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Flow Gauging Strategy for Water Resource Assessment in Scotland

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Introduction

- Water Resources Hydrology in Scottish Water
- Historical Context and the Current Network
- Scottish Water SR15 Flow Gauging Strategy
- Climate Change
- Benefits and Conclusions

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Water Resources Hydrology in Scottish Water

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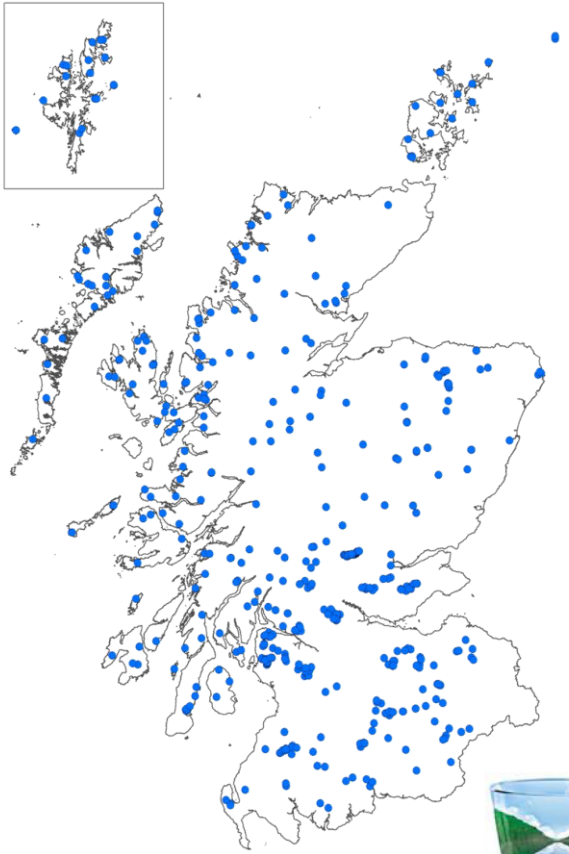
Scottish Water Resources

194 Water Resource Zones

238 Water Treatment Works

450 Sources



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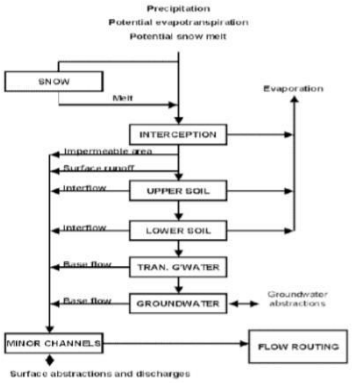
Source Types

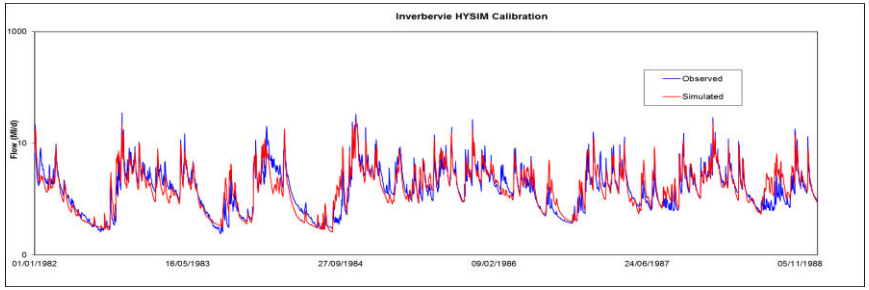
Tools and Models

1) HYSIM

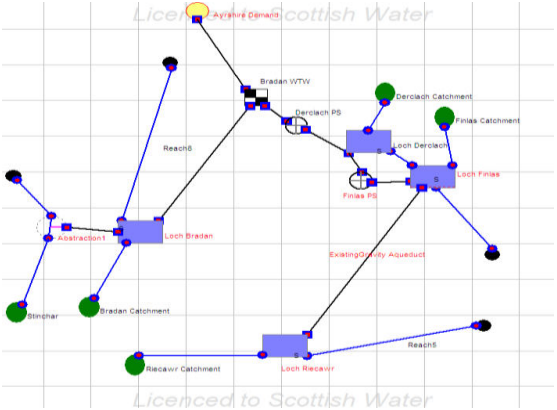
Rainfall- Runoff Model



2) Hysim Calibration



3) Aquator Water Resource Simulation



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Lack of data and model limitations

- Both HYSIM and Aquator require reliable inflow and storage data to validate and calibrate models
- Lack of hydrological data can lead to large uncertainties in model outputs (evidence base) which underpin our investment decisions
- In certain parts of Scotland the coverage of river flow gauging network is very sparse

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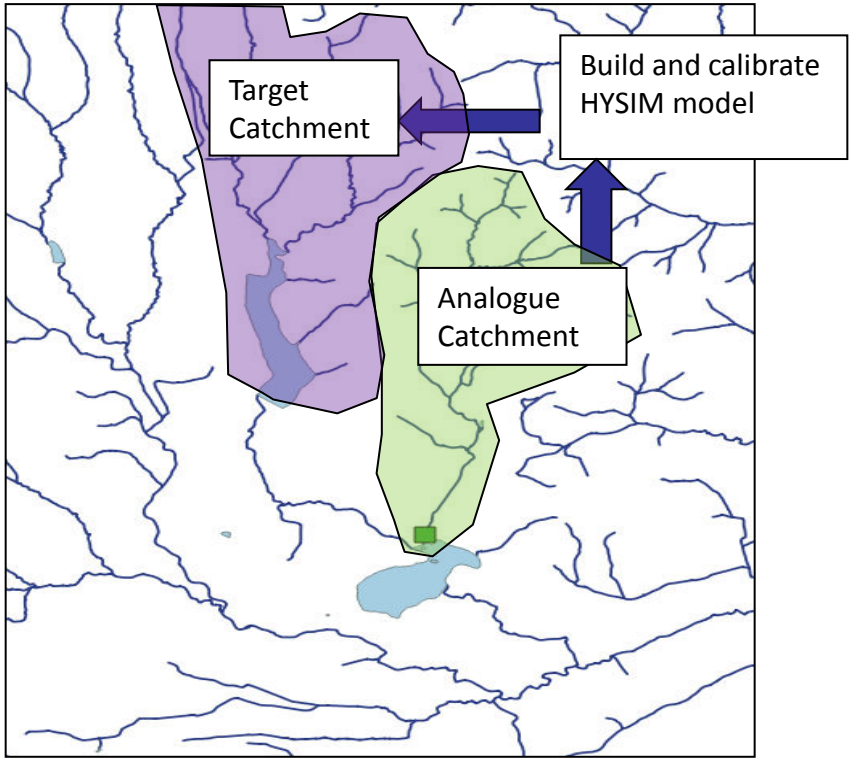
Analogue Gauges



- Analogue flow gauges are flow gauges that are near an ungauged catchment of interest and have similar (analogous) hydrological characteristics to the catchment of interest and more than 7 years of data
- Analogue gauges can provide valuable hydrological information about SW sources that they are analogous to
- But…the reliability of that information is proportional to the similarity of the analogue catchment to the catchment of interest

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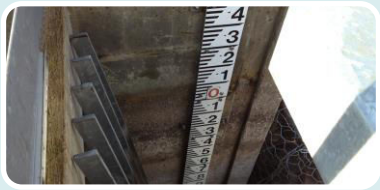

The current hydrometric network

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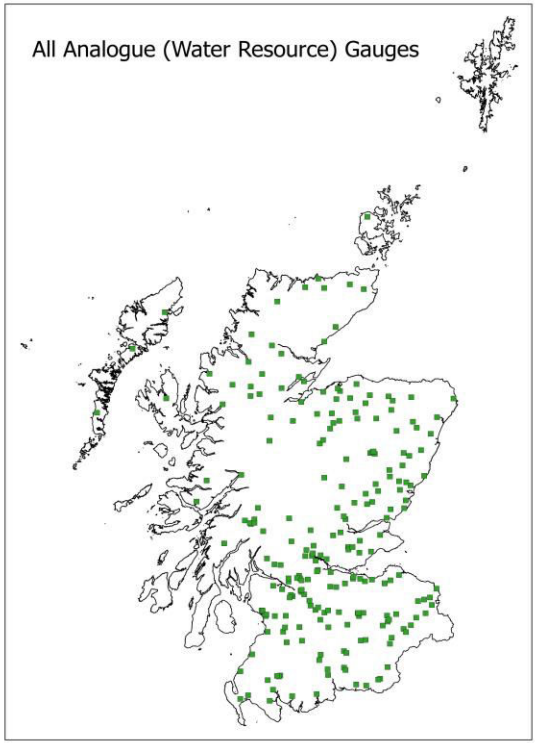
Current hydrometric network



- 396 river gauging stations
- [redacted]
- Approximately 225 suitable for water resource use

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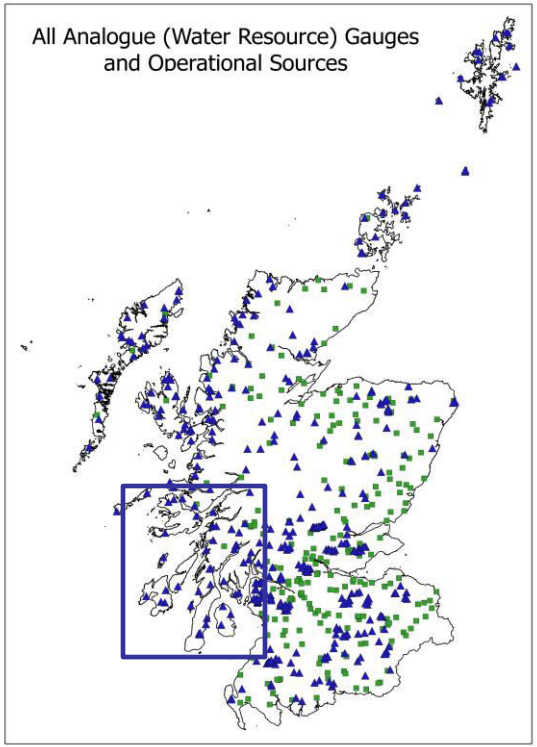
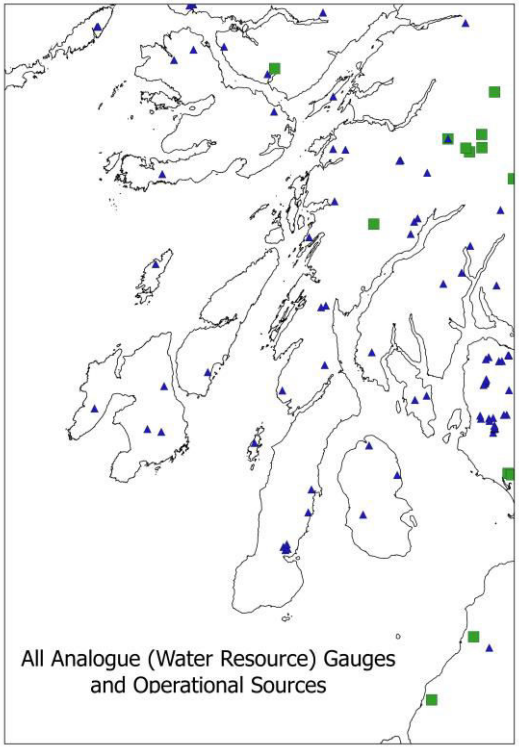
Current hydrometric network in relation to water sources





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Scottish Water SR15
Flow Gauging Strategy

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SR15 flow gauging strategy

- Installation of river flow gauges to reduce uncertainty and improve long term evidence base for investment decisions

- Working from basis of existing SEPA hydrometric network

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Gauging strategy

Options for 'plugging the gaps' in the hydrometric network

- Permanent flow gauges at every source
- Permanent gauges at all sources except very small sources

  Both these options very expensive and would generate unnecessary data (poor value for money)

- Temporary flow gauging at all sources except very small sources

  Expensive, would not pick up on long term trends

- Preferred option = combination of long term analogue gauges and temporary gauges prioritised by locations where uncertainty in hydrology thought to be high.

Preferred option allows both yield improvement and climate change/trend detection

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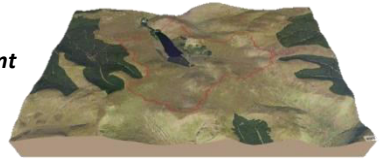
SEPA Analogue Selector Tool

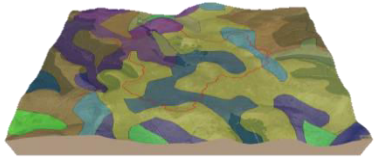
Catchment Data

Catchment Area



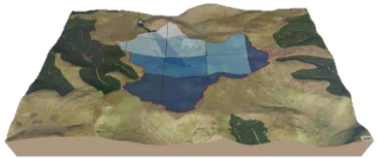
Area

Soils



BFI Host

Annual Rainfall



SAAR

Geographical Location

Distance

- Score for all 4 components calculated based on similarity to target catchment
- Weighted total calculated using different weightings for each component
- Total Confidence score calculated for each analogue gauge (100= best, 0 = worst)
- Best analogues ranked. Scores >70 selected

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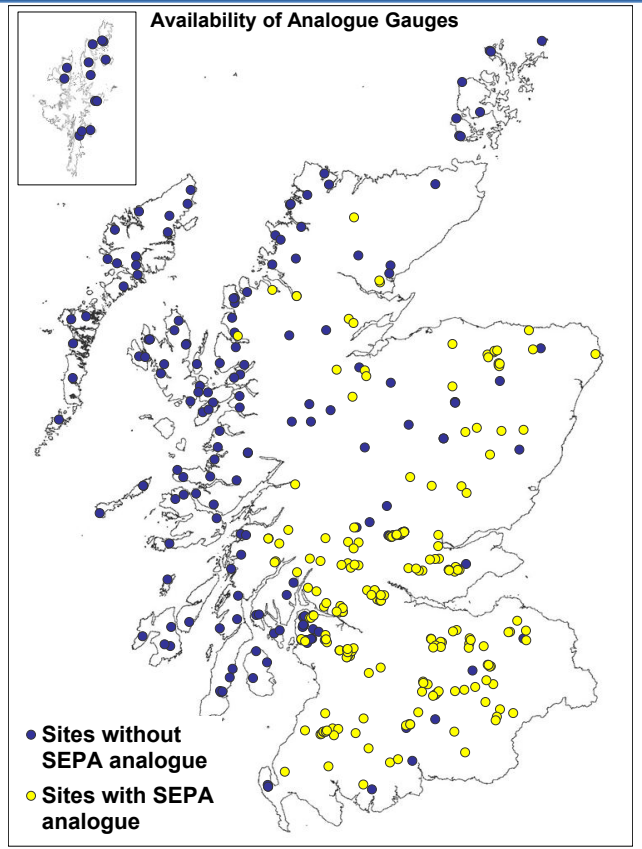
Sources with existing analogues



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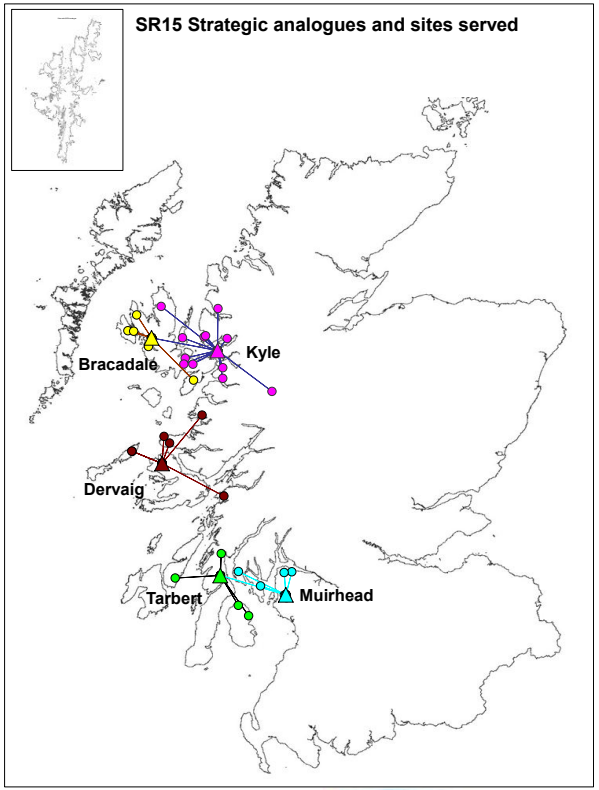
Analogue Site Selection

- Identify sources with no analogue which could act as an analogue for other target sites if gauge installed
- Rank sources according to the number of target sites they could serve
- Final selection based on rank, location/site suitability, and alignment with other investment projects
- Whole process aimed to maximise the hydrological (and financial) value of analogues by situating them in the optimal locations.



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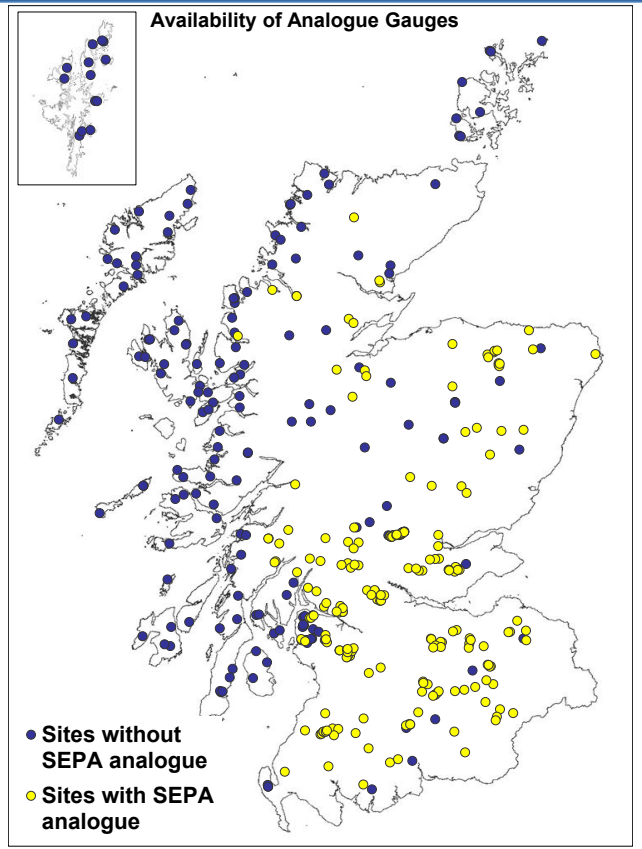
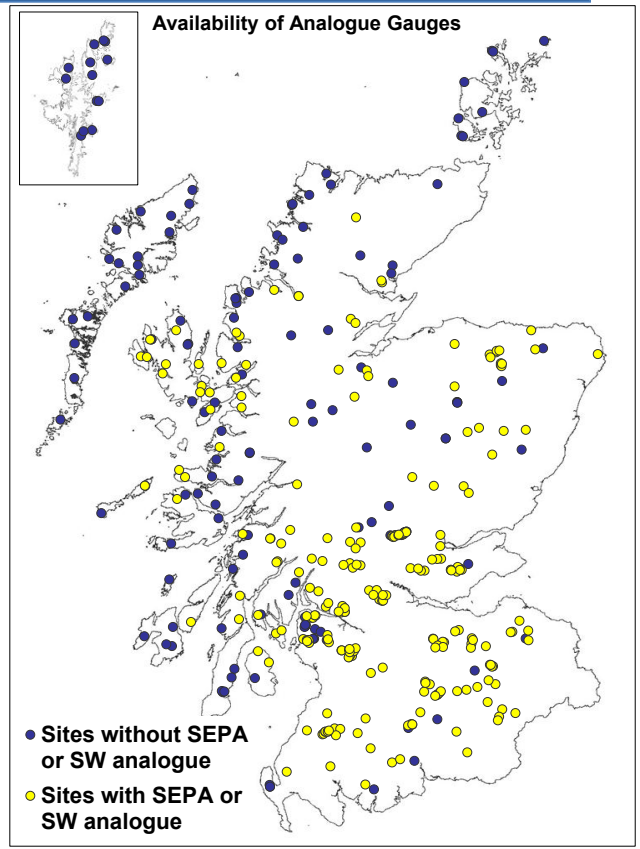
Sources with analogues before and after





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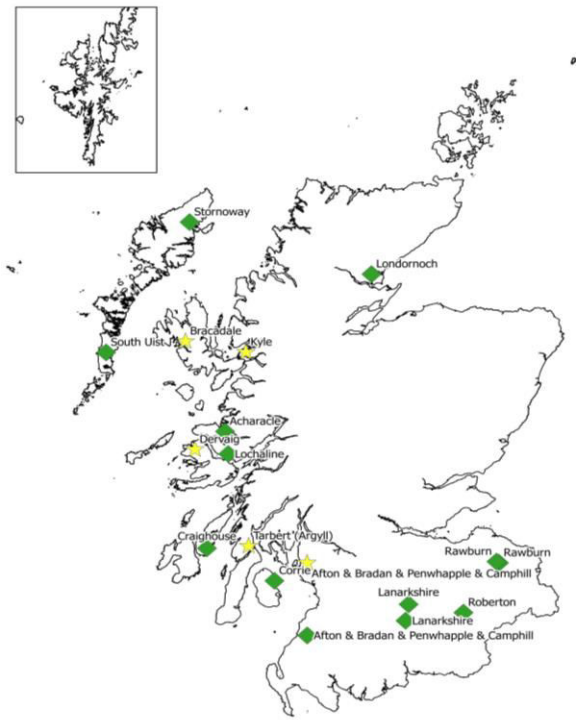
All SR15 flow gauging activities

- Five long term analogue flow gauges
- 13 temporary gauges
- Support investment projects (need to include growth driver)
- Improve our understanding of hydrology at sources where hydrological uncertainty deemed to be high and perceived supply demand balance is marginal



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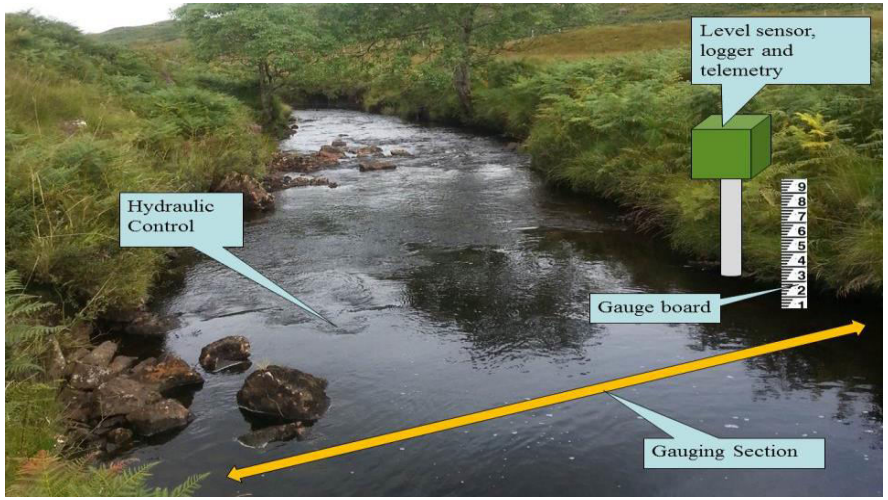
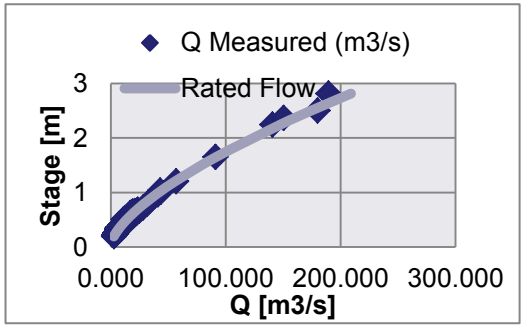
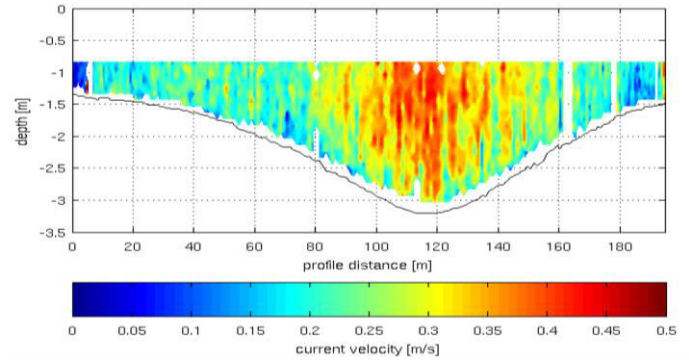
Flow measurement methods







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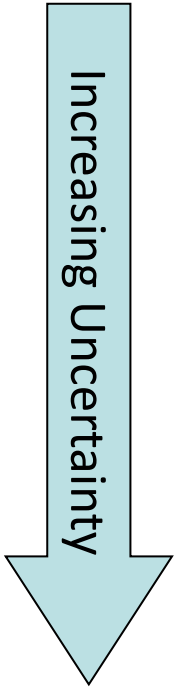
Reduction in uncertainty

Flow estimation method	Uncertainty in yield (+/- %)
Analogue upstream of source	10%
Good analogue and local temporary gauge	15 - 20%
Local temporary gauge only	25 %
No flow data (desk-top methods only)	30 - 40%



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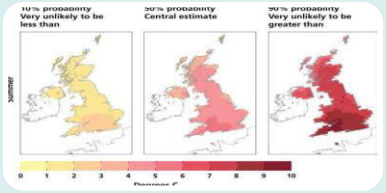

Climate Change

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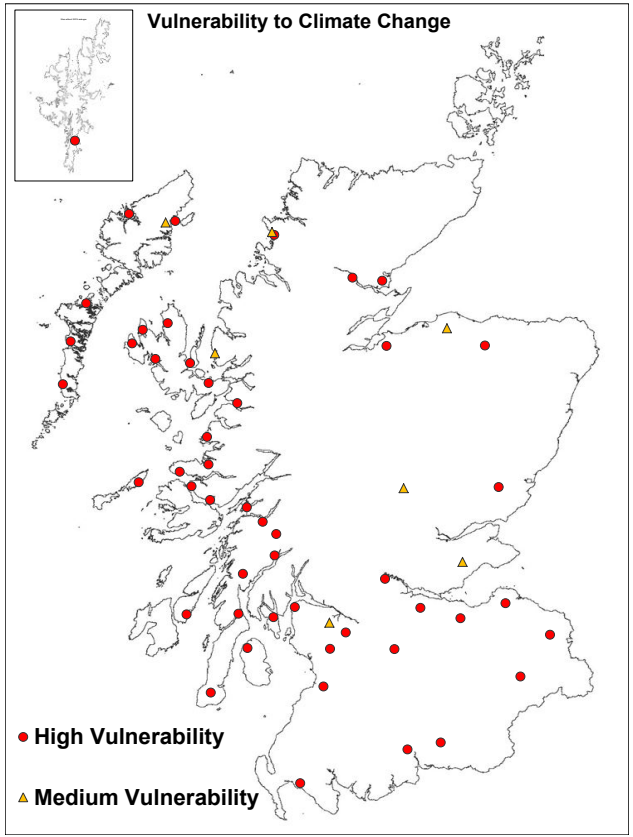
Vulnerability to Climate Change



- Initial assessment using UKCP09 Future Flows data
- Identified where changes to river flow would have impact on Deployable Output
- Classified as High, Medium or Low based on change to central estimate and Range of uncertainty
- 57 zones High or Medium requiring further analysis

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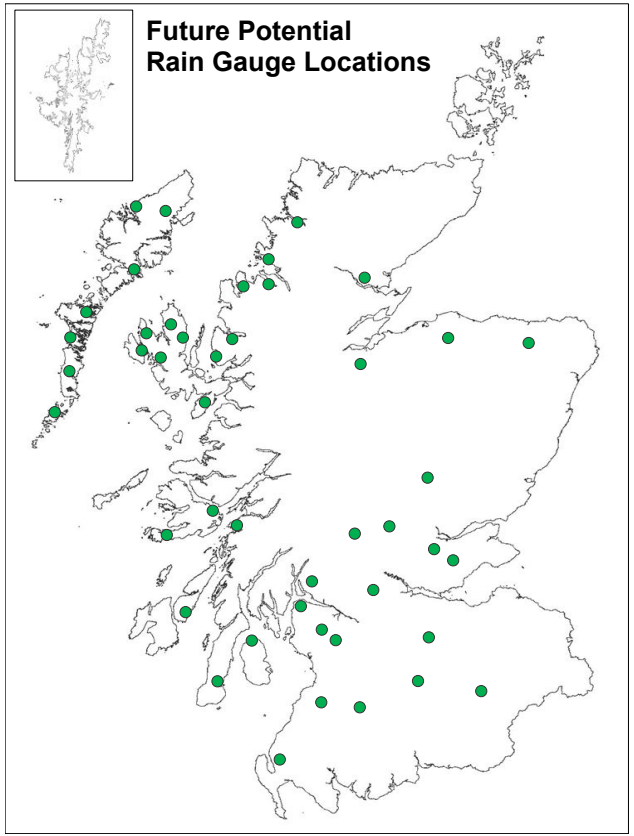
Rain Gauges for long term monitoring



- Identified Scottish Water sites which were >5km from nearest Met Office rain gauge
- Aim also for reasonable coverage of Scotland
- Secure locations to minimise vandalism
- 50 sites identified
- Exact locations to be confirmed by site visits

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Benefits and Conclusions

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Benefits

- Hydrological data collection results in greater certainty in our understanding of the quantity of water resources we can utilise for supply which contributes to greater certainty in our supply-demand balance methodology
- In turn our evidence base which underpins water resource investment is more robust
- Vital contribution to our aim that no customers will exercise long term supply interruptions by 2027 (all zones in surplus). **In the mean time, data is essential for producing robust drought plans**
- Detection of long term trends, climate change analysis etc
- Contribution to the wider field of hydrology

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Conclusions

- Scotland has a long pedigree of hydrological monitoring and survey, but despite this it is still a ‘data sparse environment’ from a water resource perspective
- Lack of data can hamper our efforts to reliably quantify the water resource that is available for supply. This means that the operation of our assets and investment decisions is underpinned by an uncertain evidence base
- Carefully targeted data collection can significantly reduce hydrological uncertainty
- Expansion of the existing hydrometric network will also increase our ability to assess and monitor climate change impacts on the water supply network

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Thank You

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