



**British  
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



Applied geoscience for our  
changing Earth

# HyDEF Project meeting: BGS Progress

Reading University - 18<sup>th</sup> January 2012

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and Andrew Hughes

# HyDEF – Running order

- Introduction and summary of activities (DWP)
- Complexity and JULES (AGH)
- Hydrogeology (SHB)
- Modelling (CRJ)
- Next steps (DWP)



# HyDEF – Summary of BGS' tasks

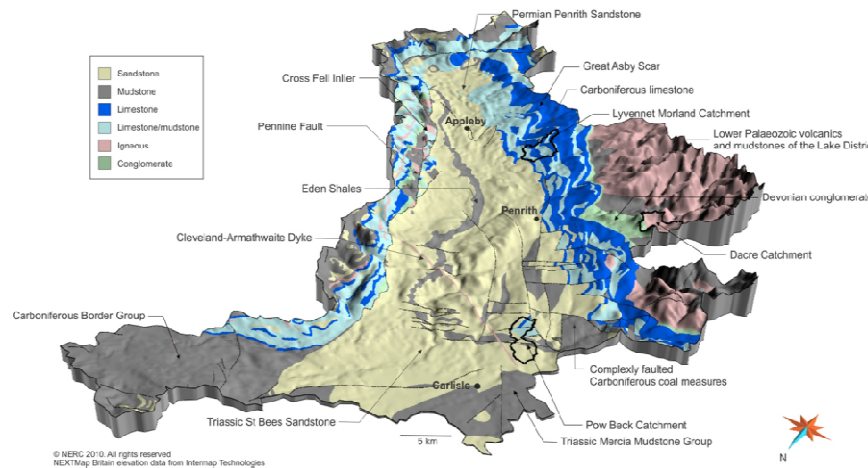
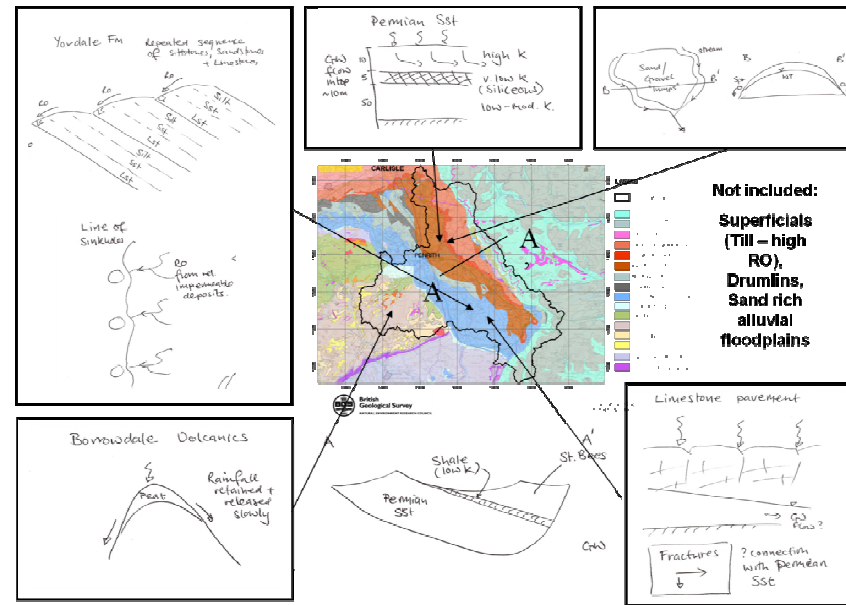
Catchment	Area	Geology	Issue	Current understanding	Approach
Eden	DTC test catchments	Permo-Triassic Sandstone overlain by superfcials	Groundwater availability during drought	Good - background u/s Limited – DTC catchments	Develop CM and GW model – recharge through superfcials likely to be higher important
Thames	Oxford	Oxford Clay overlain by superfcials	Groundwater flooding	Very good	Build on existing understanding/model
	Pang and Lambourn	Chalk overlain by superfcials	Groundwater flooding and drought	Very good	Build on existing understanding/model
	Cotswolds Jurassics	Sub-karstic limestone and complex structure	Baseflow to River Thames during droughts	Limited	Develop understanding of whole area then apply simplified approach.
Isle of Wight	Colne Valley	Chalk overlain by superfcials	Behaviour of adited sources during droughts	Good in valleys, poor elsewhere	Extend MaBSWeC to east by one catchment and then develop understanding/simulation of adited sources in the Colne Valley.
	Chalk	Cretaceous overlain by superfcials	Groundwater availability during drought	Good - background u/s	Develop understanding of whole area then support PhD student.

# HyDEF – Activities since the last meeting

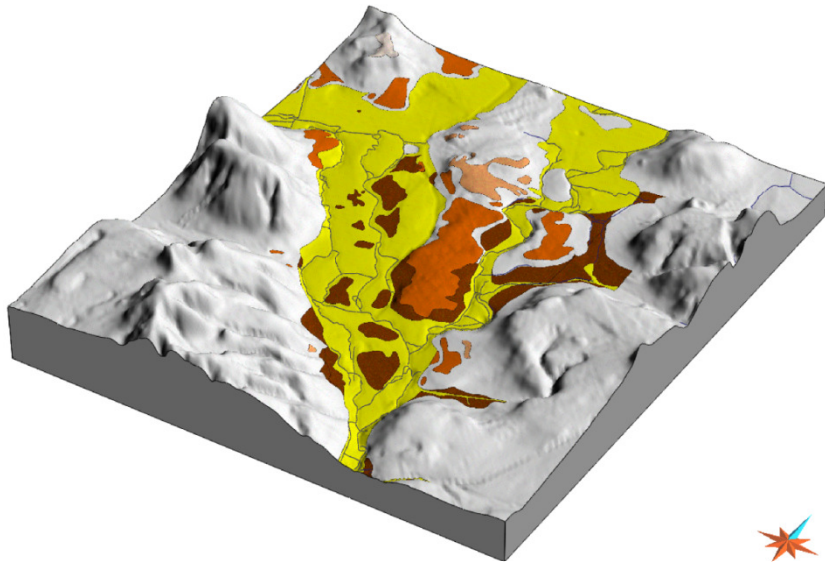
- MSc projects:
  - Imperial (Blue Pool and Pang/Lambourn GW flood)
  - Cardiff (Cotswolds)
- Improved P/L GW flood model
- Liaised with other BGS projects:
  - Thames Basin and Oxford Modelling
  - Thames superfcials
  - Cotwolds/Thames Basin geological modelling
  - DTC Eden work
- Presented at the GSA/ModelFusion
- Written JULES Strategy (2<sup>nd</sup> Draft)
- Planned borehole drilling
- (Re)Advertised for PDRA – short-list produced interviewing shortly
- Hosted PhD Mike Simpson (IOW) and MEng – Edoardo Borgomeo (Eden) students

# HyDEF – Eden Valley

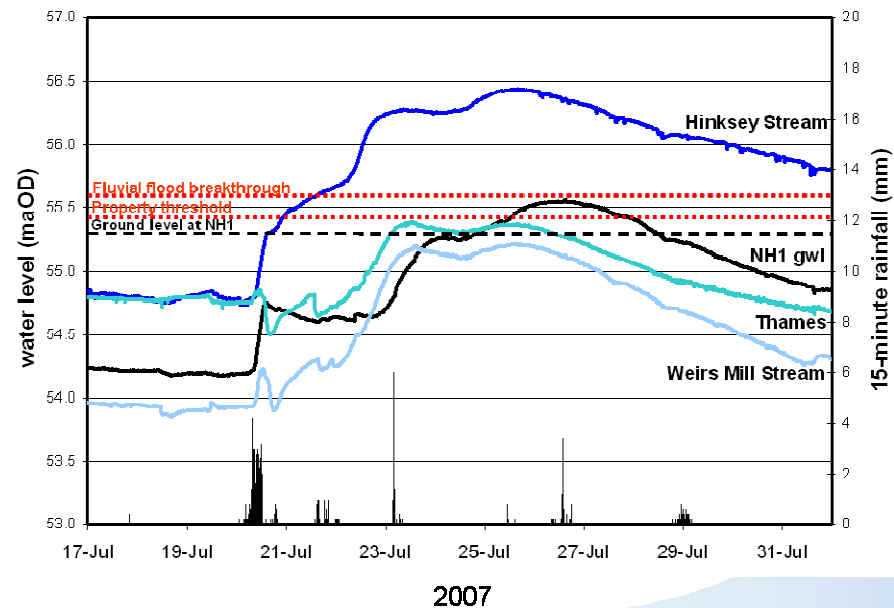
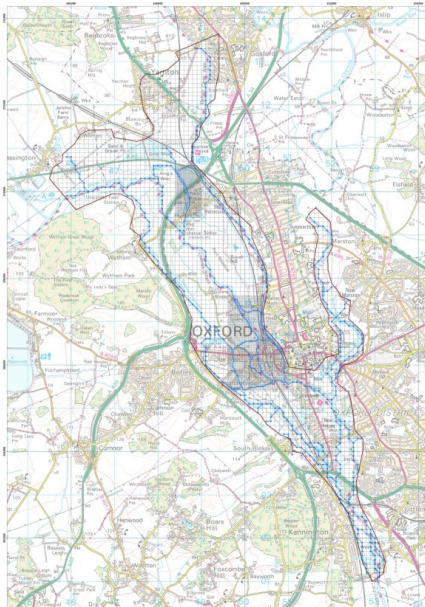
- Geological understanding: Catchment scale, Lazonby Gorge and granulation seams
- Hydrogeological understanding – DTC
- Project-based: conceptualisation



# HyDEF – Oxford



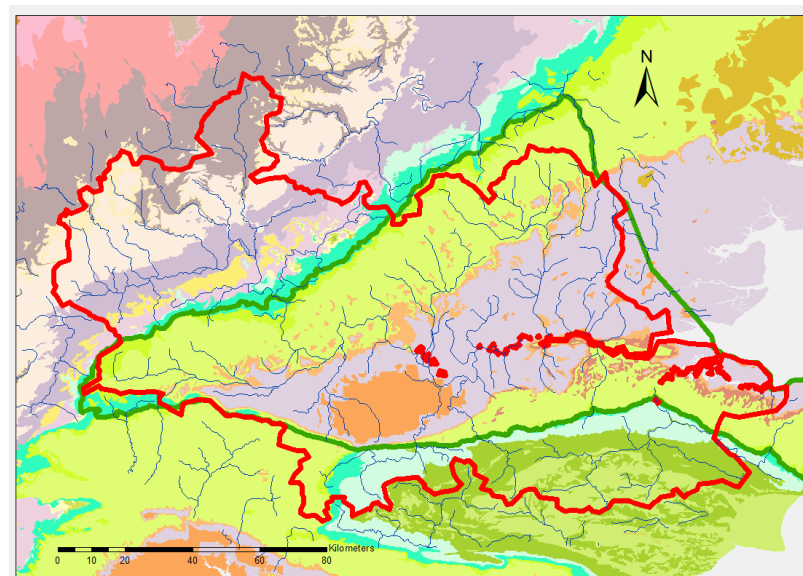
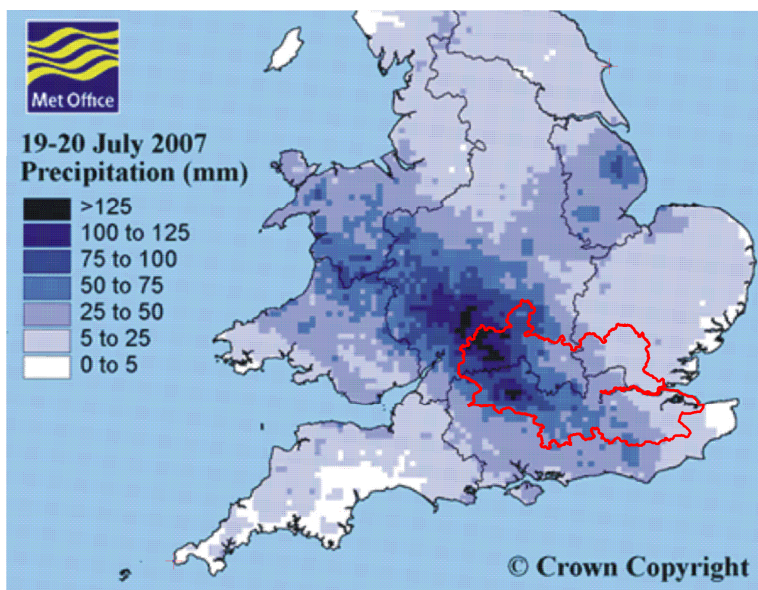
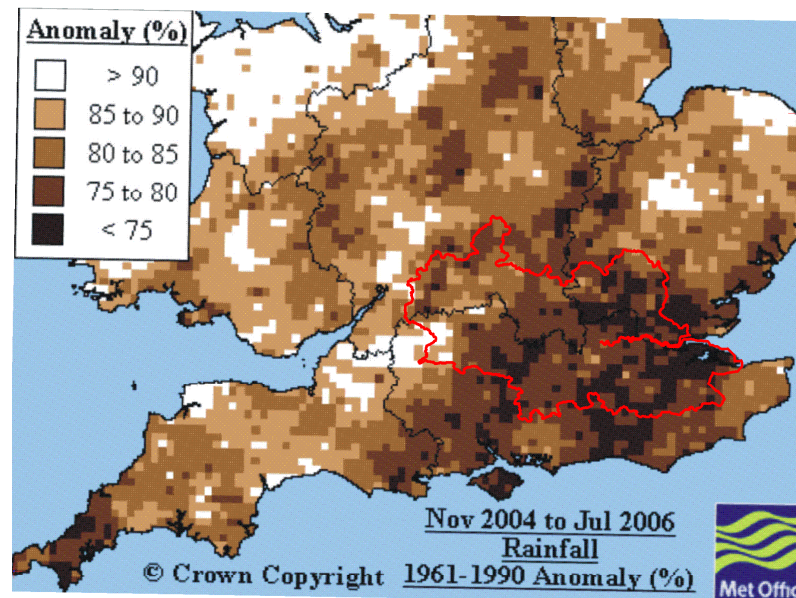
- Model composition under development
- BGS now has RS Infoworks licence for 1 years and model files
- Linked model only north of Botley Road
- Issue over representation of flood plain storage



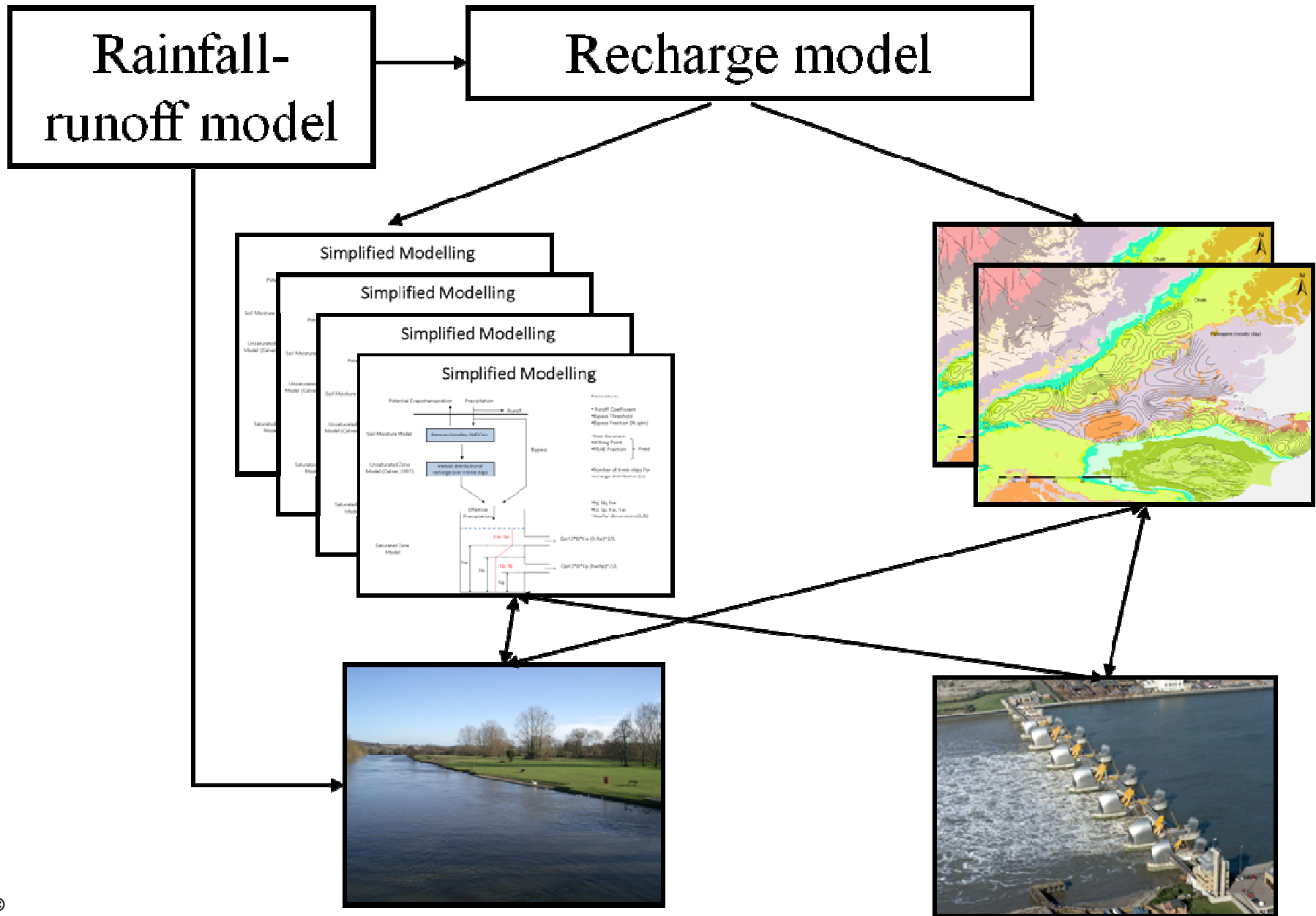
# HyDEF – Complexity

## Spatial variability in extreme events

- Rainfall extremes exhibit high variability – even across (relatively) modest sized basin
- Hydrogeology impacts on flood response
- Variation of rainfall anomalies during droughts



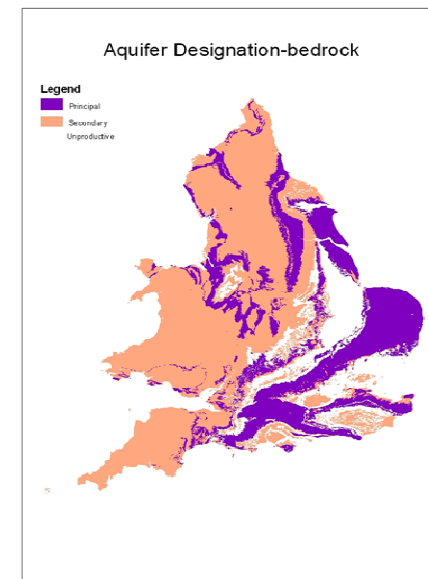
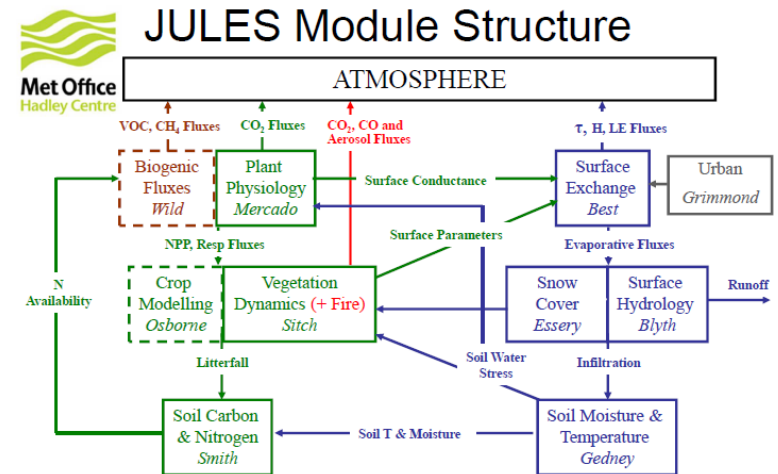
# HyDEF – Complexity





# HyDEF – JULES Strategy

- Result of meeting 16<sup>th</sup> March 2011
- 1<sup>st</sup> Draft sent out 18<sup>th</sup> October
- Comments provided and draft revised – 14<sup>th</sup> December
- Sub-surface hydrology is included in JULES (PDM, TOPMODEL, Grid2Grid), but...
- ...limited assumptions, including representation of sub-surface as a continuous layer
- Approach depends on scale of approach, but proposed including UZ and improving Grid2Grid



# HyDEF – Understanding the hydrogeology

## Pang - Lambourn

MSc project on Blue Pool (Tim Foster – Imperial )

- Dual response system – rapid karstic flow chalk, sustained diffuse flow from palaeogene and chalk
- Model for diffuse & point recharge and rapid & sustained flow

- Pang
- Lambourn
- Palaeogene

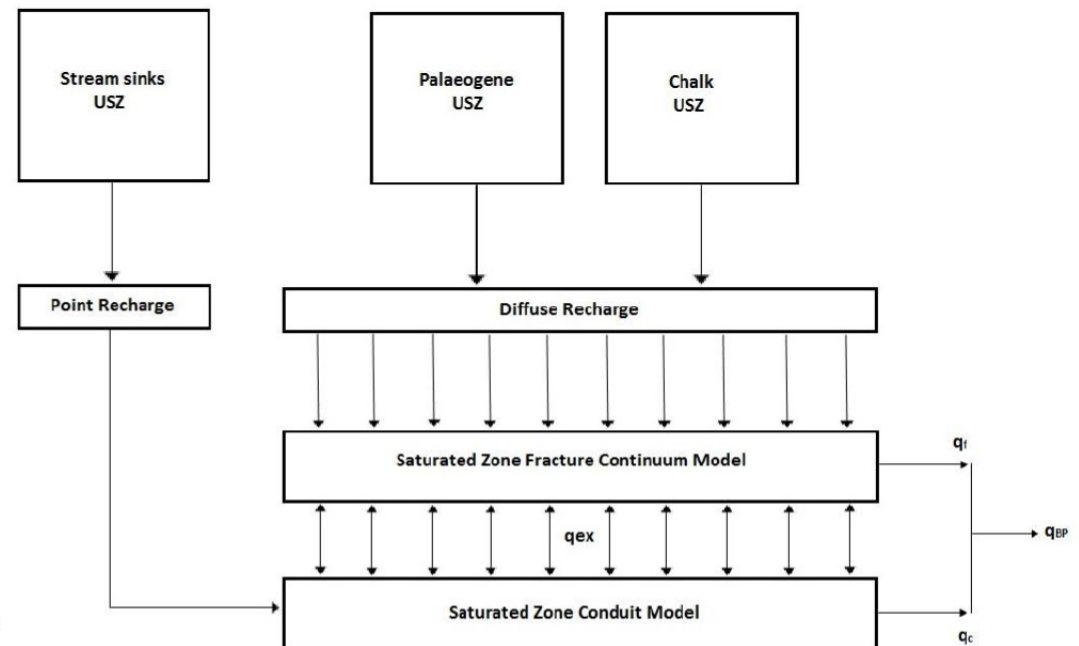
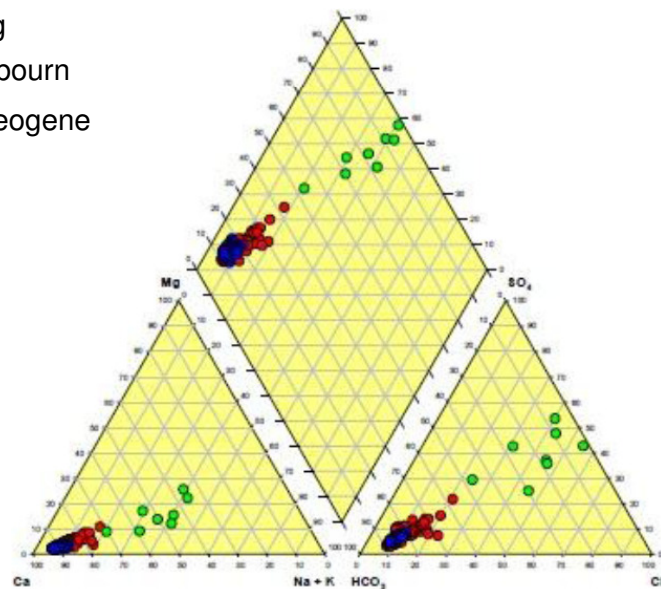


Figure 4.1 – PIPER plot of major ion chemistry at sites in the Pang and Lambourn catchments as well as for Palaeogene springs samples on the Reading Beds (from Wheater et al, 2006).

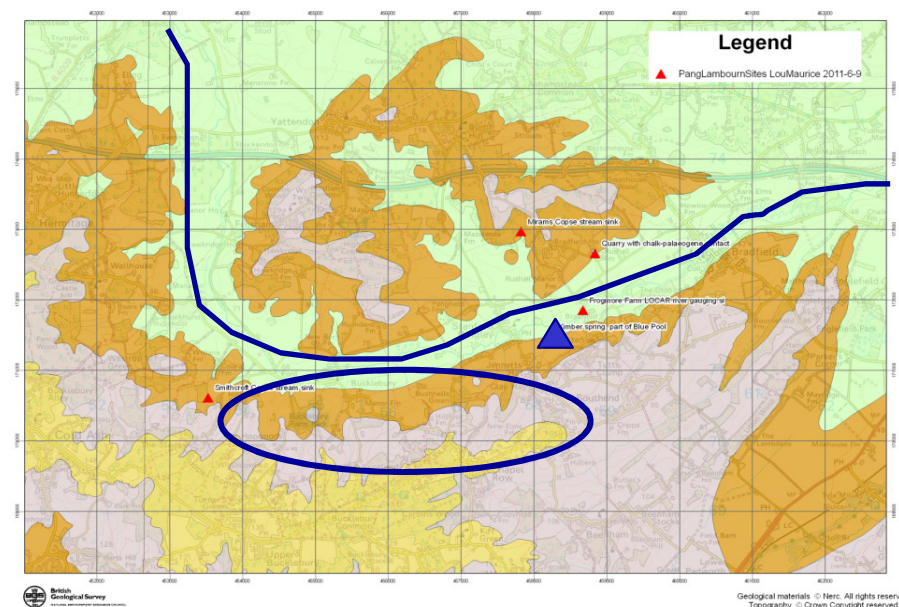
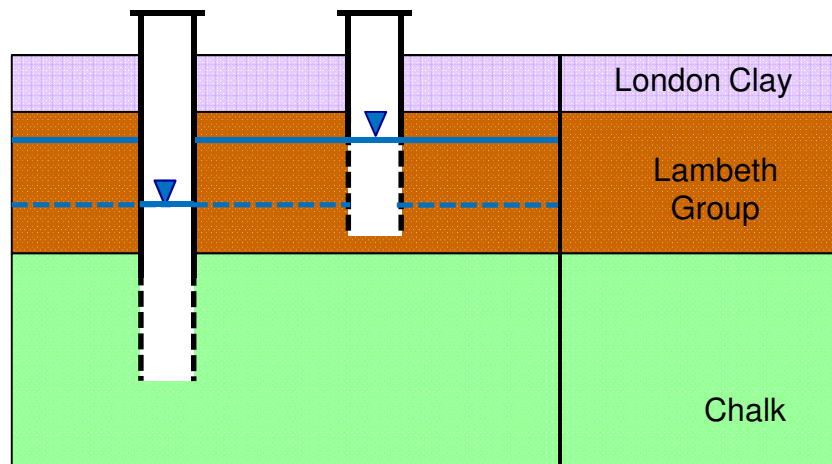
# HyDEF – Understanding the hydrogeology

## Pang - Lambourn

Drilling project (BGS funded)

- To assess the contribution of the Palaeogene deposits to the Blue Pool
- Two boreholes side by side (one chalk, one Palaeogene)

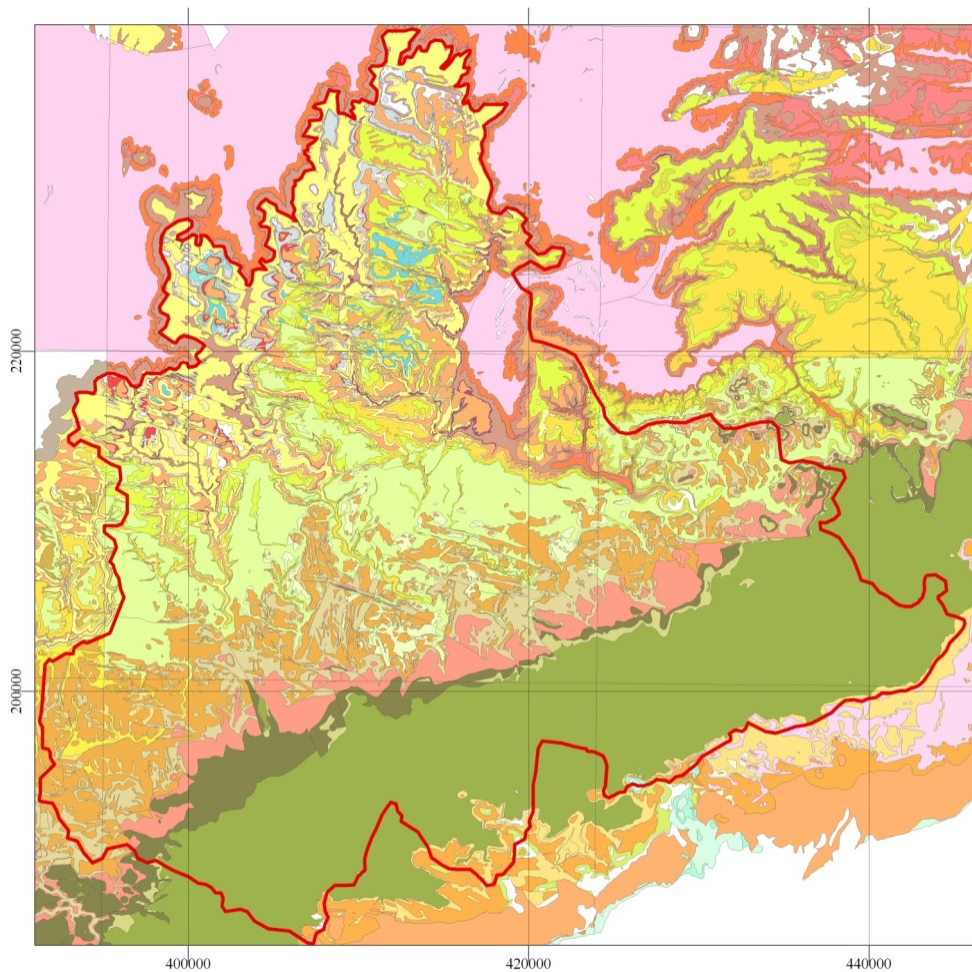
Another MSc project to follow on from the work Tim did.



# HyDEF – Understanding the hydrogeology

## Cotswolds

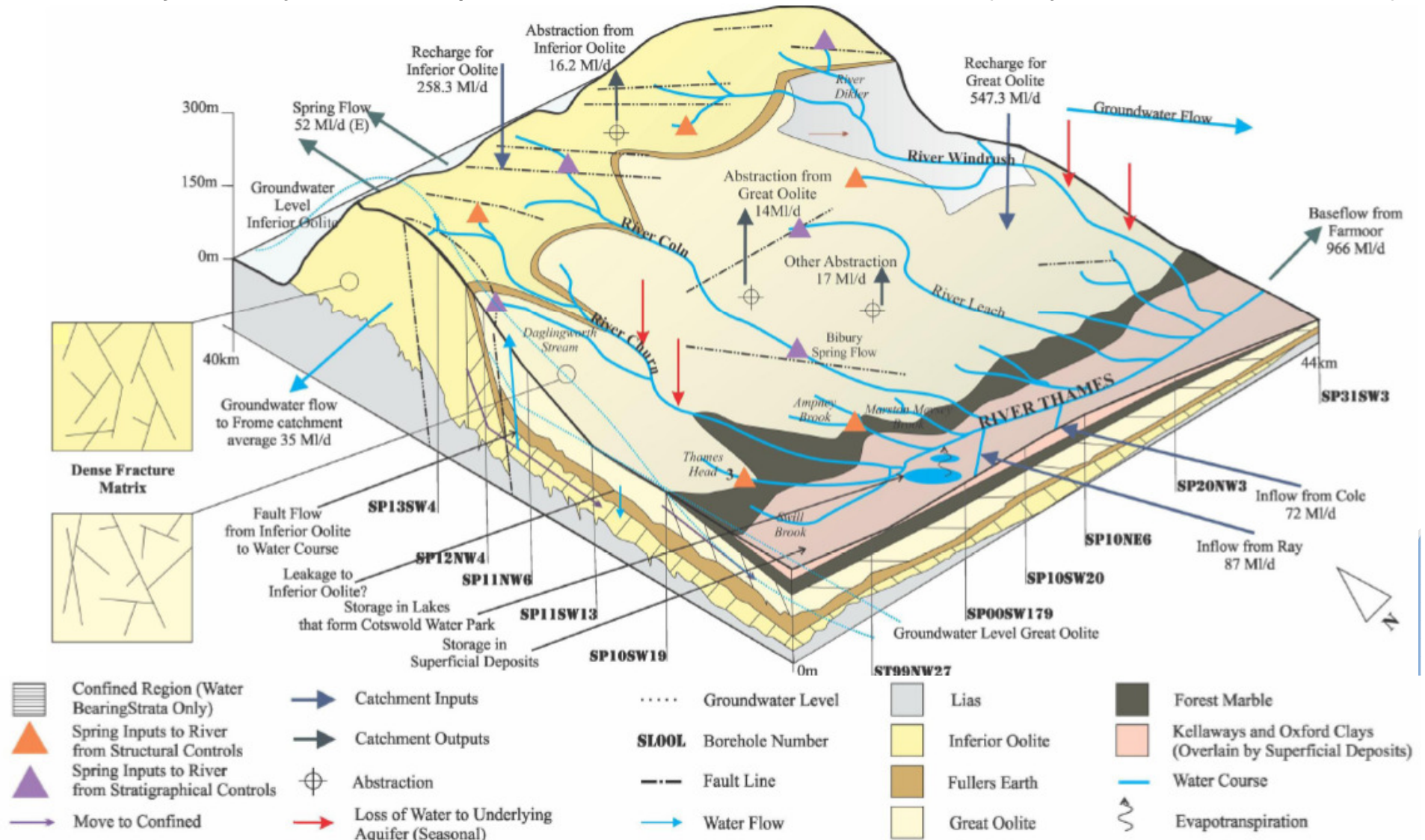
MSc Project - hydro conceptualisation and neural networks (Katy James – Cardiff Uni)



# HyDEF – Understanding the hydrogeology

## Cotswolds

MSc Project - hydro conceptualisation and neural networks (Katy James – Cardiff Uni)



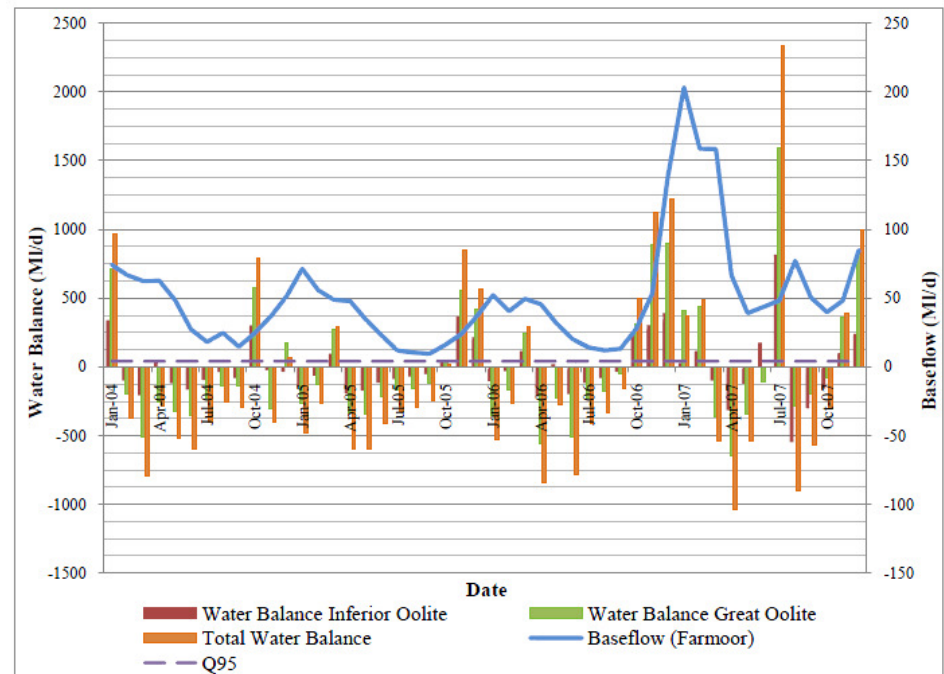
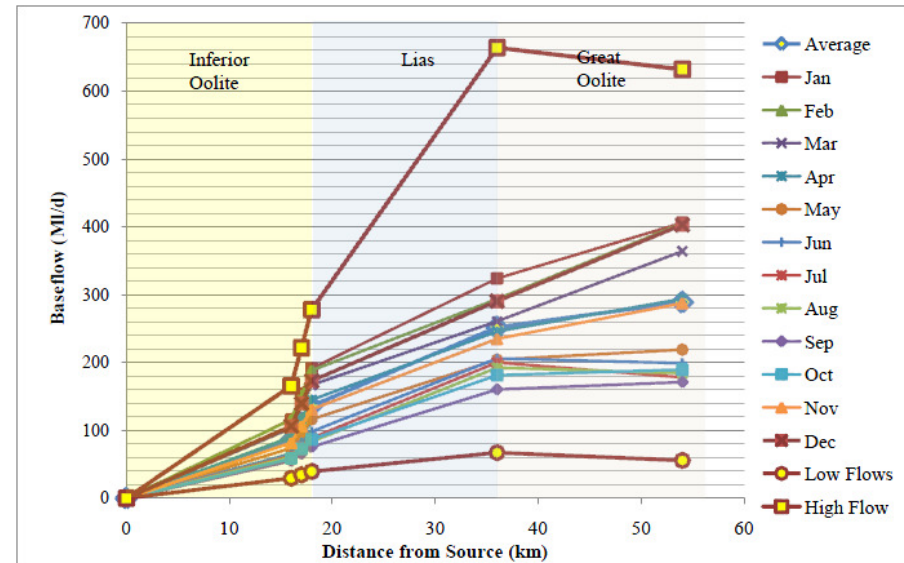
# HyDEF – Understanding the hydrogeology

## Cotswolds

- Water balances
- Lithological vs structural control on flow
- Stream head migration
- Flow accretion profiles

Catchment	Water balance
Cotswolds @ Farmoor	- 20 MI/d – springs (Deficit)

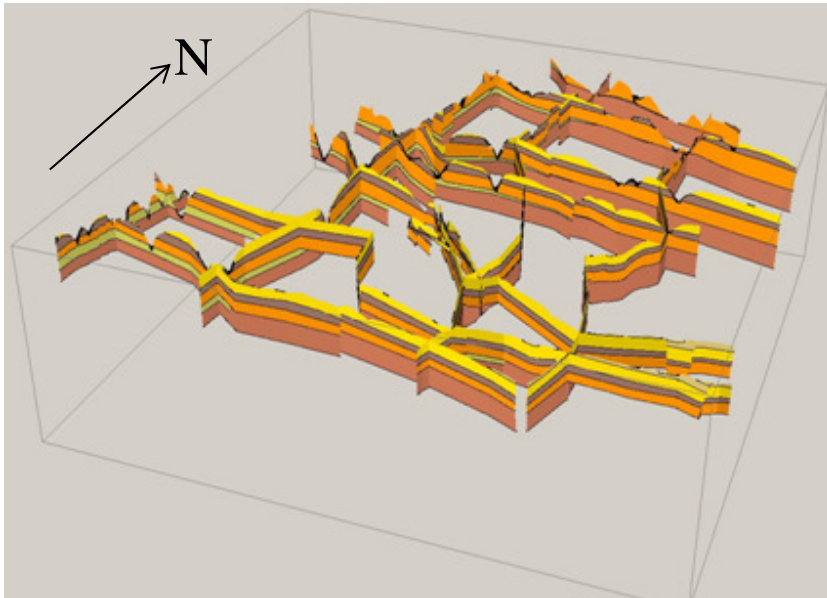
Water balance	MI/d
Inferior Oolite	+ 8
Great Oolite	+ 112
Abstraction (non-Oolite)	- 22
Springs (Estimated)	- 52
Outflow to R. Frome (E)	- 35
<b>Total</b>	<b>+11 MI/d (~balanced)</b>



# HyDEF – Understanding the hydrogeology

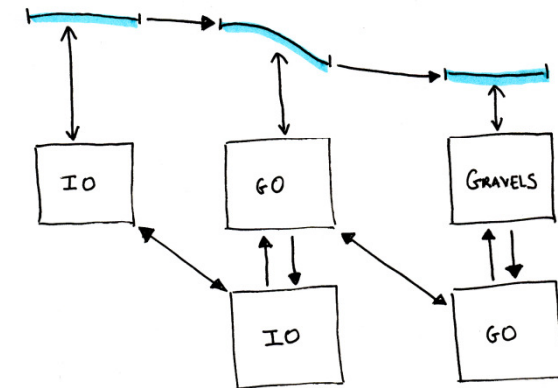
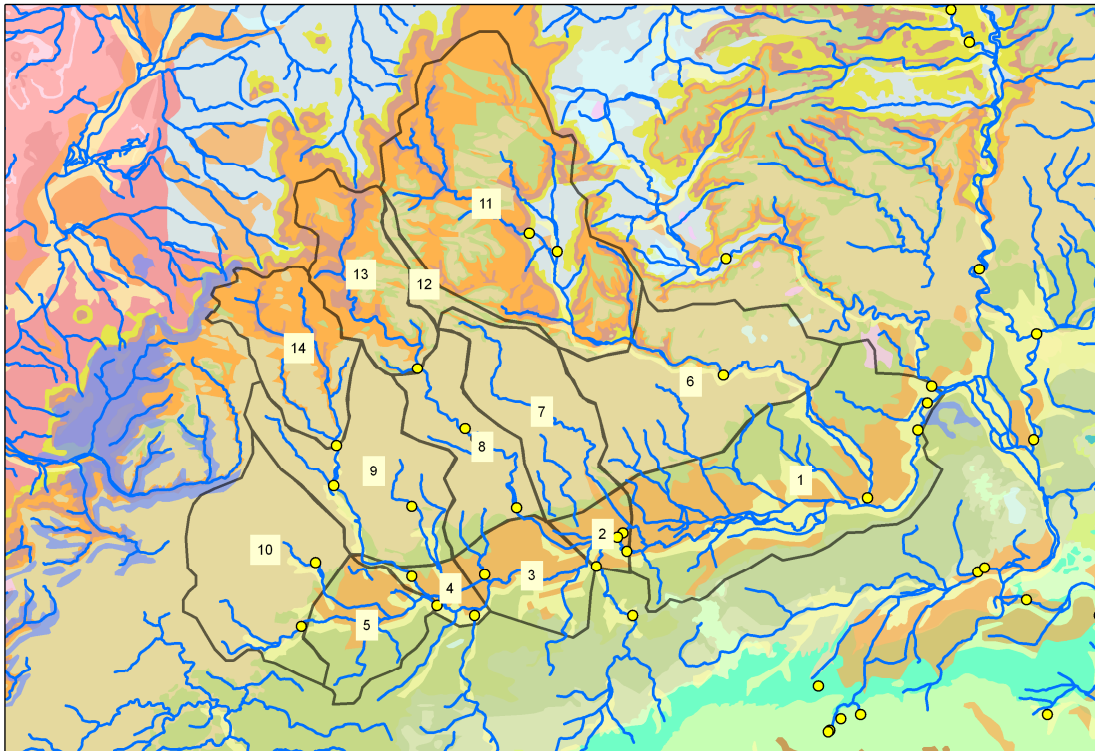
## Cotswolds, next steps...

- BGS funded 3D geological model
- More interpretation of existing hydro data and integrate with 3D model
- MSc project – field based, Birmingham University
- Abstract accepted at the IAH Fractured Rock conference in Prague, May 2012
- Paper - using a geological framework to underpin hydrogeology understanding of extremes



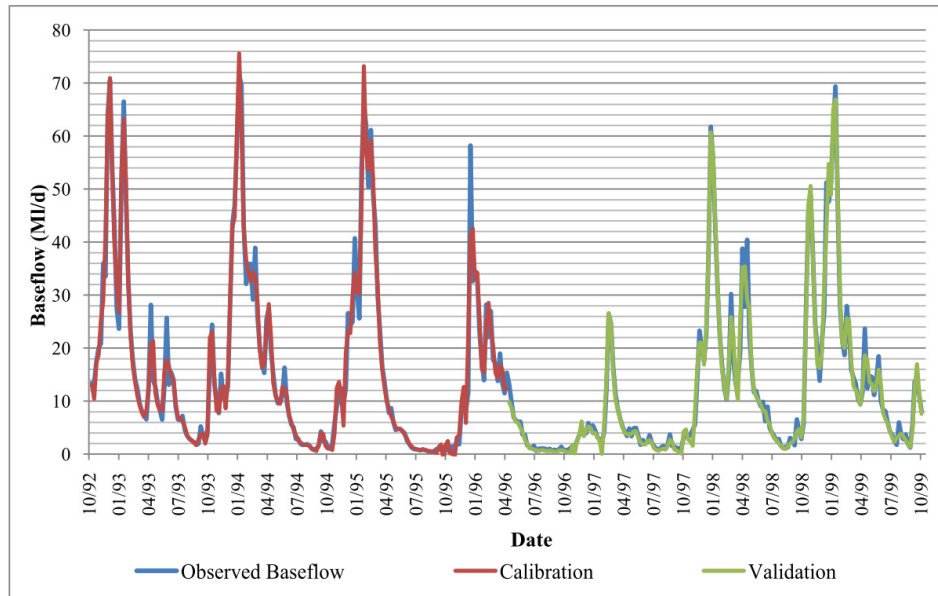
# HyDEF – Cotswolds groundwater modelling

- Developing semi-distributed model of aquifer system.
- Will be incorporated into multi-aquifer model of Thames catchment.
- OpenMI compliant code almost complete.

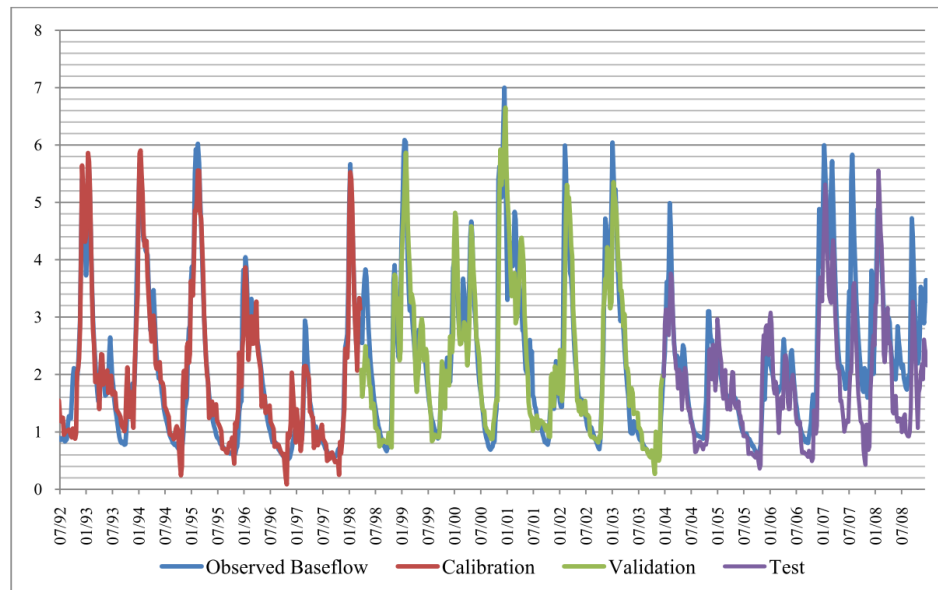




# HyDEF – Modelling as part of Cotswolds MSc

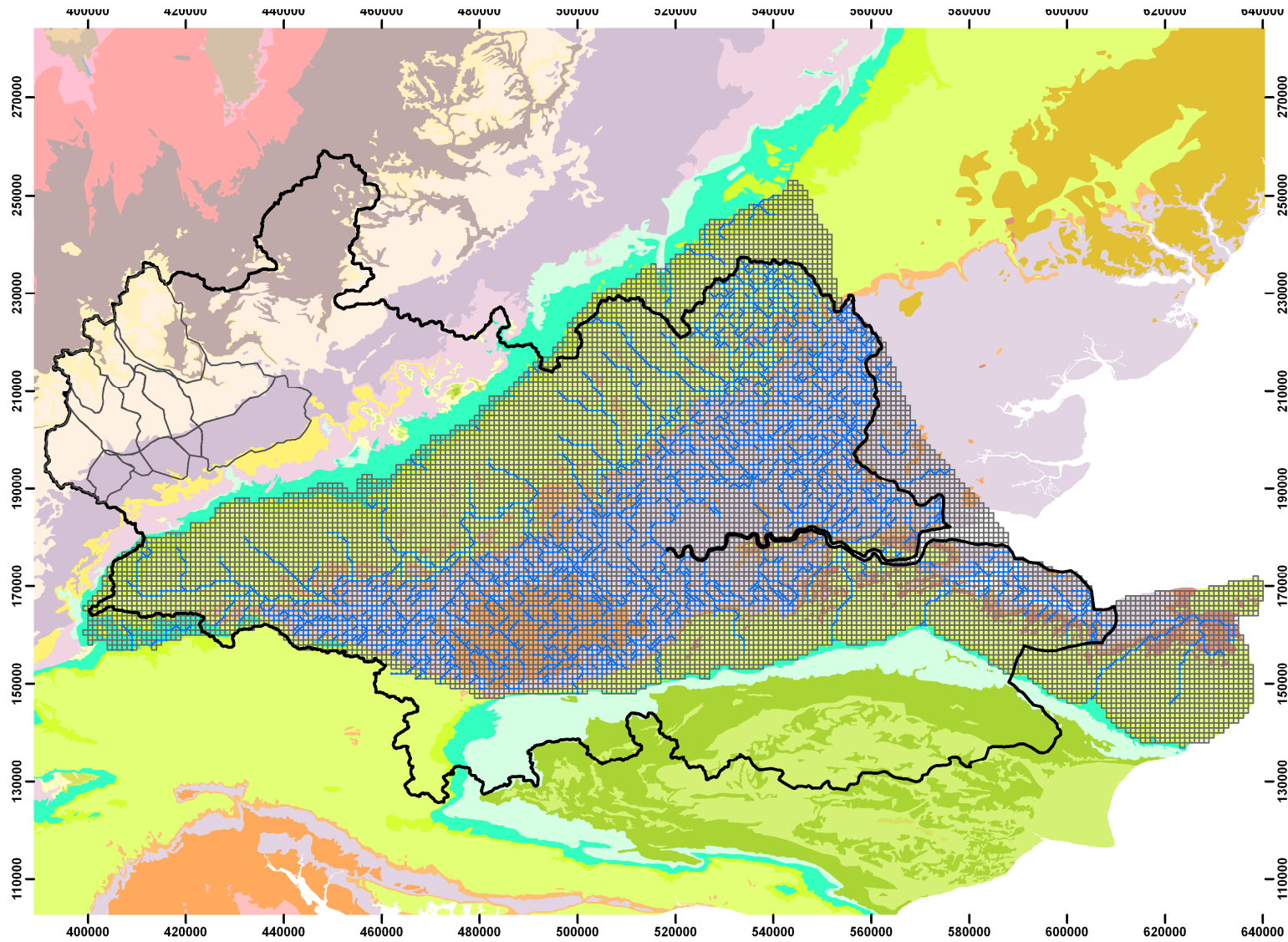


Coln at Fossebridge



Coln at Fairford

# HyDEF – Thames catchment multi-model composition



## HyDEF – Next steps for Q1 2012

- Employ PDRA
- Support project partners: PhD, JULES, etc
- Decide on MSc projects for summer
- Get borehole drilled
- Scope Colne work
- Distribute JULES strategy and get feedback
- Continue with paper drafting:
  - Complexity – Thames
  - Cotswolds Hydrogeology
- Presentations
  - Planet under Pressure
  - GwFR2012