LANDWISE Project Overview June 2021

Prof Joanna Clark, PI
University of Reading

LANDWISE: LAND management in loWland catchments for Integrated flood riSk rEduction

Research & Consultancy: University of Reading, British Geological Survey, Centre for Ecology and Hydrology, University of Gloucestershire, Forest Research, JBA Consulting, CGI Group, Institute for Environmental Analytics JBA Trust, University of Sheffield, Agrimetrics,

Policy: Environment Agency, Natural England, Forestry Commission

Flood Groups: National Flood Forum, Loddon Valley Residents Association, Swallowfield Flood Resilience Group, Pang Valley Flood Forum

Farm Advisors: National Farmers Union, Farm and Wildlife Advisory Group (SE), Farm and Wildlife Advisory Group (SW), Arcadian Ecology & Consulting

Farmers: Wilts Soil and Root Innovators, Penn Croft Farm, Hendred Farm Partnership, Fincham Farm Partnership, Yatesbury House Farm, Kingsclere Estate, Farmer Guardians of the Upper Thames

Conservation NGOs: The National Trust, Loddon Fisheries & Conservation Consultative, Blackwater Valle Countryside Partnership, Wild Oxfordshire, Foundation for Water Research, Action for River Kennet, South East Rivers Trust, Freshwater Habitats Trust, Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust, Hampshire and Isle of Wight Wildlife Trust, Westcountry Rivers Trust

Local Flood Authorities: Wokingham Borough Council, West Berkshire Council, Hart District Council, Swindon Borough Council, Thames Regional Flood & Coastal Committee

Water Utilities: Affinity Water, Thames Water

Catchment Partnerships: Loddon, Chilterns, Upper Thames, Evenlode, Kennet, Ock and others
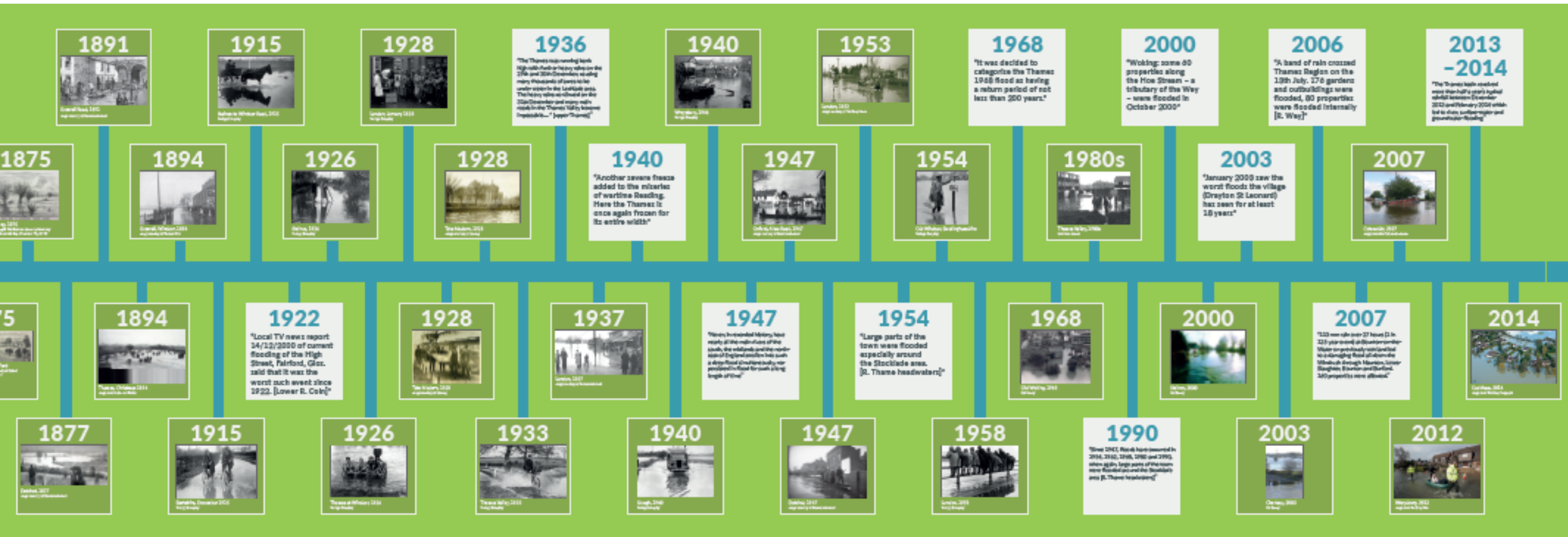
Evaluating the Effectiveness of Natural Flood Management Programme Scope

- 2017-2022* £4 million programme
- Aim: carry out novel research on hydrological processes, including measurements and flood modelling
  - NFM measures
  - flood risk scenarios
  - from feature to large-catchment scales
- 3 projects
  - Landwise (end summer 2022*)
  - Protect NFM (end summer 2022*)
  - Q-NFM (most research ending Spring 2021, final end 2022*)
- Robust evidence base to support decisions made on the design and delivery of NFM
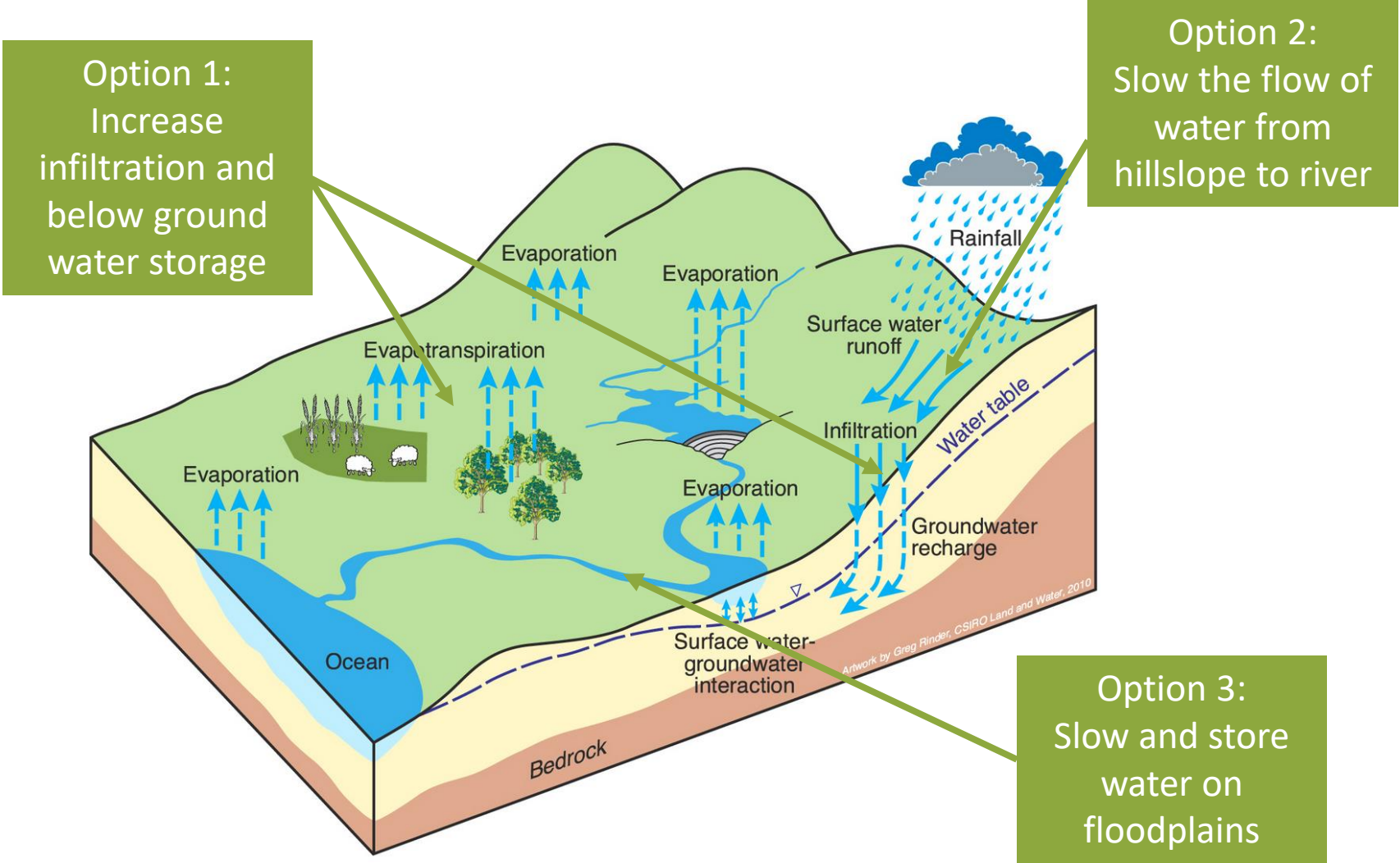
*Extended end date
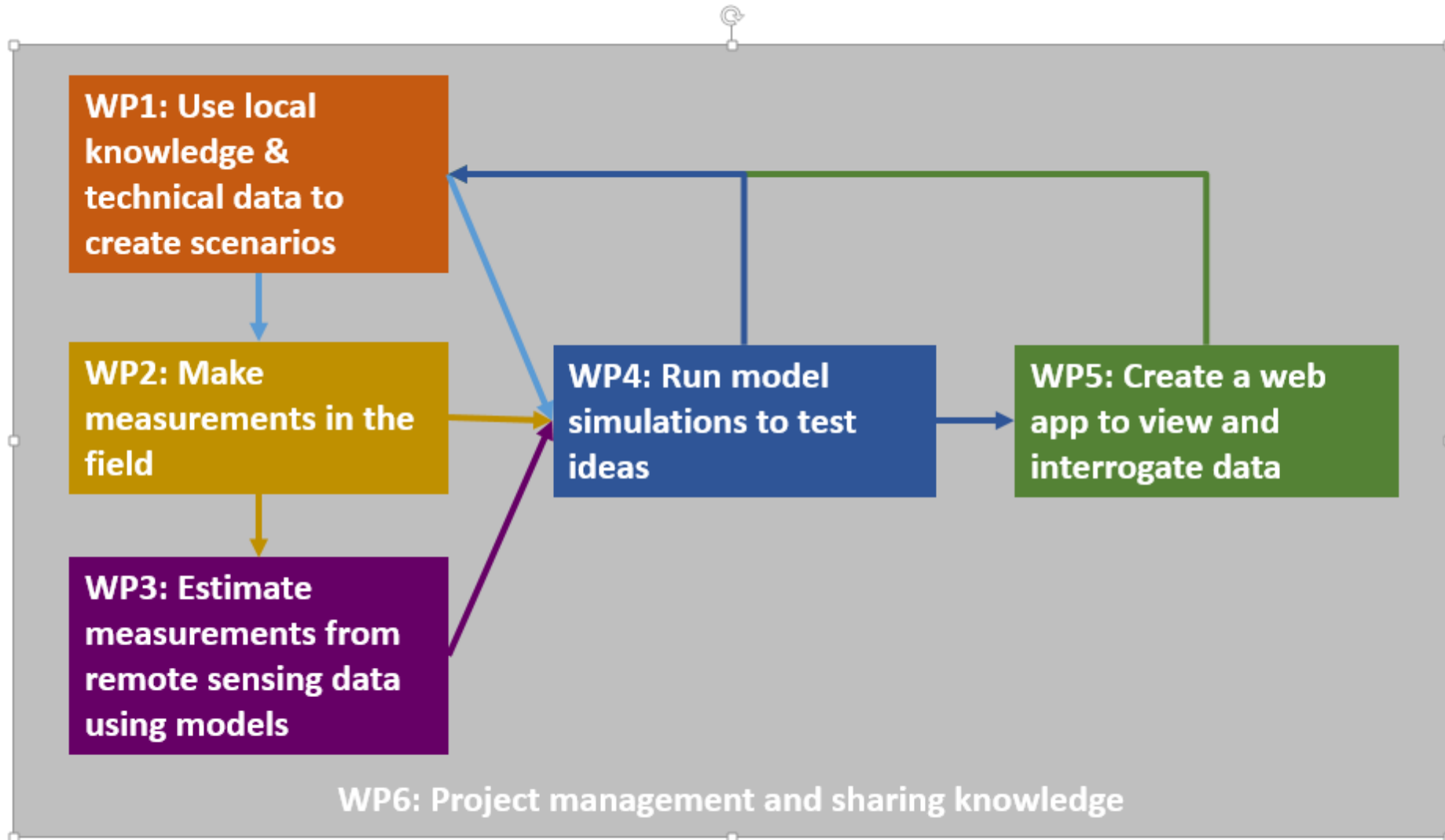
Rationale
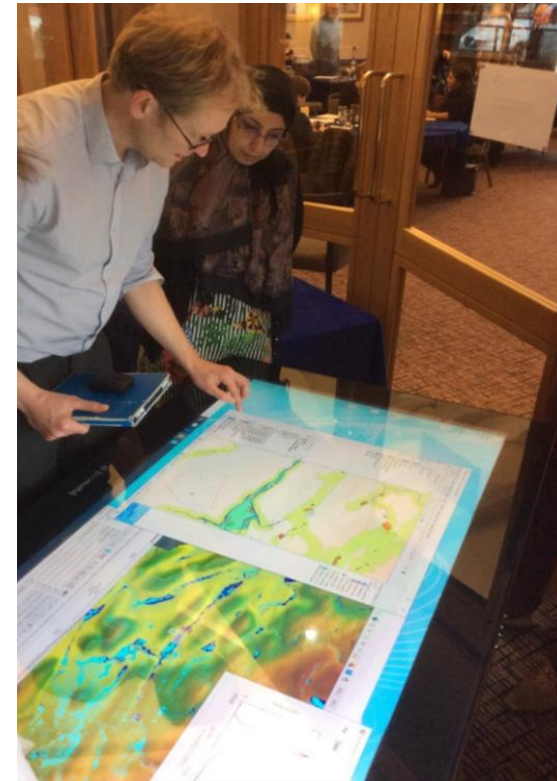
History of Flooding in the Thames Valley

Flooding can come from surface runoff, rivers and groundwater

NFM options

Option 1: Increase infiltration and below ground water storage

Option 2: Slow the flow of water from hillslope to river

Option 3: Slow and store water on floodplains

Evaporation

Evaporation

Rainfall

Surface water runoff

Evapotranspiration

Water table

Infiltration

Evaporation

Evaporation

Groundwater recharge

Surface water-groundwater interaction

Ocean

Bedrock

Artwork by Greg Rinder, CSIRO Land and Water, 2010
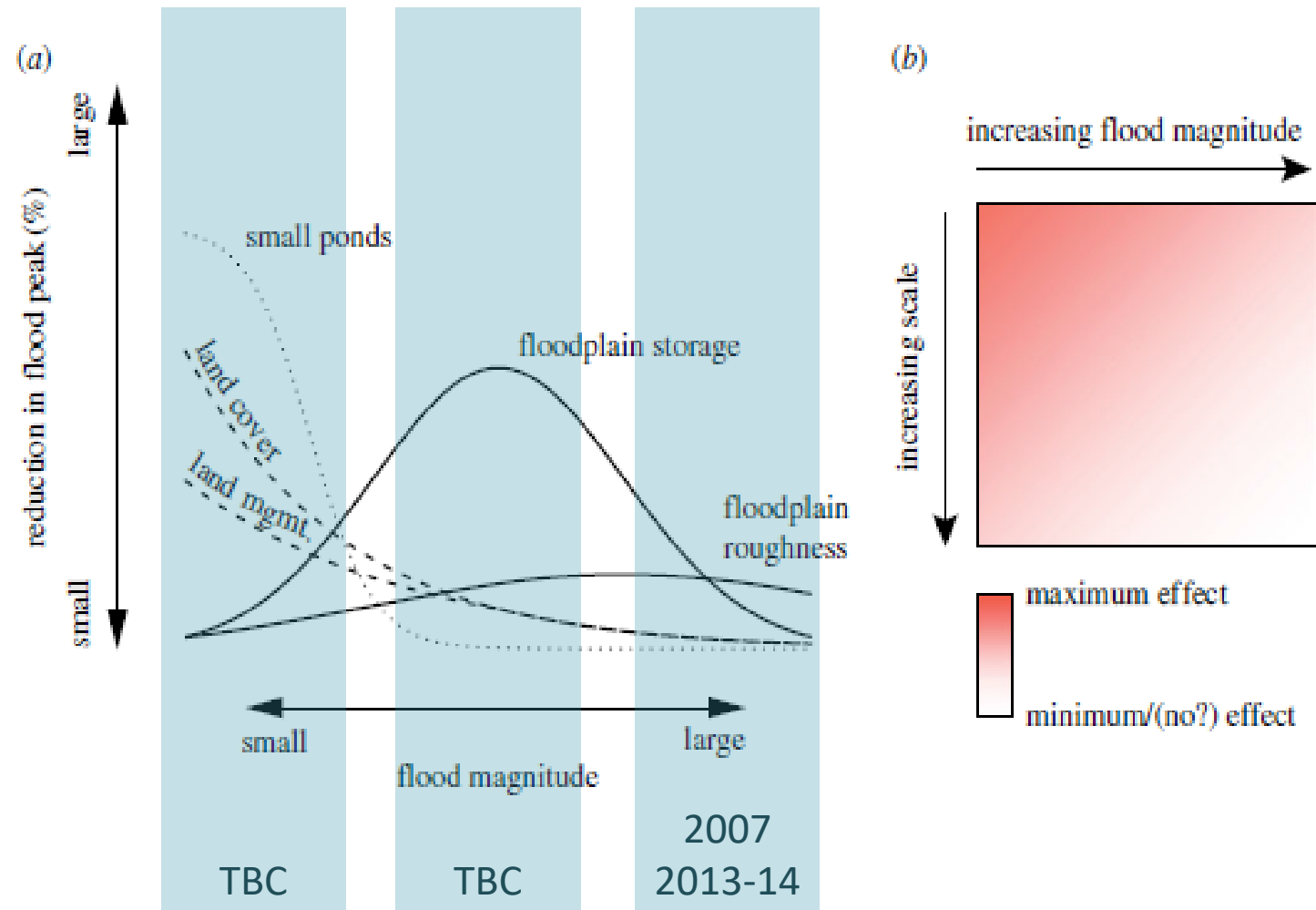
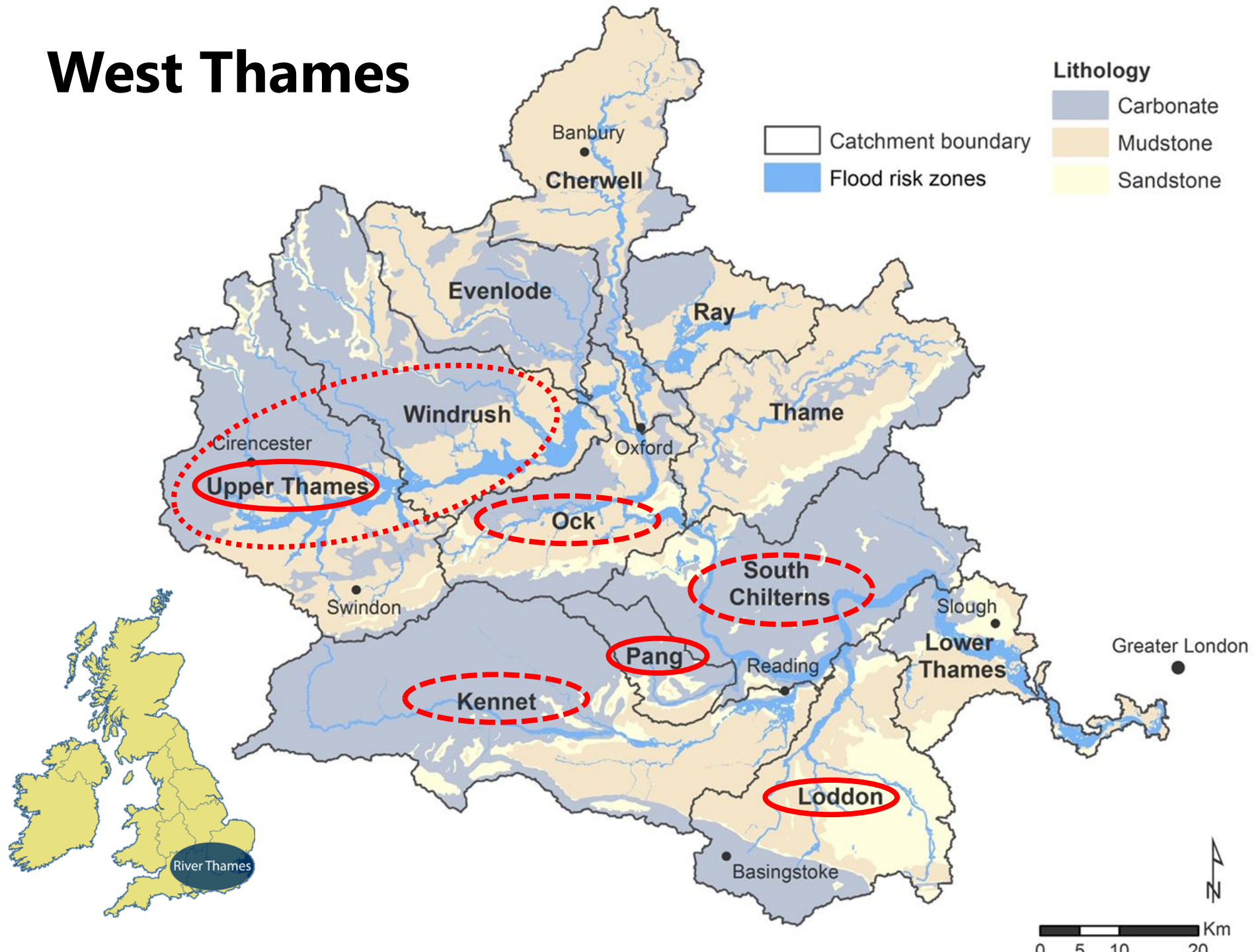# Work Packages 1-6

Research Questions

Research Questions	Scale and link to work packages
Qa. How effective are different land-based NFM measures at increasing infiltration, evaporative losses and below-ground water storage in different locations across lowland catchments?	**Field Scale** WP1 Farmer knowledge & mapping WP2 Field work WP3 Satellite and field based WP4 1D LSM modelling
Qb. How does the effectiveness of land-based measures vary seasonally and between years with respect to antecedent conditions, precipitation magnitude and duration?	**Field Scale** *building on Qa….* WP3 Satellite soil moisture WP4 1D LSM modelling
Qc. How effective are land-based measures at delivering catchment-wide water storage and infiltration, thereby reducing runoff rates, compared to targeted approaches to reduce downstream flood (and drought) risk across different catchment scales (<100-8000km^2)?	**Small, medium and large catchments** *Building on Qa and Qb* WP1 NFM Scenarios local and technical WP4 Catchment models

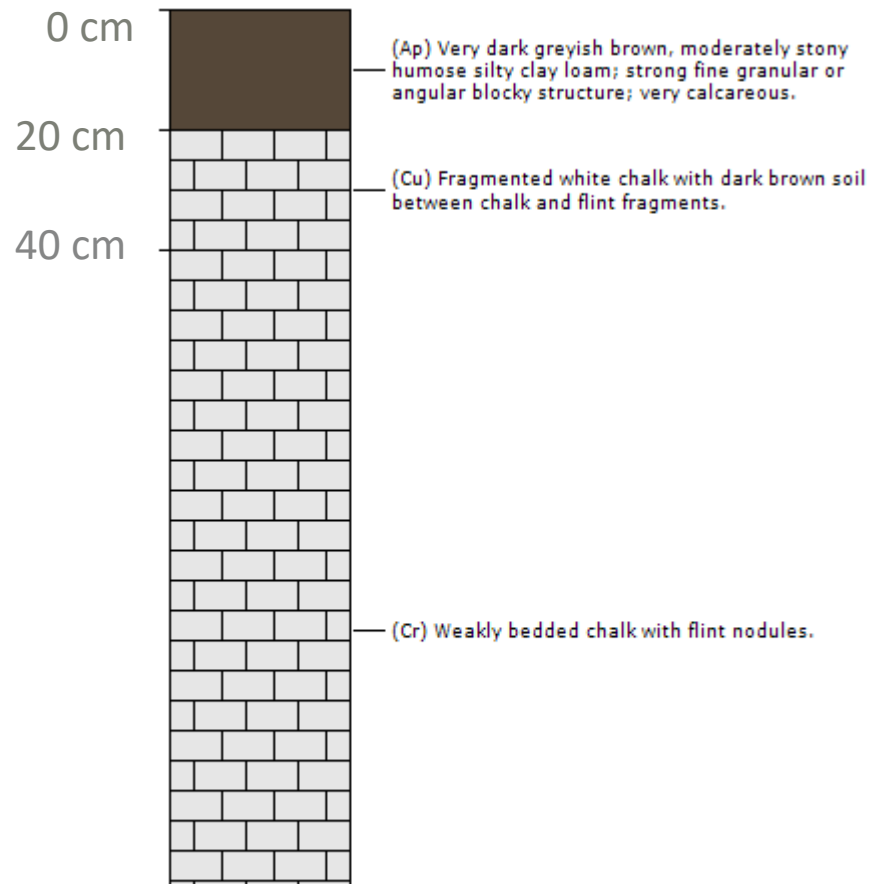# Testing a Theoretical Framework

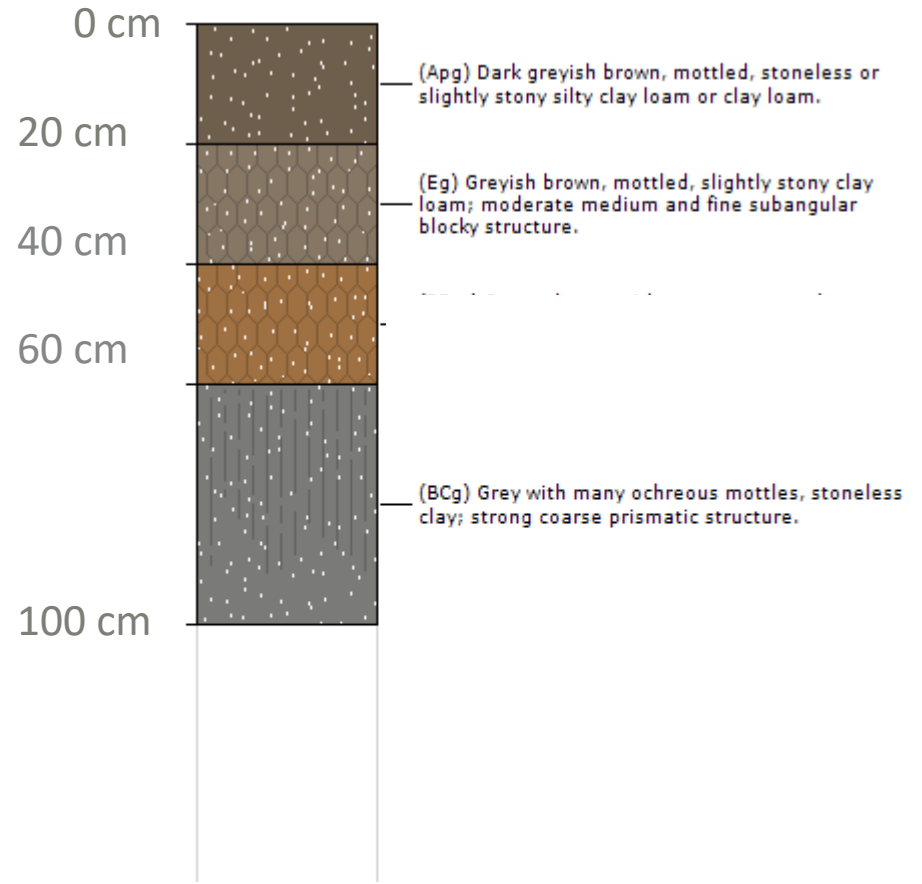- Dadson et al (2017) propose a conceptual framework for NFM measures

Shallow lithomorphic soil over Carbonate

Left profile labels:
- 0 cm — 20 cm — 40 cm
- (Ap) Very dark greyish brown, moderately stony humose silty clay loam; strong fine granular or angular blocky structure; very calcareous.
- (Cu) Fragmented white chalk with dark brown soil between chalk and flint fragments.
- (Cr) Weakly bedded chalk with flint nodules.

Deep surface water gleys over Mudstones

Right profile labels:
- 0 cm — 20 cm — 40 cm — 60 cm — 100 cm
- (Apg) Dark greyish brown, mottled, stoneless or slightly stony silty clay loam or clay loam.
- (Eg) Greyish brown, mottled, slightly stony clay loam; moderate medium and fine subangular blocky structure.
- (BCg) Grey with many ochreous mottles, stoneless clay; strong coarse prismatic structure.

Typical soil profiles

www.landis.org.uk

Project timeline

WP	Task	2018			2019				2020				2021				2022			
		2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Evidence from local and technical knowledge	🟩	🟩	🟩	🟩	🟩	🟩	🟥	🟥	🟥	🟥	🟪	🟪	🟪	🟪						
2	Evidence from field data		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟥	🟥	🟥	🟥	🟪	🟪				
3	Evidence from remote sensing data				🟩	🟩	🟩	🟩	🟩	🟥	🟥	🟥	🟥	🟥		🟪	🟪	🟪			
4	Modelling	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟥	🟪				
5	Web Tool				🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟪					
6	Communications	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟥	🟥	🟪			

🟩 Original scheduled dates
🟥 Project slippage
🟪 Covid19 delays

Pre-Covid19 restrictions, awarded a no-cost extension to May 2022
With Covid19 restrictions, awarded a no-cost until Aug 2022, that will need to be extended to Oct 2022
Note: **Programme Coordination Work to be completed July 2022**

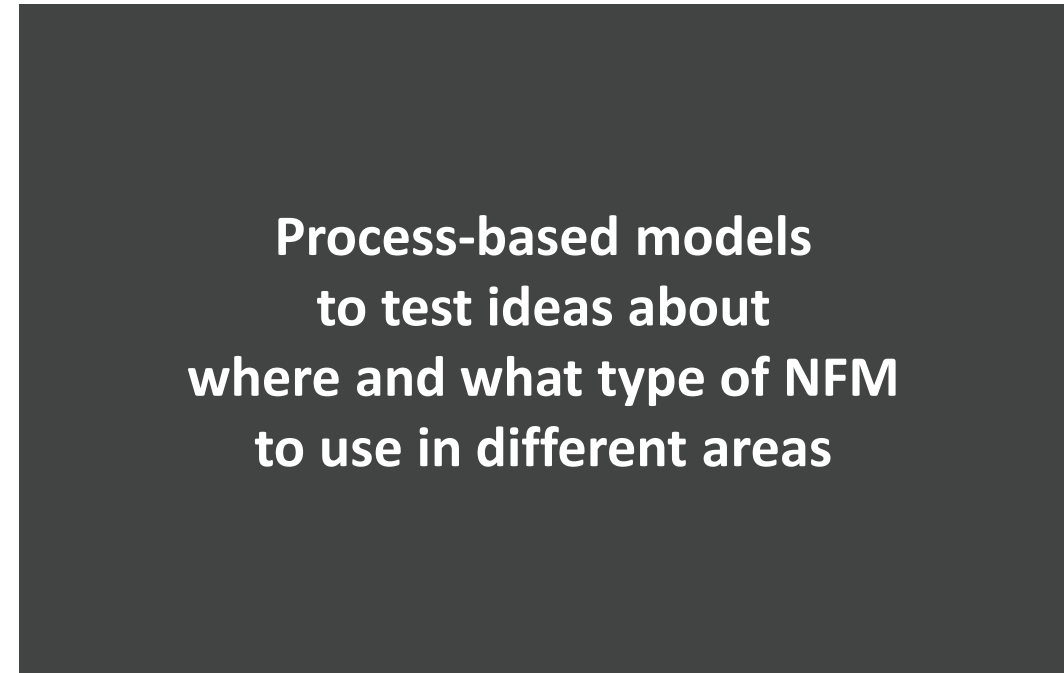# NFM Scenarios, local knowledge and modelling: Integrating WP1 & WP4

WP1 Local and technical knowledge to create scenarios

Joanna Clark, Chris Short, Angie Elwin, Jess Neumann, Maleki Badjana, Samantha Broadmeadow,
Anne Verhoef, Ian Davenport,
Farmer Knowledge Working Group,
Upper Thames CP, Chilterns, CP, Kennet CP, Loddon CP, Ock CP

WP4 Modelling

Steve Rose, Ryan Jennings, Barry Hankin, David Macdonald, Majid Mansour, Sarah Collins,
Maleki Badjana, Anne Verhoef, Patrick Mcguire

# Local knowledge, technical knowledge and modelling

Technical knowledge about likely NFM effectiveness from Opportunity Maps

Local knowledge about acceptability and feasibility of NFM

Process-based models to test ideas about where and what type of NFM to use in different areas

11 different types of Natural Flood Management
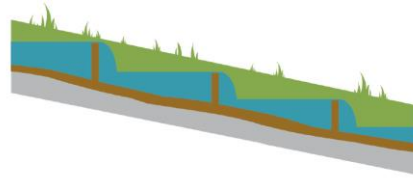
From EA WWNP Evidence Directory

SOIL AND LAND-USE MANAGEMENT
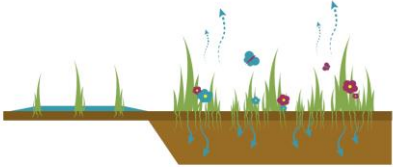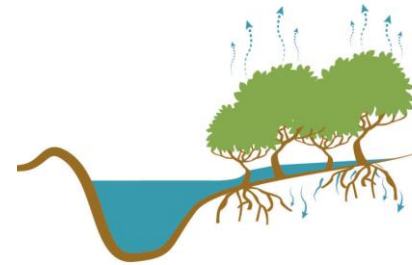
RUN-OFF PATHWAY
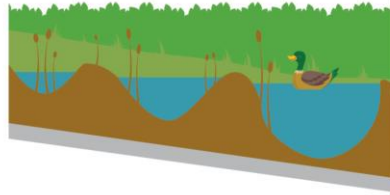
HEADWATER DRAINAGE

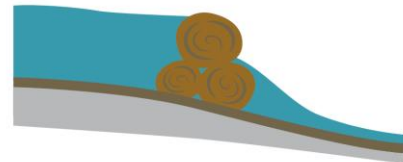CROSS-SLOPE WOODLANDS

CATCHMENT WOODLANDS
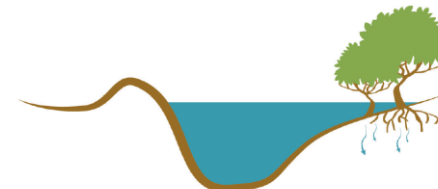
FLOODPLAIN WOODLANDS

RIPARIAN WOODLANDS

LEAKY BARRIERS

OFFLINE STORAGE AREAS

FLOODPLAIN RESTORATION

RIVER RESTORATION

Local knowledge workshops: NFM Scenarios   [can view on web tool]

In small groups....

Part 1: Ranking NFM measures on acceptability and feasibility: picking top 3

• Individually, score 11 NFM measures   [*scores on the web tool*]

• Pick top three individual scores

• Share with group, work out top three from group scores

Part 2: NFM location – situation in landscape

• Individually map top 3 measures   [*mapped data on the web tool*]

• Share with group on larger map

• Discuss and agree final map

After workshop

• Using digitised maps and notes, identify NFM landscape character area to create a rule table based on soil, geology, slope, agricultural land classification, river network

• Plot full extent of NFM landscape character area from the rule

Example NFM scenario map of local preferences

Loddon
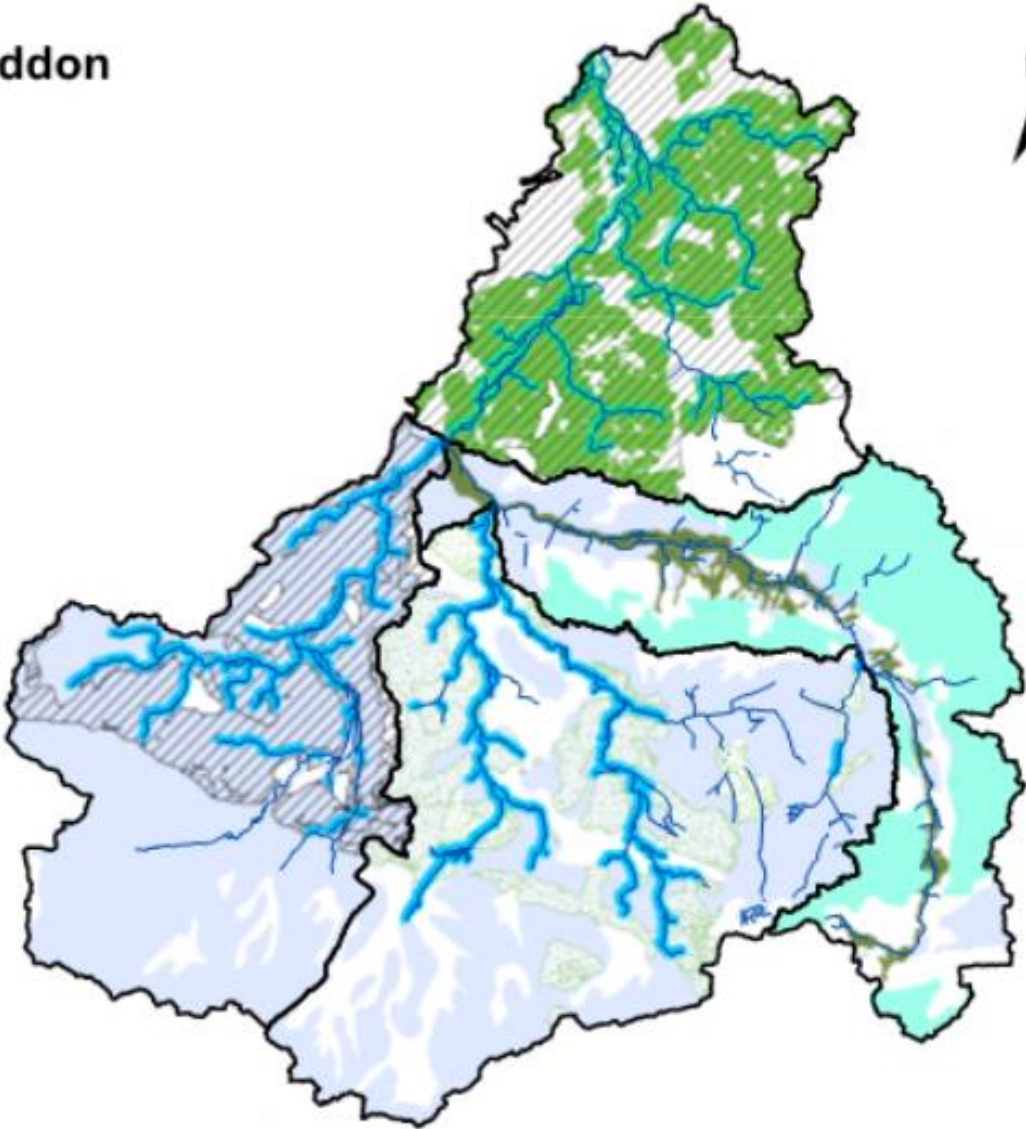
NFM Scenarios based on local knowledge
Joining four different groups together across the Loddon

—— River		Catchment woodland
Leaky barriers		Floodplain restoration
Offline storage areas		Soil + land-use management
Riparian woodland		Run-off pathway management

Developing a web tool to explore workshop data (see in Gather Town)
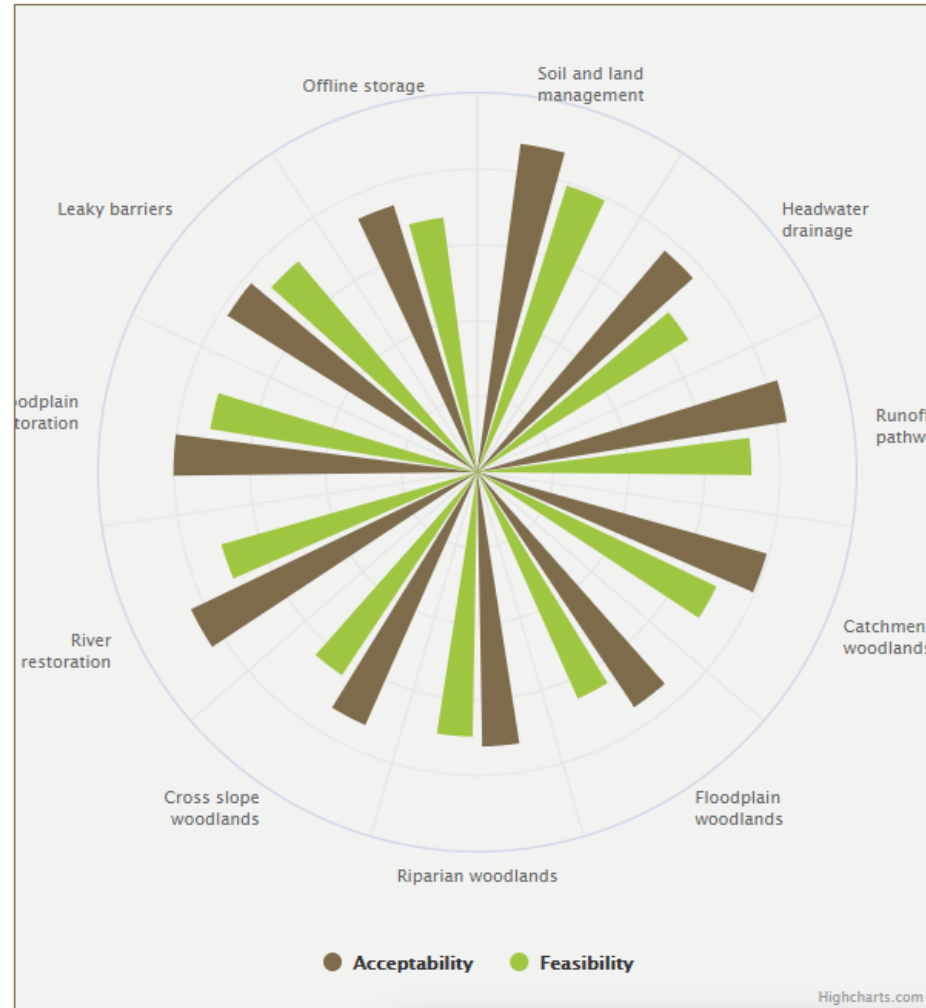
Local knowledge Workshops: Top Scoring NFM Measures

	REGIONAL	LOCAL																Total
		Upper Thames				South Chilterns			Kennet			Loddon			Ock			
NFM MEASURE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Soil and land management	■		●	●	●	●	●	●	●	●	●		●	●	●	●		15
Run-off pathway	■			●			●		●		●		●					6
Headwater drainage												●						1
Catchment woodlands		●			●	●		●	●	●			●		●	●		9
Floodplain woodlands					●					●								2
Cross-slope woodlands																		0
Riparian woodlands	■				●							●	●					3
Leaky barriers	■		●				●	●	●					●	●	●		8
Offline storage areas	■		●			●												2
River restoration		●		●				●		●				●		●		6
Floodplain restoration		●	●	●								●		●				5

Upper Thames: Upper Churn & Coln (1,2), Lower Churn & Coln (3), Cole (4); South Chilterns: Thames Corridor (5), Pang (6), Wye (7), Kennet: Lower Lambourn & Winterbourne (8), Upper Lambourn & Winterbourne (9,10); Loddon: Blackwater (11), Lower Loddon (12), Upper Loddon (13).

Model scale, complexity and scenarios

Field
Land surface
model

Small catchment
Surface water
model

Medium catchment
Integrated model:
Land surface, surface
water, Groundwater

Large catchment
Integrated model:
Land surface, surface water,
Groundwater,

Farmer knowledge to inform NFM scenarios for soil and land management
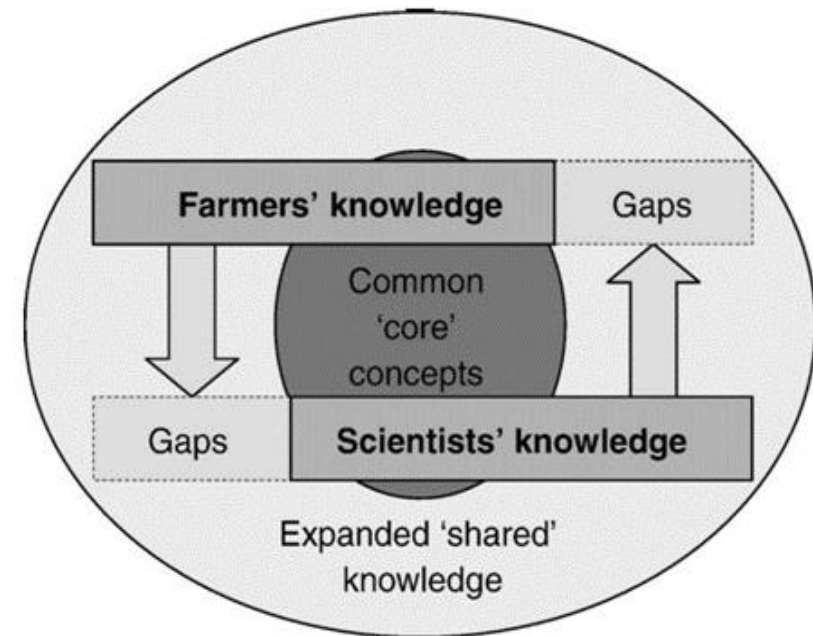
Data collected

- Survey on soil and land management for West Thames Farmers, co-designed with farmer knowledge working group

- Survey sent to farmers who took part in field survey

- 20 farmers from field survey interviewed

- Preliminary analysis...

- to be discussed further with working group

Expanding shared knowledge systems (Barrios et al., 2006)

Many different farming systems, all affect the condition of the land surface and balance between infiltration & water storage vs runoff

'Conventional' Intensive Farming

- Artificial chemicals
- Ploughing and mixed tillage
- Focus on yield

Regenerative Farming

- Reduce artificial chemicals
- Reduce or no tillage
- Restore soil health
- Build soil organic matter
- Diverse rotations
- Focus on profit, not yield

Organic Farming

- No artificial chemicals
- Typically ploughing
- Restore soil health
- Build soil organic matter
- Diverse rotations
- Focus on profit, not yield

Linking Scenarios and Modelling

Spatial extent – Where?

Technical opportunity maps

NFM Scenarios from Catchment Partnerships

GIS scenarios
Full cover
10%, 20% random
or targeted

Specific NFM Measure – What?

Woodland management

Farmer survey and interviews

1D measure modelling
Evaluation

Storylines for NFM measures (soil and woodland)

2D catchment modelling
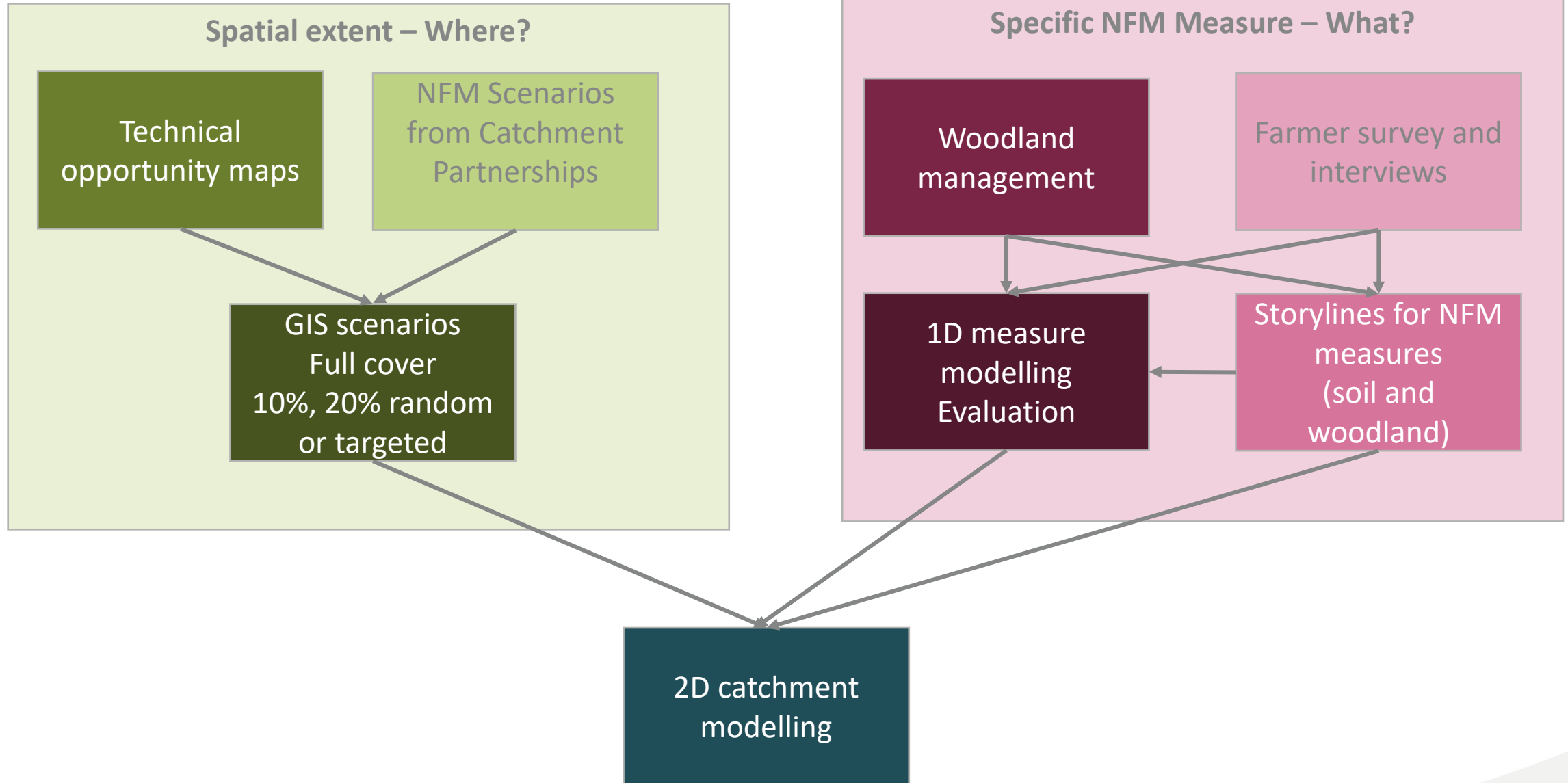
Next steps…..

- **Talks today**
    - Samantha Broadmeadow – mapping
    - Chris Short and Charlotte Chivers – farmer knowledge

- **Gather Town today**
    - Explore workshop data in the web tool
    - Sarah Collins groundwater modelling poster
    - Anne Verhoef modelling land-based measures poster

- **Webinars**
    - Modelling team to present work to date on 29 July 2021
    - Final outputs and web tools to be presented in November 2021

- **Follow up discussions**
    - Farmer knowledge working group to discuss scenarios July
    - Catchment Partnership workshop (Sept-Nov 2021 – TBA)

Soil and land management evidence from field measurements and remote sensing: Integrating WP2 and WP3

WP2 Field survey

James Blake, Emily Trill, Alex O'Brien, Elinor Sherlock, Bel Whitwam, Adrian Hares, Amanda Ingham, Tim Clarke, Joanna Clark,
Field work working group

WP3 Remote Sensing

Kevin White, Anne Verhoef, Keith Morrison, Will Meslanka, Rob Fry, Ian Davenport, Colm Jordan

Land management can reduce runoff by managing soil compaction, organic matter, surface cover, roughness
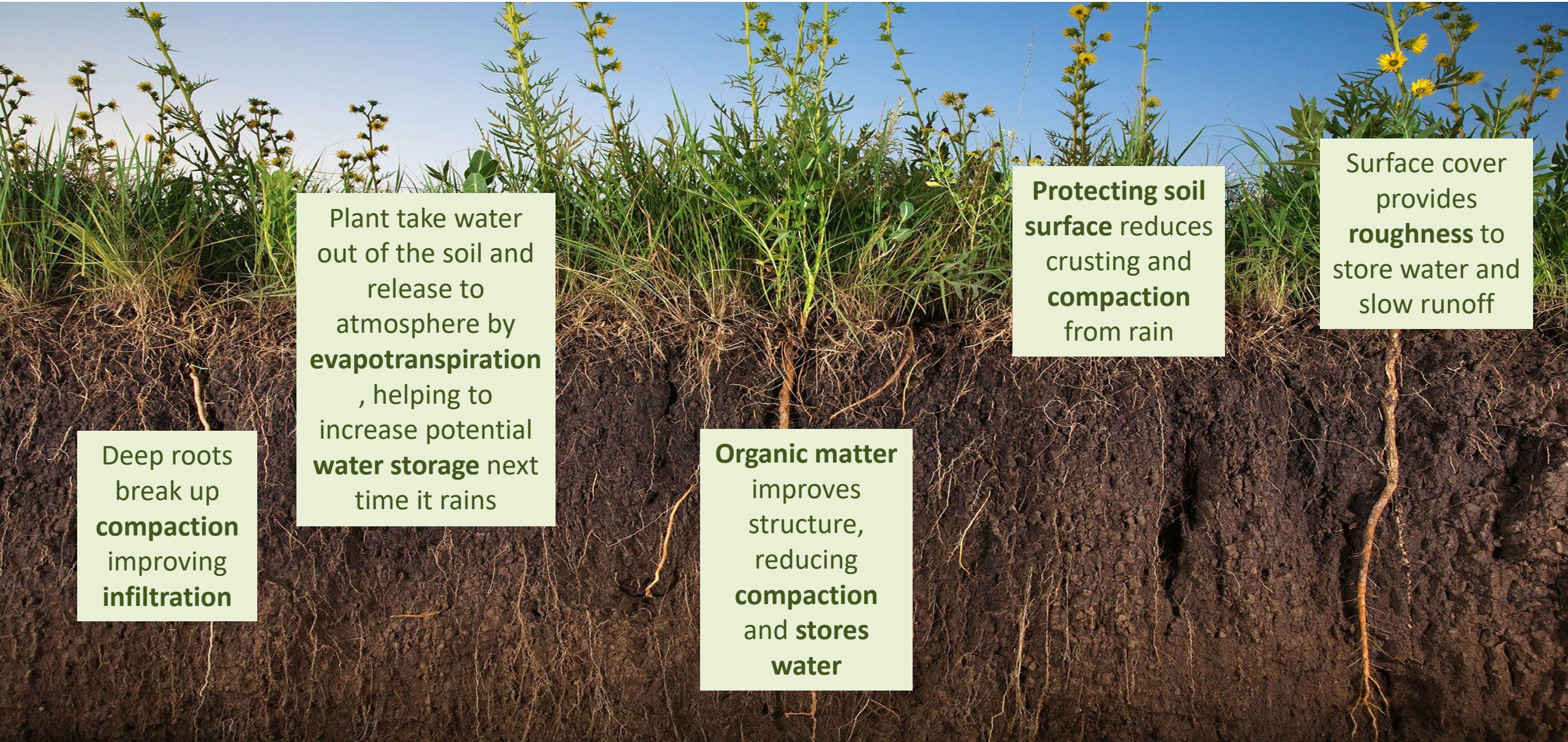
Deep roots break up **compaction** improving **infiltration**

Plant take water out of the soil and release to atmosphere by **evapotranspiration**, helping to increase potential **water storage** next time it rains

Organic matter improves structure, reducing **compaction** and **stores water**

Protecting soil surface reduces crusting and **compaction** from rain

Surface cover provides **roughness** to store water and slow runoff

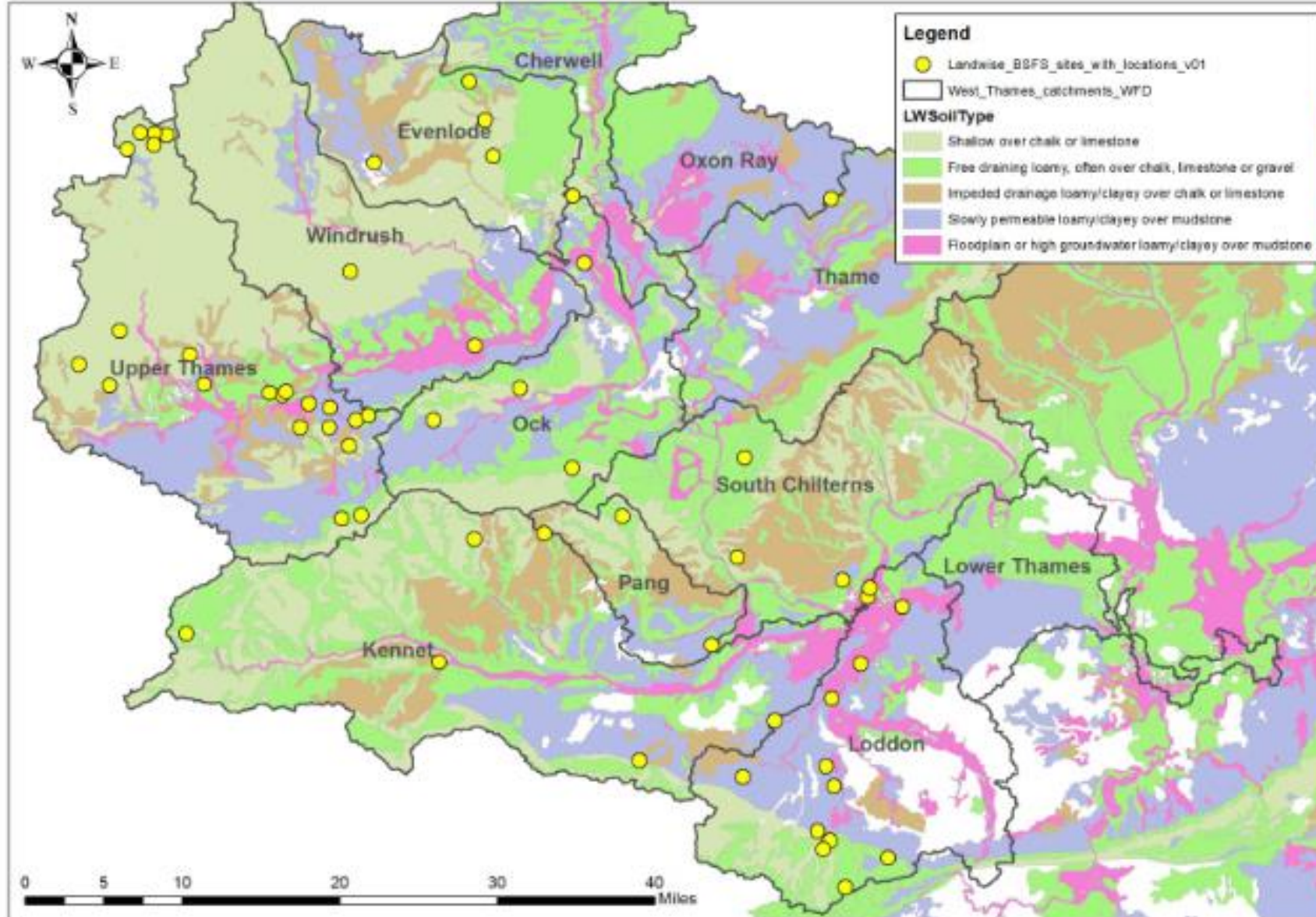# Measurements concepts

Measure properties

Measure water

Broad-scale survey of 150+ fields
Measure **properties of soil**
that help it to store water

Detailed survey of 3 locations/7 fields
Measure **properties of soil and**
Infiltration and water storage over time

Satellite remote sensing
Measure changes in **soil water** across
large areas

Measurements concepts

Broadscale survey

Land use and Management Classes measured

Land use			
Arable –G	Arable +G	Grassland	Woodland
Field drains			
Farm system (Conventional/organic)			
Tillage			
Controlled Traffic			
Cover crops			
Buffer strip			
Crop rotation			
Organic amendments			
	Grass Mix		
	Livestock		
	Grazing weeks		
	Winter grazing		
	Mob Grazing		
			Management Age

Evaluation through statistics: Mixed Model and Hierarchical Model

Soil Type				

X

Land Use			
A+G	A-G	G	W
Within field – 3 levels		Within field – 2 levels	
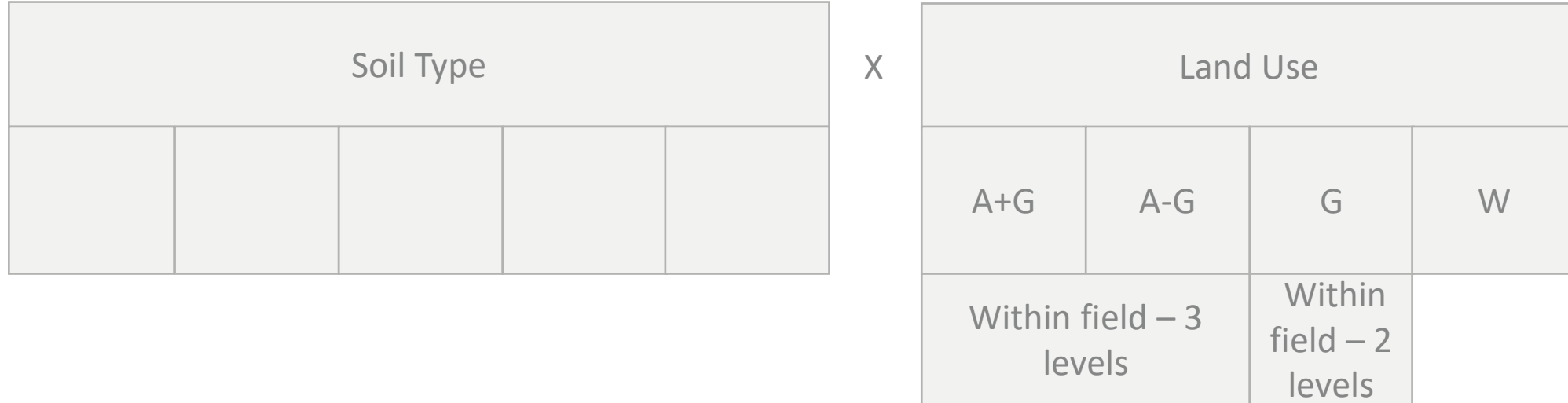
Response = Fixed effects + Random effects + covariates + error

Bulk density =   Soil Type **X** Land Use X **Land Use/Within Field** ....#Fixed effects
+ Farm + Field + Researcher + **Land Use/FarmingSystem** +
+LandUse/GrassMix.....#Random effects
+LOI + %clay...................................#covariates
+error (unexplained variance)

Sentinel 1 remote sensing images – how wet is the land?

Sentinel-1 retrieved Soil Moisture: 03/03/2018
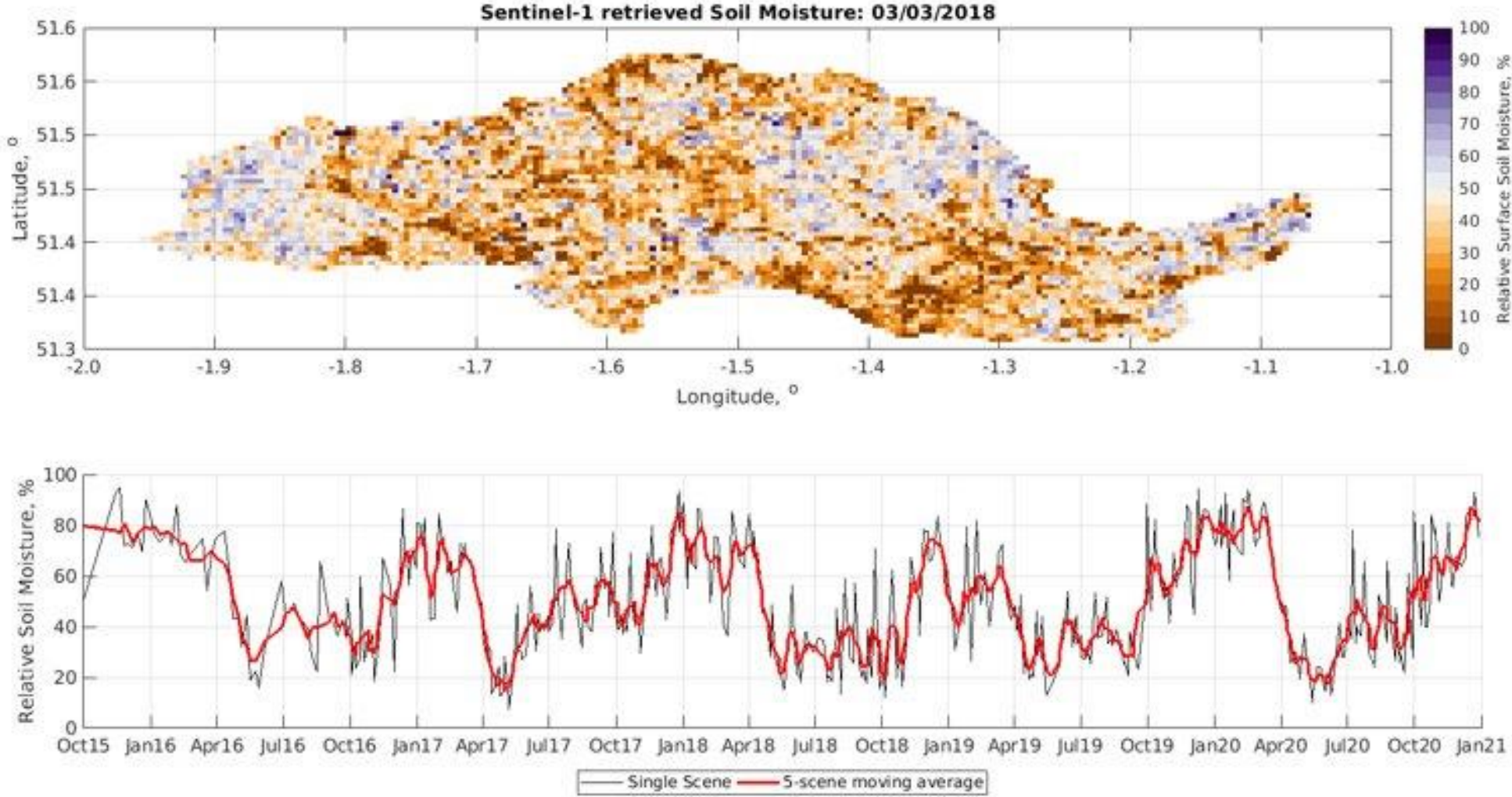
Kennet Catchment, image from Will Maslanka Webinar

Next steps

- **Talks today**
    - Emily Trill – field work

- **Gather Town today**
    - Will Maslanka – remote sensing soil moisture poster

- **Webinar**
    - Recording of Will Maslanka's webinar from April available on NFM website

- **Follow up**
    - Field work working group (TBA)

WP6: Knowledge sharing and communications

Joanna Clark, Joanne Beales, Barbara Percy and project team

Working together with our partners (2018-2021/22)

- **Working groups**
  - Farmer knowledge and new agri-policy report
  - Field work
  - Data visualisation (working with Catchment Partnerships)
  - Communications

- **Workshops on NFM scenarios** (modelling follow up to come)
  - Catchment Partnerships: Upper Thames, South Chilterns, Loddon, Kennet, Ock

- **Advisory Board**
  - Four meetings, one more to go

- [almost] **Annual workshops**
  - Reading, 6 Nov 2018
  - Culham, 20 Feb 2020
  - Online/GatherTown, 9 June 2021
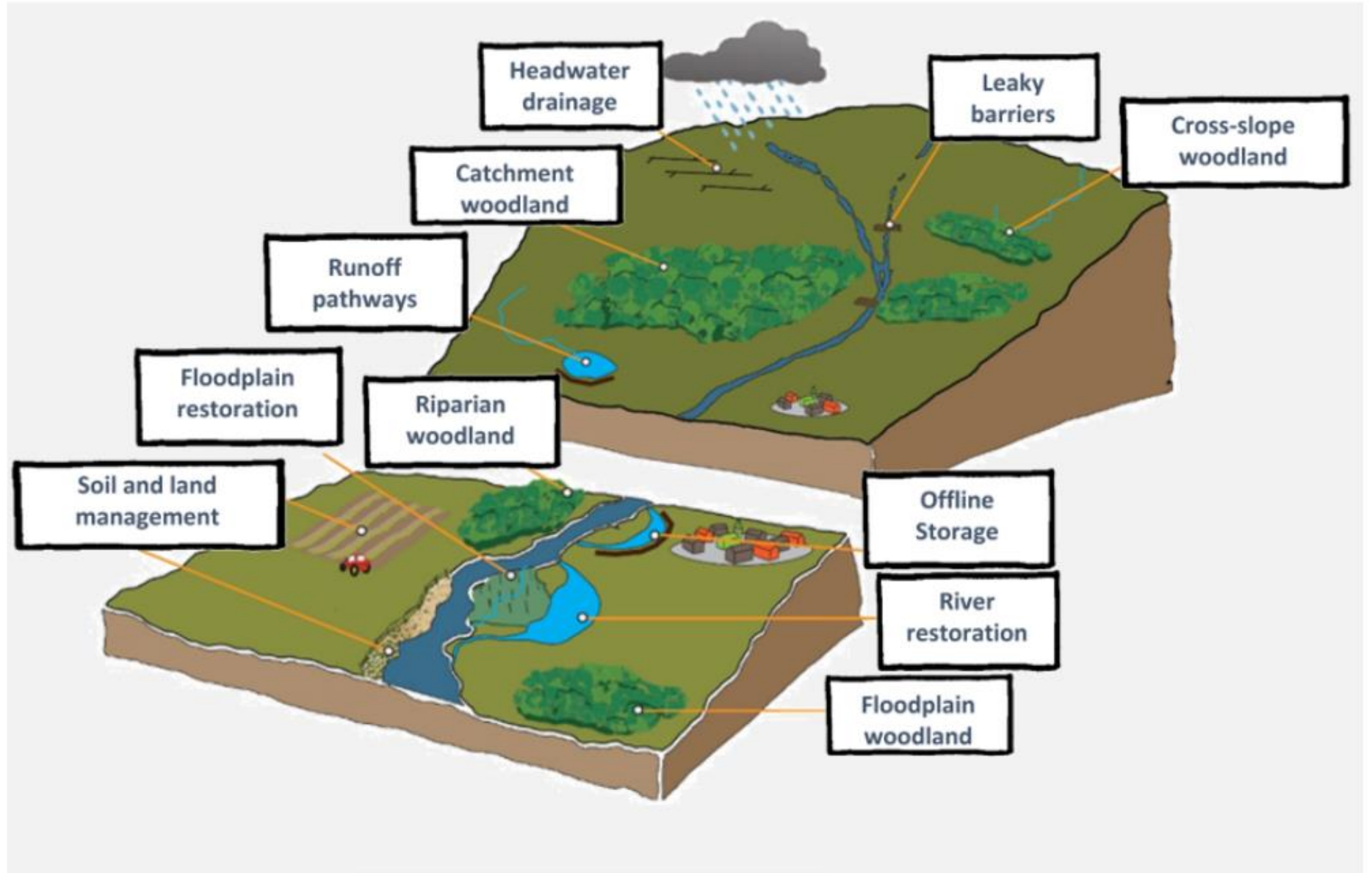 - FarmEd, Honeydale Farm, 8 Jun 2022

LANDWISE NFM

MARCH 20, 2021

LANDWISE Project Team (BGS) – The trouble with catchments: why groundwater and surface water don't match up

LANDWISE
NFM

Log in   About   Vote now!   Event results   All results

You have
3 tokens

Cancel

Add my
votes

Headwater
drainage

Leaky
barriers

Cross-slope
woodland

Catchment
woodland

Runoff
pathways

Floodplain
restoration

Riparian
woodland

Soil and land
management

Offline
Storage

River
restoration

Floodplain
woodland

Creative knowledge sharing – exploring poetry, film, photography....

somewhere-nowhere

> "
>
> *Poetry offers a way into the immediate, sensory and emotional world, and provides a space for thought, connection and questioning.*

Plans for final outputs....

- Main finding in the Web Tool – way to explore data online
- Information available and accessible from the website
- Policy report for Environmental Land Management Scheme ELMs
- Short project summary for key audiences
  - Catchment Partnerships
  - Farm advisors/Farmers
  - Local residents
- Case studies to update EA WWNP Evidence Directory
- Academic publications
- Data sets archived for use in other projects (where possible)
- Creative resources
  - PVFF leaky barrier video and animations
  - Landwise Video – to be filmed August (TBC)
  - Animations – to be created
  - Poetry, images.......

Next steps

- **Gather Town today**
    - Meet Harriet and Rob Fraser – help with the Landwise creative project
    - Explore the web site and blogs
    - Vote for your favourite NFM measures – share ideas with Barbara Percy
    - View project and partner videos and posters

- **Webinar**
    - Final outputs and web tools to be presented in November 2021

- **Working groups & workshops**
    - Jan-Mar 2022 Programme synthesis activities (TBA)
    - Apr-Jun 2022 Developing final dissemination resources

- **Landwise finale – 8 June 2022 Farm Ed**
- **NFM Programme finale – July 2022 TBC**