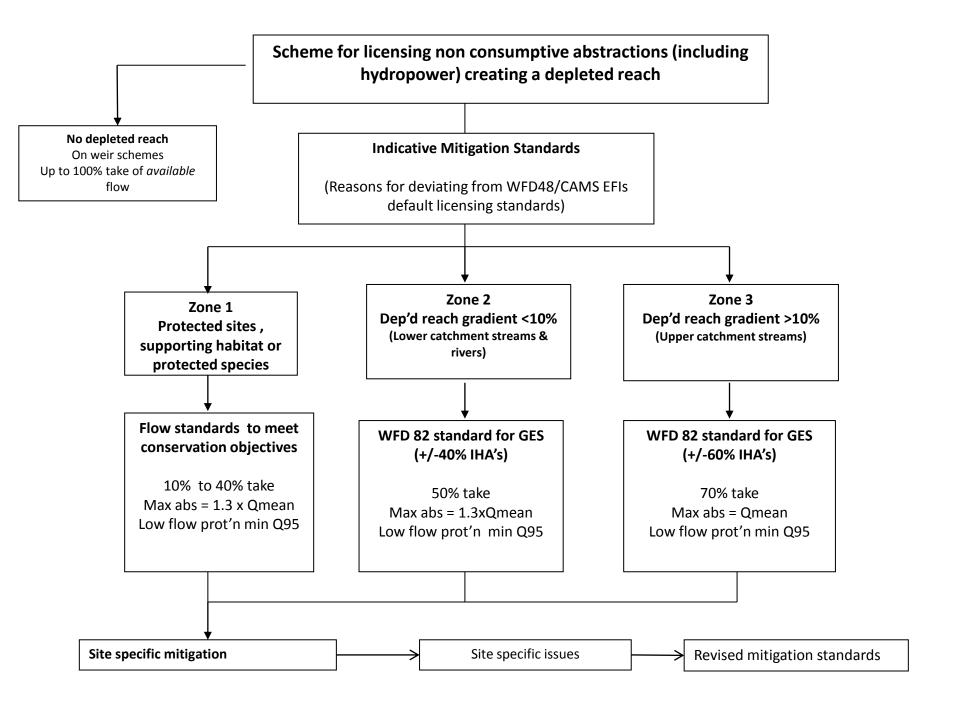


Developing an approach to regulate hydropower in Wales

G Carpenter Hydrology & Water Resources Management Team 27 September 2013







Ecological Limits to Hydrological Alteration

Uncertainty in quantifying river flow-ecology relationships

BUT

Ecosystems adapted to natural flow regimes



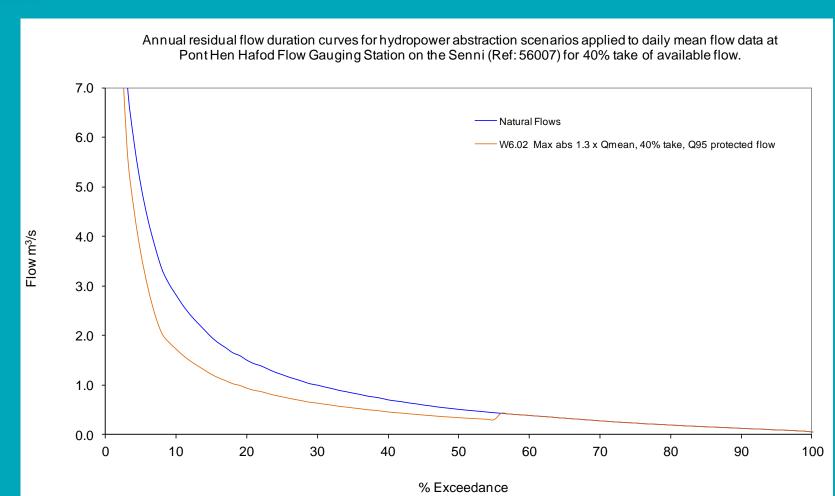
Restrict deviations from the natural flow regime



Ecological Limits to Hydrological Alteration (ELOHA)

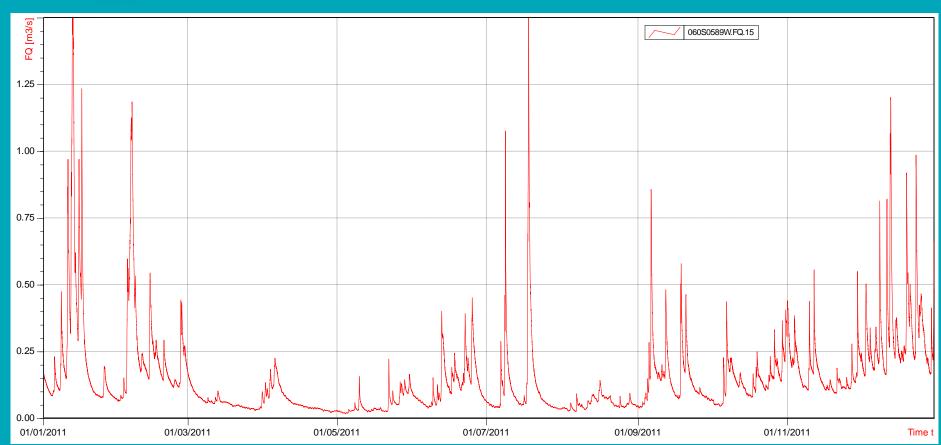


Flows as duration statistics





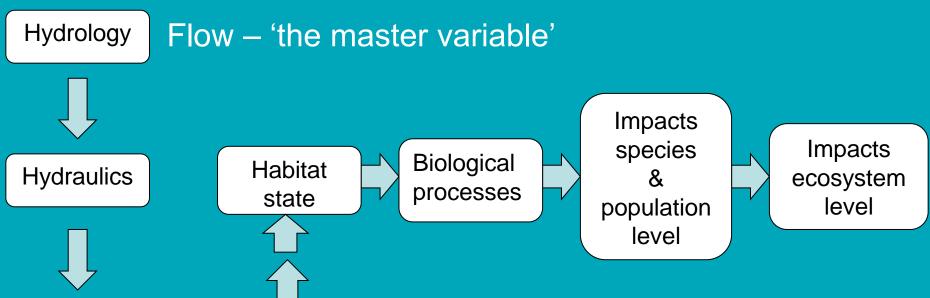
Annual Flow Hydrograph





Geomorphology

Impacts of hydrological change - conceptual model





Limits to hydrological alteration - how does this work?

Richters Indicators of Hydrological Alteration (IHA's)

Assessing deviation

UKTAG Standards (Water Framework Directive Report 82)

0-10% for protected areas and HES.

10-40% low risk of failing to achieve GES

40-80% moderate risk

>80% high risk



Mitigation principles for operational abstraction regimes

- Low flow protection HoF %ile
- Flow variability % take of available flow
- High flow protection maximum abstraction rate



Number of Low-Pulses Duration-Hi-Pulse Duration-Lo-Pulse

Mean-increase Mean-decrease No-rises

Group 5: Rate and frequency of change in conditions

Indicators of Hydrological Alteration

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Richter IHAs					
Group 1: Magnitude of month	.nly water conditions				
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Jeo III. Cari	25			1	
Group 2: Magnitude and dura	ation of annual extremes				
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-oay-minimum now -day-maximum flow	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	10 10 10 10 10 10 10 10 10 10 10 10 10 1	21 0 0 11 0 0 45 0 13 21 01 05 05 05 05 05 05	20 20 20 20 20 20 20 20 20 20 20 20 20 2
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50-day-maximum flow	10 -10 -20 -20 -10 -10 -10 -10 -10	6 4th 4th 4th 4th 4th 4th 4th 4th	-ch	The state of the s	-ch -ch -ch -ch -ch -ch -ch -ch -ch
90-day -minimum flow 90-day -maximum flow	475 -186 -185 -186 -185 -185 -185 -185 -185 -185 -185 -185	A 40 40 40 40 40 40 40 40 40 40 40 40 40	The state of the s	-ch	- m - ch -
Zero-flow days	475 427 425 425 425 425 425 425	473 -423 -475 -425 -425 -425 -425 -425 -425	at at at at		on the second second second
Group 3: Timing of annual ext	adrem es				
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	ration of high and low pulses (flows above Qn25 and	September 1997 August 1997	Acres and the second se	War and the same of the same o	And the second second
Number of High-Pulses	ch -1th -1th -1th -1th -1th -1th -1th	of of oth off off at at oth oth	-orb -orb -orb -orb -orb -orb -orb -orb	ork out out out to out out	-m 4n 4n -m -m -m -m -m



Spatial Approach



Wales scale





High value ecosystems - protected sites



Maintaining ecosystem connectivity

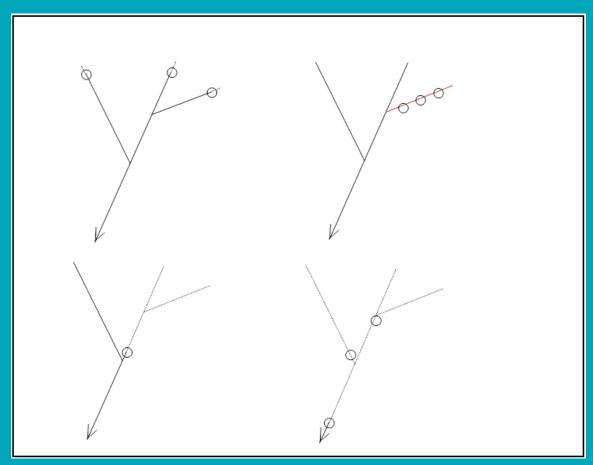


Minimising spatial impact

Managing risk



Minimising spatial impact



Sources: CCW Guidance on Small Scale Hydro Electric Power (HEP) Schemes 2011 CCW Science Report No. 932 Landscape Connectivity of Freshwater Ecosystems: Strategic Review and Recommendations

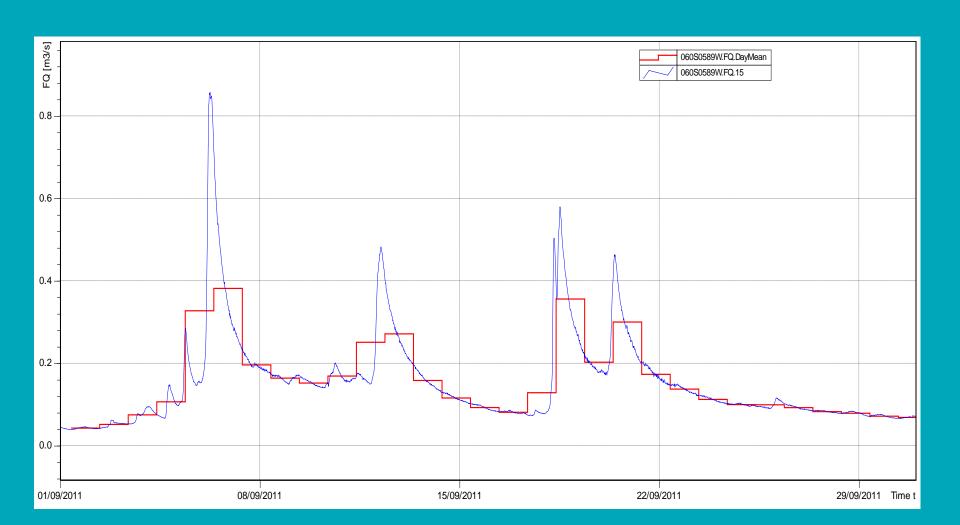


Zoning: Channel location & typology

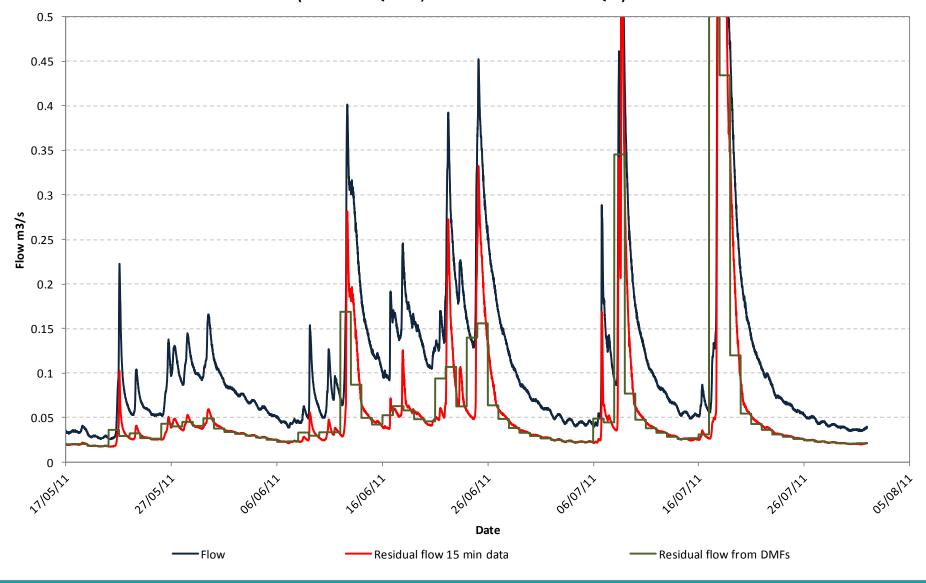
- Varying responses to abstraction
- Flashy upland hydrological regimes
- Assessment criteria
- Stream bed gradient
- GIS mapping digitised river network
- Zoning

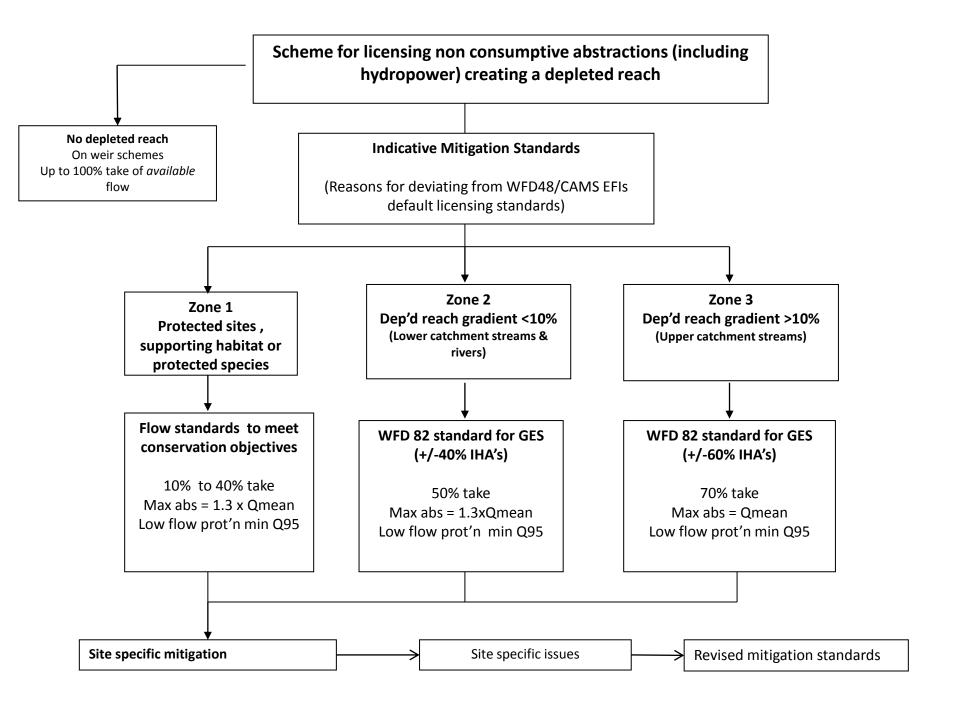


Hydrograph – small catchments data resolution



Plot showing comparison between use of 15 min date and DMFs at Brianne Flume to calculate residual flows (Max abs = Qmean, 70% take above HoF of Q95)







Finally...

- The start point
- Balance between environment & abstraction
- ELOHA approach flexibility & adaptive management
- Ecological monitoring required to collect empirical data
- Longer term development of regional flow requirements