Modelling land and water interactions in the Strine catchment to assess urban, agricultural and environmental trade-offs

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Outline

1. Strine IDB within the broader catchment
2. Land and water interactions – Hydrology
3. Key questions
4. Hydrological modelling – The tool, data, setup and evaluation
5. Answering questions
6. Wrap-up

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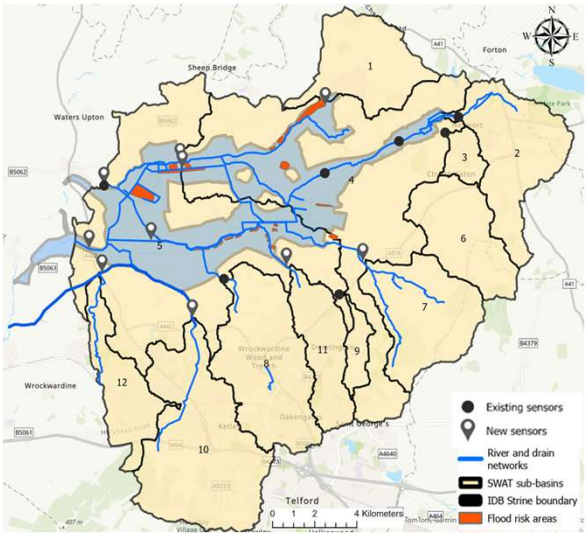
Strine IDB within the broader catchment

The IDB

- Highly **productive agricultural** area
- Drained through **natural water courses and drain network**
- Key challenges:
  - **Flooding** – from urban areas and lack of channel maintenance
  - **Water scarcity and drought** – due to climate change, Environmental Destination targets, and abstraction management reforms
- Within a broader catchment



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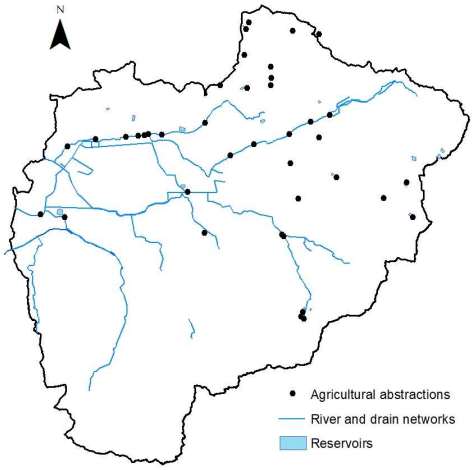
Strine IDB within the broader catchment

The catchment

- Land draining through Crudgington gauging station
- **Diverse land cover**: 53% arable & horticulture, 26% improved grassland, 11% urban & suburban, 9% broadleaved woodland
- Water abstractions for **irrigation, storage, farming and domestic uses** – Surface & groundwater
- Water discharges from WWTW
- Water management infrastructure – **Drains and reservoirs**



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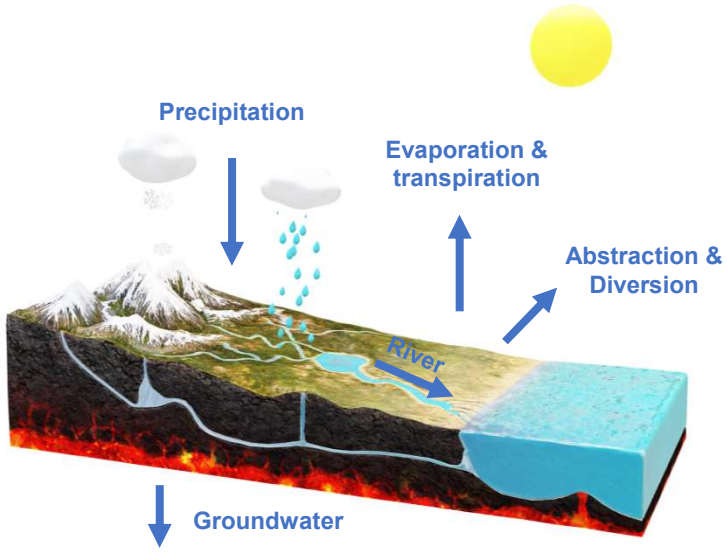
Land and water interactions - Hydrology



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Key question

How to manage water now and in the future?

- How much of the precipitation leaves the catchment via channels (discharge – m^3/s or Ml)?
- How does this change seasonally?
- How does this vary within and between storm events?
- How much and when do human interventions affect channel discharge?

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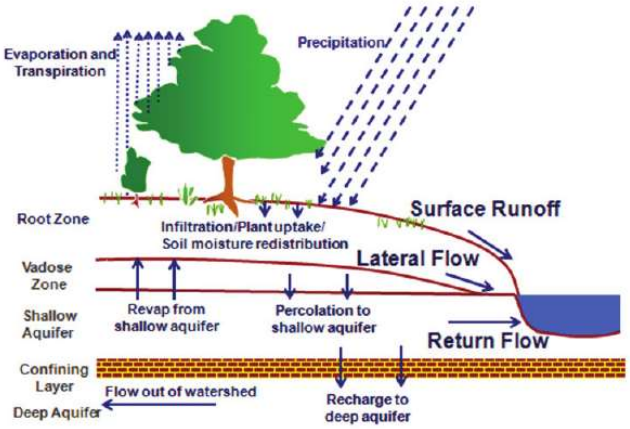
Hydrological modelling – The tool

Soil and Water Assessment Tool (SWAT)



- **Conceptual** hydrological model
- Represents **main flow pathways**: surface runoff (quick response), subsurface flow, and baseflow (slow response)
- Accounts for **spatial variability** in a semi-lumped way – Sub-basins and hydrological representative units
- Hydrology based on topography – Not possible to incorporate drains
- Limited water management capabilities – abstraction thresholds, timings…

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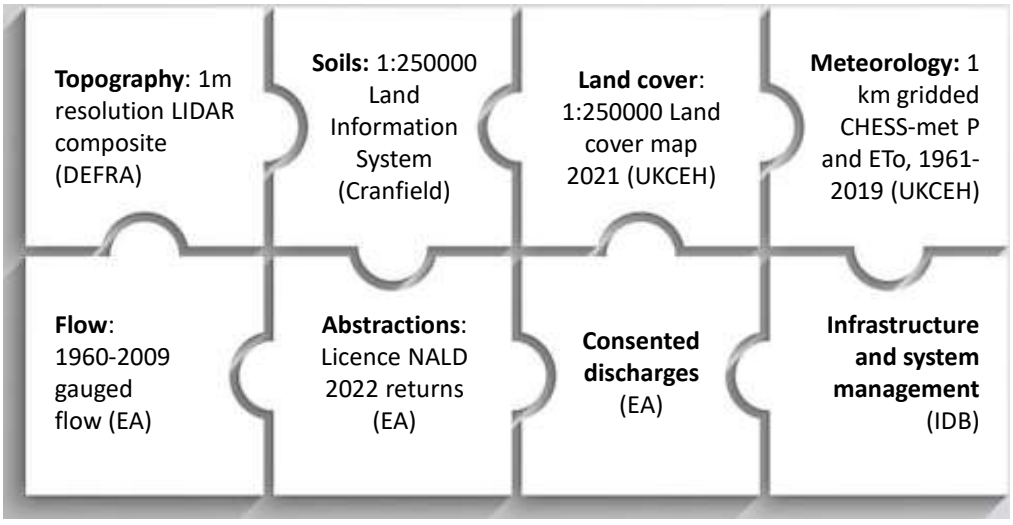
Hydrological modelling – Model data



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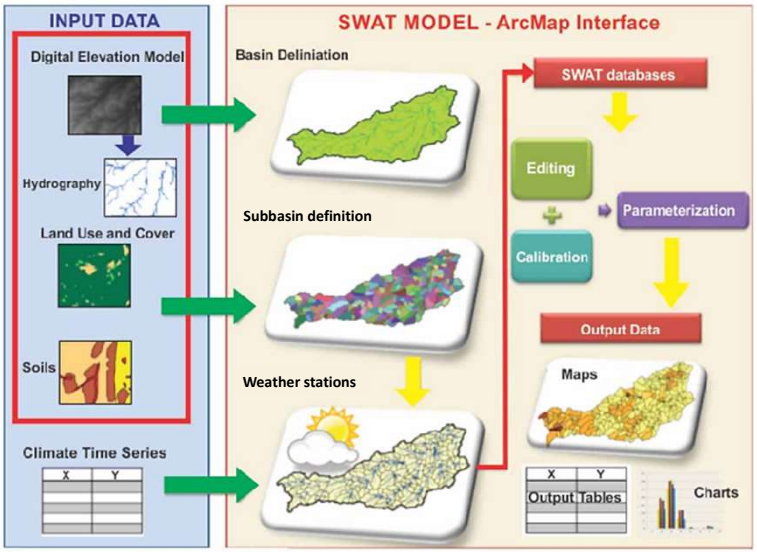
Hydrological modelling – Model setup



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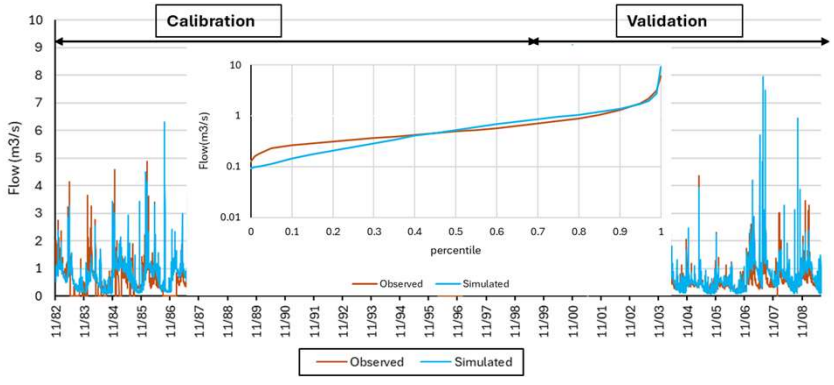
Hydrological modelling – Model evaluation

	Time period
Calibration	1983-2000
Validation	2000-2009



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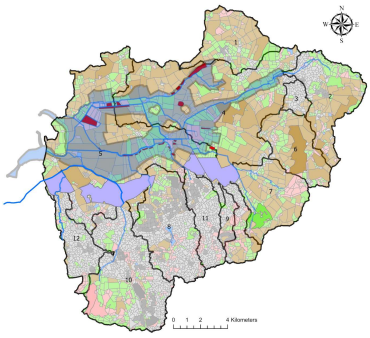
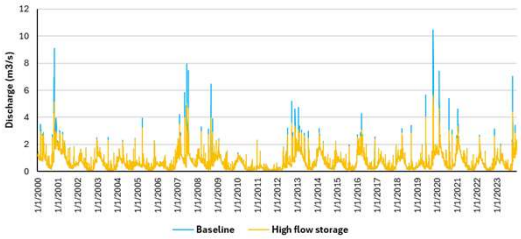
Answering key questions

Scenario analysis: "What if…"

- **Suburban development took place in Telford?**
  - 5 km^2 agricultural area planned development



- **High flow was stored for irrigation?**
  - Storage locations in subbasins 1, 4 and 11 to prevent downstream flooding



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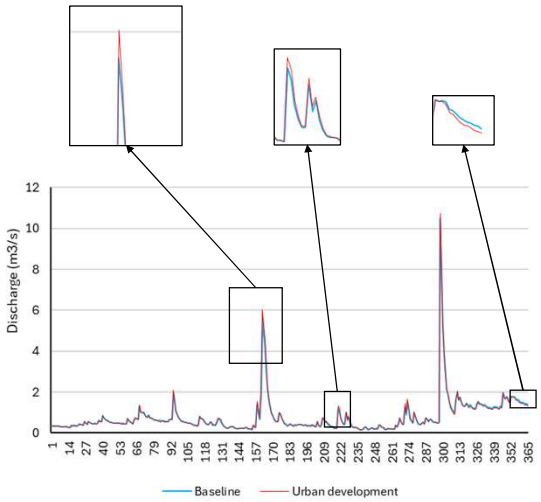
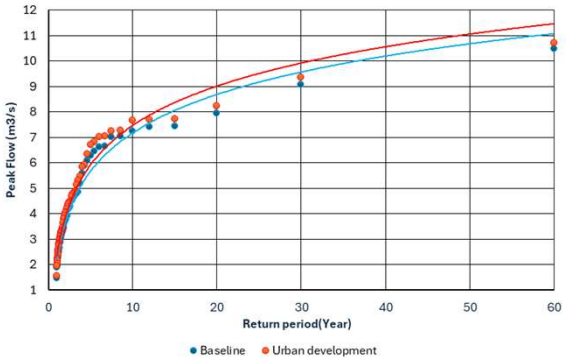
Impacts of urban development





- Suburban expansion increases peak discharges (4% avg; 22% max) and reduces baseflow stability (2% avg; 6% max)
- Slightly higher flood peaks for all return periods

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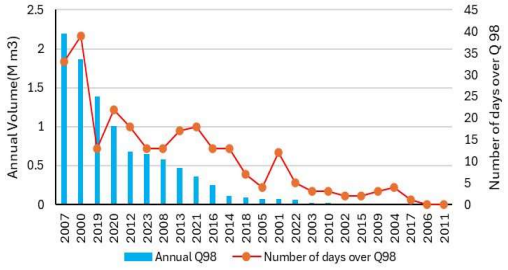
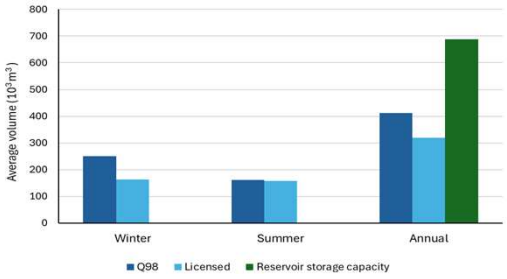
High flow storage for irrigation

- **Significant volumes available**
- Reservoir storage capacity exists for normal years, but not for wet years
- **New storages** are required for flood mitigation above Q98
- Storages in subbasins 4 and 5 can provide additional benefits; e.g., peat restoration





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Wrap-up

Key learnings

- Urbanisation increases flood risk, but the planned urbanisation is not very significant (4% area)
- High potential for flow peak storage to reduce flood risk and support environmental destinations

Further work

- Climate change scenarios
- Urban creep impact on flood risk
- High flow abstraction based on remotely sensed flooded areas
- Modify SWAT source code to better incorporate abstraction management

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Questions?

Thank you!

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Model assumptions and uncertainty

- Abstraction return data
- Consented discharges data
- Norther interceptor diverting all from sub 10 and 12
- All crops consider as potato, maize, field peas

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