (% Rg)	19.8	9.9	14-55	16	10	22-30	-8.9-32.2	2-100 (estimated
Time frame (1 = ann., 2 = win; 3 = sum; 4 = mon; 5 = day; 6 =	2	2	2	1	2	2	4	6 (2)
Experimental weighting (calculated)	0.8	0.67	0.7	0.5	0.8	0.5	0.86	0.9
Environmental weighting (calculated)	0.6	0.9	0.6	0.6	0.4	0.5	0.4	0.4
EXPERIMENTAL METRICS								
Study period	16/9/2006 to	1/11/1963 to	Winter months	4/1989 to	1/11/2002 to	Winter months	Dormant season	Storm events
Sampling frequency (hrs)	0.08	168	24	336	0.08	336	0.05	0.05
Throughfall collector type: 1 = funnel 2 = trough	1 & 2	1	1	1	1	1	2	2
Number of collectors; (type); [x No. plots]	30 (1); 4 (2)	20	15	8; [x15]	20	15; (x12)	1	1
Total collector area (m^2); (type); [x No. plots if > 1]	0.502(1); 1.81 (2)	0.647	0.19	0.01; [x15]	0.46	0.0087; [x12]	3.02	3.02
Plot area (m^2); [x No. plots if > 1]	1925	225	1800	100; [x15]	9 (single tree)	2500; [x12]	600	600
Gross rainfall measurement 1 = ground 2 = canopy 3 = roving	1 & 2	1	1 &2	3	2	1	1	1
Gross rainfall measurement proximity (m)	AWS @ 3000m	< 200	- (nearby); 0	2 pairs (1 pair in	50	200-1200 (to	1000 (estimated	1000 (estimated
Number of trees with stemflow collectors	6	7	17	4	1	50	11	11
Total gross rainfall in study period (mm)	360.8	871	283.972	607	677.9	204	86 - 564.6	1-125 (estimated
Total throughflow in study period (mm)	276.9	784.3	-	490	546	132.6 - 153	-16.9 - 70.9	-
Total stemflow in study period (mm)	12.8	- (estimated	-	2.1	64.6	2.86 - 9.6	5.2-40.2	-
Distance of instuments from edge of canopy block	-	-	-	20, 50, 100, 200,	-	-(see Fig. 1)	250 (estimated	250 (estimated
Statistically significant (p value; statistical test name)	-	-	-	-	-	-	-	-
ENVIRONMENTAL METRICS								
Location	Grimsby Wood,	Bogle Crag	Bagley Wood,	Black Wood,	Aelmoeseneie	Hainich	Malalcahuello	Malalcahuello
Koppen's climate index	Cfb	Cfb	Cfb	Cfb	Cfb	Cfb	Cfb/ET	Cfb/ET
Canopy vegetation species	Oak (*Quercus*	Oak (*Quercus*	Beech (*Fagus*	Beech (*Fagus*	Beech (*Fagus*	Beech (*Fagus*	Roble–raul´ı–coi	Roble–raul´ı–coi
Canopy vegetation age (yrs); canopy height (range or mean [m])	Various; 22	- ; 15-18	55; -	20-40; 21	30	79-193; 27-41	- ; 20-38	- ; 20-38
Understorey vegetation species	primarily hazel	-	-	-	Removed for	-	Shrubs, bamboo,	Shrubs, bamboo,
Througflow collectors below understorey (Y/N)	Y	-	-	-	-	-	NR (troughs at	NR (troughs at
Mean temperature of period (°C)	8	3.96	-	-	6.84	5	8.3 (mean ann.)	8.3 (mean ann.)
Criteria(on) for separation of storms	-	-	-	-	-	-	-	> 5 hrs. with Rg =
Number of storms	-	-	-	-	-	-	-	91
Range of event magnitudes	-	-	-	-	-	-	-	~1 - 230mm

Task 2. New observations to inform the modelling and fill unacceptable evidence gaps

The investigator team, working with partners delivering NFM, will collect new field-observed evidence of *hydrological change* at NFM-feature scales. This will add to the scientific evidence base filling knowledge gaps and increasing our confidence in subsequent modelling results.

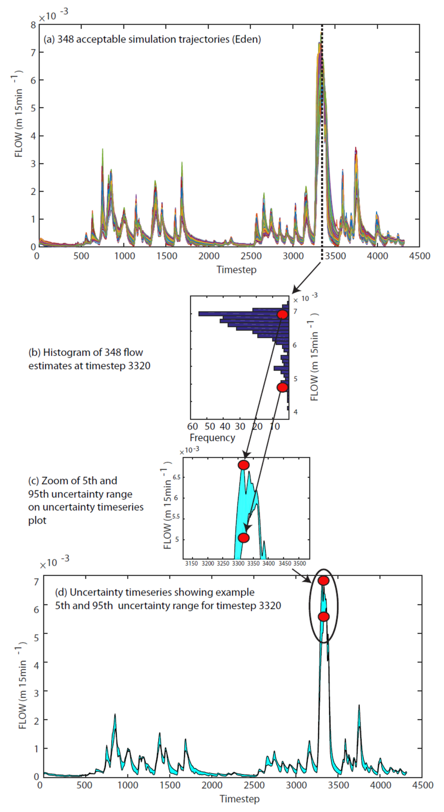


Paired-plot (left) and < 1km² micro-basin observations (below)

Task 3. How well can we model the flood record distributed across Cumbria?

The first modelling task is to produce models of the observed records of river discharge across the three catchments; so that partners and wider stakeholders have trust in the way that we have captured and reduced modelling uncertainties.

Use of 30-yr Agency rainfall, borehole and river-flow observations (e.g., St John's Beck @ Thirlmere)

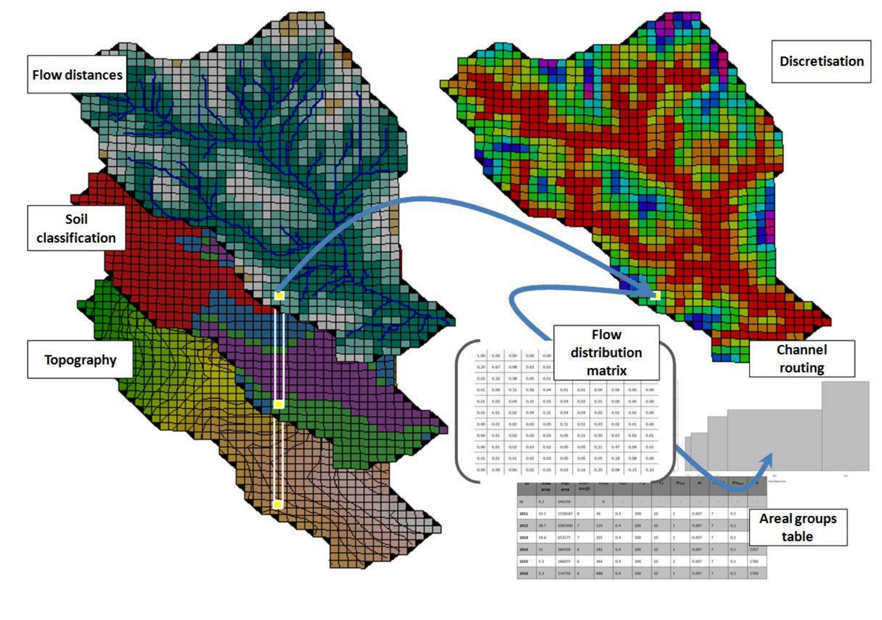


NFM flood-mitigation benefit across large catchments

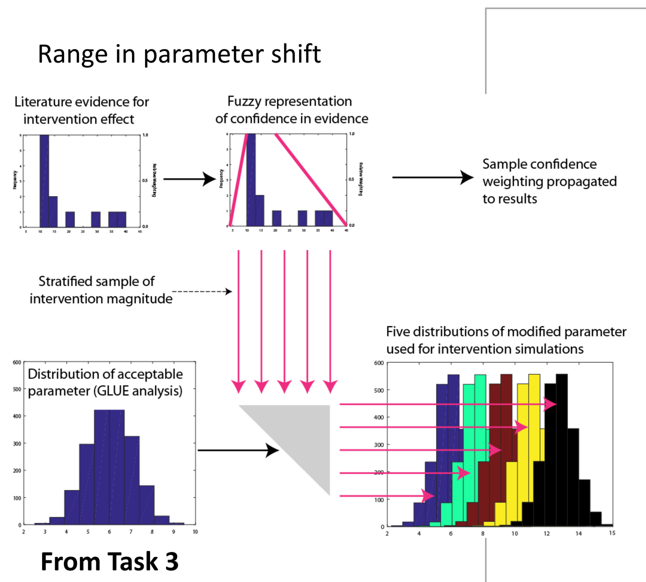
2287 km² **Eden** @Sheepmount (below Carlisle)

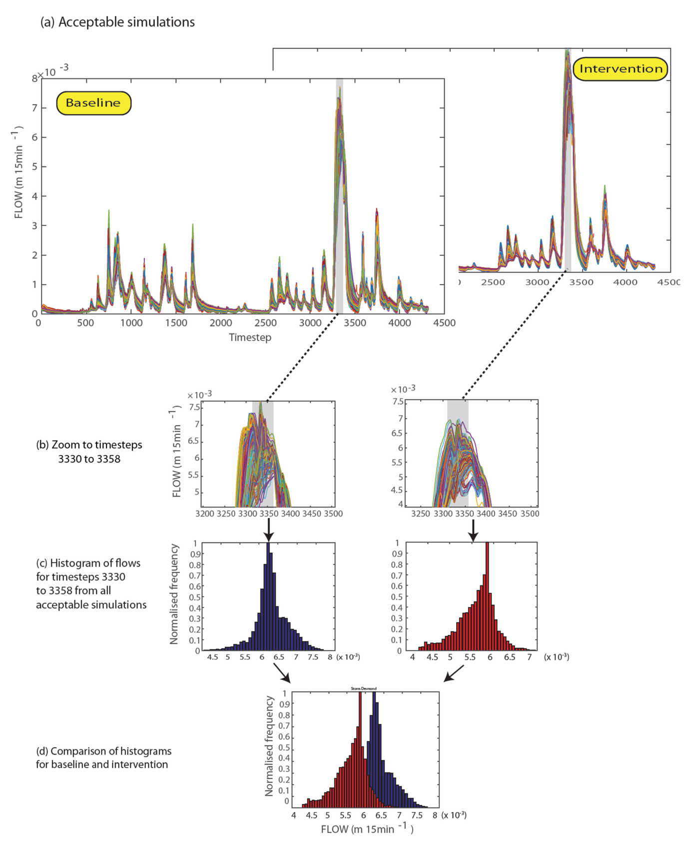
+663 km² **Derwent** @ Camerton / SM (below Cockermouth)

209 km² **Kent** @ Sedgwick (below Kendal)



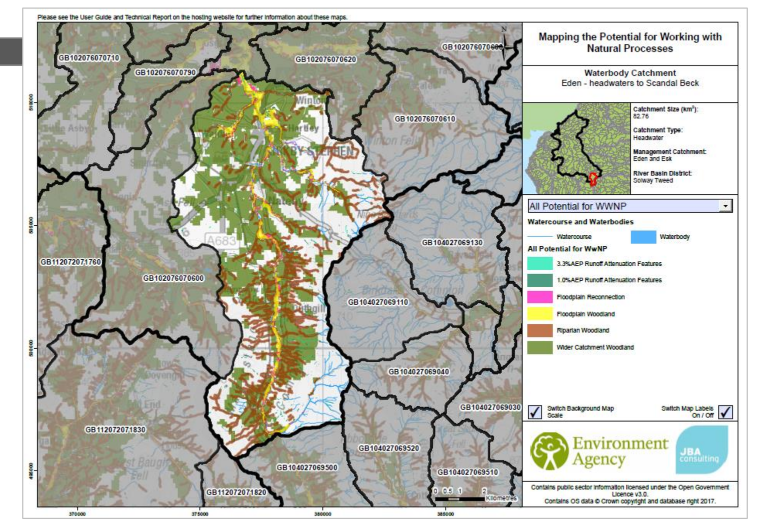
Dynamic-TOPMODEL





Task 4. What are the flood mitigation benefits of NFM from feature-scales to large catchment scales in Cumbria?

This is the core task of the whole Q-NFM project. Here we combine the acceptable models of observed river discharge records with shifts in the model parameters based on our Task 1 NFM evidence base, and with a range of spatially-distributed NFM scenarios set by Task 5.



e.g., http://wwnp.jbahosting.com

Task 5. Scenarios for NFM in each catchment

The NFM deployment scenarios used in modelling (Task 4) are set within this task and cover: (a) the theoretical maximum extent of interventions and hence maximum possible flood mitigation benefit; (b) a range of scenarios where optimal placement of NFM features is investigated; and (c) a range of 'realistic' scenarios defined by our partners with their local (or wider expertise) in NFM deployment possibilities. This third set of scenarios come from a range of partner and wider stakeholder activities undertaken in Task 7.

Task 6. What are the non-optimal or negative aspects of NFM performance and how effective will be they be with climate change?

The use a second modelling tool to run a range of scenarios for key 'at risk communities', where the NFM features are performing sub-optimally, to quantify the risks arising from NFM interventions. We use the same tool to explore NFM performance for a wider range of storm scenarios than present within the existing records to quantify NFM's role in climate change mitigation.

Task 7. Engagement and co-design with Q-NFM partners and wider stakeholders

This task is as important as the core modelling Task 4. We need the expertise of our Q-NFM Partners to: (a) prioritise the types of possible NFM interventions to be investigated with modelling; (b) define spatial extents of NFM deployment that are 'realistic' in the Cumbrian and wider setting; (c) to help us present results that have both credibility and meaning for policy makers, the wider CaBA community and the wider public; and (d) help us fully inform partners and other NFM implementing organisations of deployment strategies that deliver optimal flood mitigation benefits.