

HYDROMETRIC DATA: THE LONG VIEW

User Perspective #2

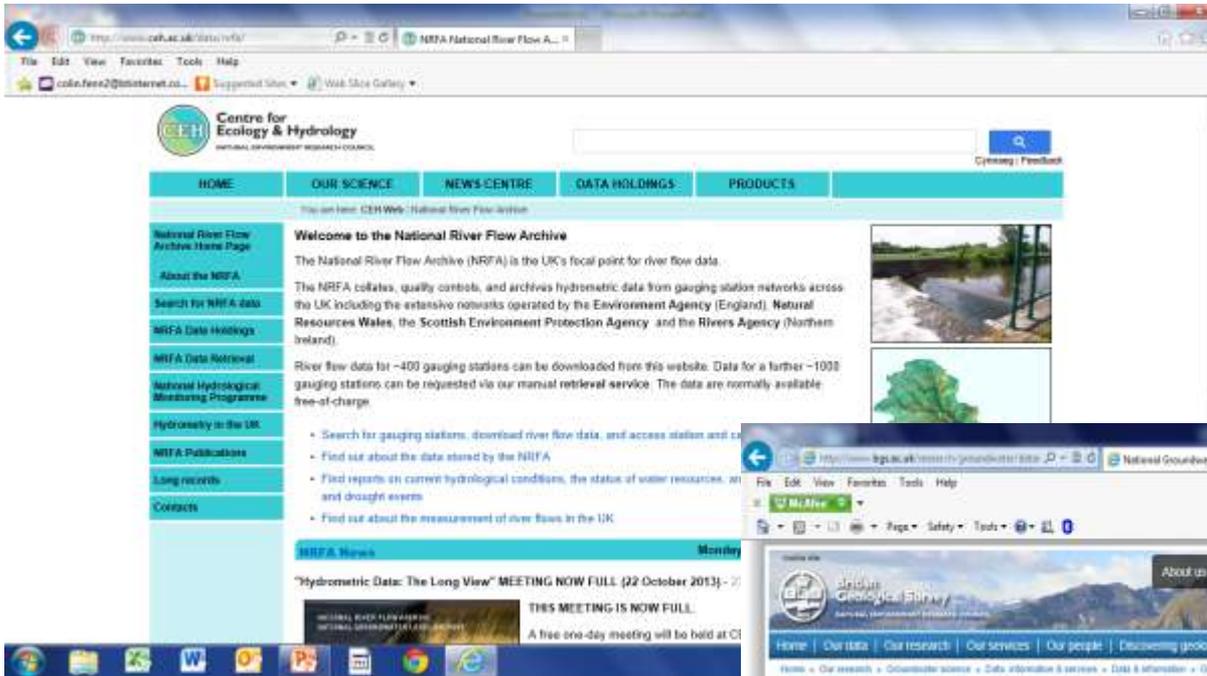
How NRFA/NGLA data support the needs of the UK water sector

Dr Colin Fenn

MD, Hydro-Logic Services LLP

Chair, CIWEM Water Resources Panel; SAGA Committee Member

How NRFA/NGLA data support the needs of the UK water sector: AN INDISPENSIBLE RESOURCE



Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Welcome to the National River Flow Archive

The National River Flow Archive (NRFA) is the UK's focal point for river flow data. The NRFA collates, quality controls, and archives hydrometric data from gauging station networks across the UK including the extensive networks operated by the Environment Agency (England), Natural Resources Wales, the Scottish Environment Protection Agency and the Rivers Agency (Northern Ireland).

River flow data for ~400 gauging stations can be downloaded from this website. Data for a further ~1000 gauging stations can be requested via our manual retrieval service. The data are normally available free-of-charge.

- Search for gauging stations, download river flow data, and access station and catchment information
- Find out about the data stored by the NRFA
- Find reports on current hydrological conditions, the status of water resources, and drought events
- Find out about the measurement of river flows in the UK

NRFA News | Monday

"Hydrometric Data: The Long View" MEETING NOW FULL (22 October 2013)

THIS MEETING IS NOW FULL. A free one-day meeting will be held at CEH Wallingford on 22 October 2013.



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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National Groundwater Level Archive

We operate the National Groundwater Level Archive (NGLA) from our Wallingford office. The NGLA is part of the National Water Archive, which we run with our sister organisation the Centre for Ecology and Hydrology.

Where do the groundwater level data come from?

The NGLA contains groundwater level data from a range of sources:

- the observation borehole network
- research monitoring sites operated by BGS/NERC (e.g. Colbitz field observatory)
- data from academic research projects funded by NERC

How are groundwater levels measured?

Groundwater levels are measured manually using a dipper or automatically by a pressure transducer. Automatic readings may be stored in a datalogger that is visited periodically and downloaded by field staff, or sent automatically over the phone network to a database in a data centre (telemetry). However, errors in groundwater level measurement can occur.

The observation borehole network

The groundwater observation borehole network comprises 181 sites: 166 in England, three in Northern Ireland and one in Scotland.

See also

- Groundwater levels home
- Data, information and services

Data

- Accessing groundwater level data
- Sites with water levels

External links

- Monthly Hydrological Summary for the UK
- National Water Archive

Contact

- Andrew McKenzie

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SUPPORTING REAL, PRESSING & GROWING NEEDS ACROSS THE UK WATER SECTOR ...



WHY: DOES THE UK NEED A NATIONAL RIVER FLOW ARCHIVE?

BECAUSE: ACCESS TO NATIONAL HYDROMETRIC DATA IS VITAL FOR EFFECTIVE WATER RESEARCH AND MANAGEMENT

What does the NRFA do?

The NRFA underpins hydrological research and water-management activities in the UK, and delivers data and expertise to UK Government and international organisations. The NRFA:

- Acts as the main focal point for hydrometric data in the UK
- Provides access to river flow data from over 1,500 gauging stations across the UK
- Offers independent, authoritative commentary on current hydrological conditions
- Supports the hydrometric monitoring activities of our partner organisations

How do we do it?

We integrate national hydrometric data from partners in the UK measuring agencies and provide long-term stewardship for national hydrometric data assets.

We operate the National Hydrological Monitoring Programme, to enable us to assess current water resources status and to examine evidence for change in long-term hydrological datasets.

We also:

- Validate river flow data to enhance quality and completeness
- Guide the evolution of the UK hydrometric network
- Develop and improve operational practices for hydrometric data management
- Design software for processing, visualisation and analysis of hydrological data
- Help UK Government meet water resources reporting obligations
- Deliver UK data to international data-sharing initiatives



What can we offer?

NRFA delivers hydrometric data and analysis to a wide range of users, including UK government departments, academia, consultancies and the water industry. NRFA services include:

- Daily mean flow data for rivers across the UK
- Catchment rainfall and spatial information to support river flow interpretation
- A Hydrometric Register and web-based portal cataloguing gauging stations on the NRFA
- Monthly Hydrological Summaries for the UK and Annual Hydrological Reviews
- Reports on major floods and droughts
- Information on long-term hydrological trends in the UK
- Advice on hydrometric data management practices
- Hydrological expertise and advice for the general public and media

How to access the NRFA

- The NRFA website <http://www.ceh.ac.uk/data/nrfa/> provides access to data, reports and other services
- A data-retrieval and enquiries service offers access to data and hydrological advice by phone (+44 (0)1491 692599) or email (nrfa@ceh.ac.uk)

Who are our partners?

The NRFA is steered by a network of hydrometric stakeholder organisations, comprising:

- Natural Environment Research Council (including the Centre for Ecology & Hydrology and British Geological Survey)
- Defra and the devolved administrations
- UK hydrometric and meteorological measuring agencies: EA, SEPA, Rivers Agency, Met Office
- British Hydrological Society/CIWEM
- UK Water Industry



How NRFA/NGLA data support the needs of the UK water sector:

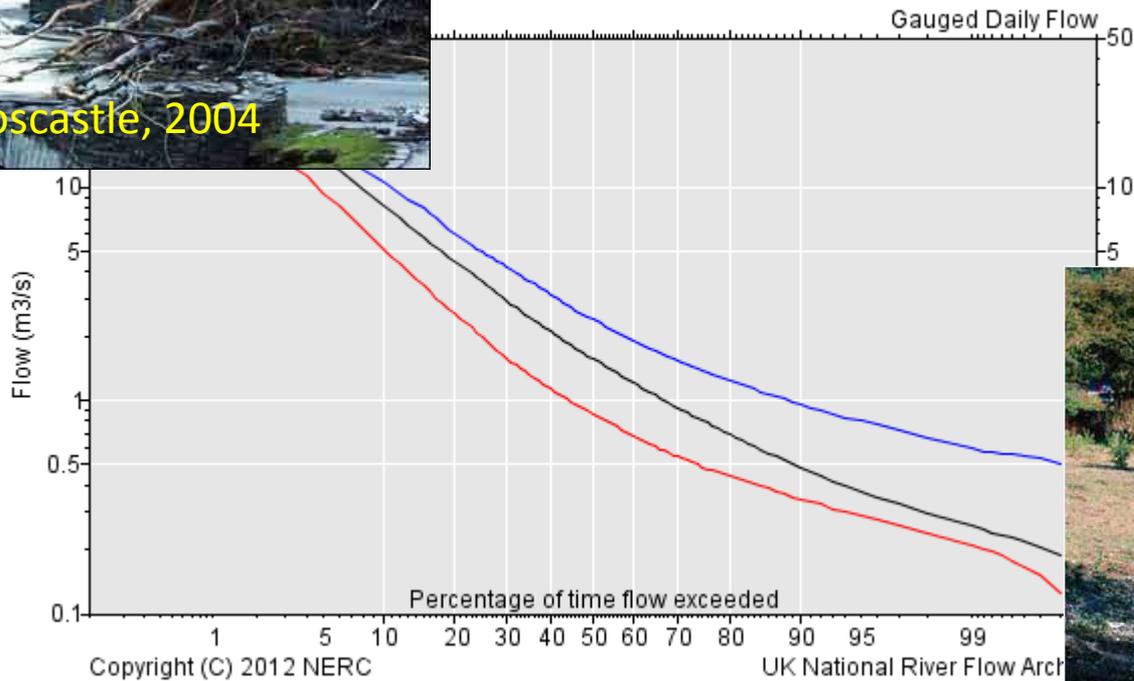
THE WATER SECTOR INCLUDES ...

The Water Sector:		WRM	FRM	WQ	WWM	UD	DWq
Water & sewerage companies	Water & sewerage companies	y	y	y	y	y	y
	Water only companies	y		y			y
EA	EA	y	y	y	y	y	y
	Ofwat	y	y	y	y		y
	DWI						y
Contractors	Contractors	y	y	y	y	y	y
	Product manufacturers						
	Consultants	y	y	y	y	y	y
	Researchers	y	y	y	y	y	y
	Defra	y	y	y	y	y	
	DECC	y	y				
	dCLG	y	y		y	y	
	Local government		y		y	y	
	NGOs	y	y	y	y	y	
	Environmental groups	y	y	y	y	y	
Households	Households	y	y				y
	Business	y	y	y	y		
	Agriculture	y	y	y	y		
	Power	y	y	y	y		

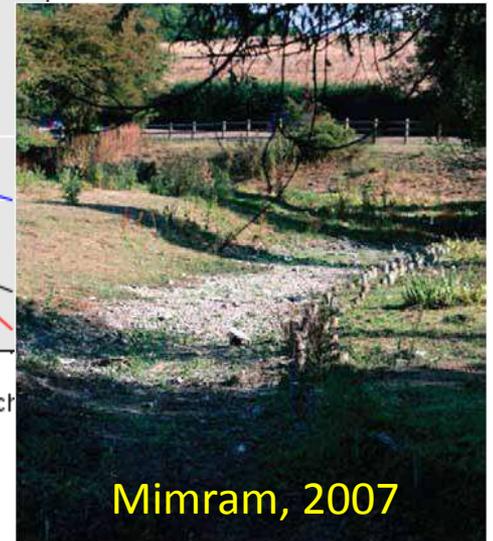
How NRFA/NGLA data support the needs of the UK water sector: WHERE NRFA/NGLA DATA COME IN



Hi-Flows + FEH/WINFAP + ReFH
+ NRFA for context, catchment data



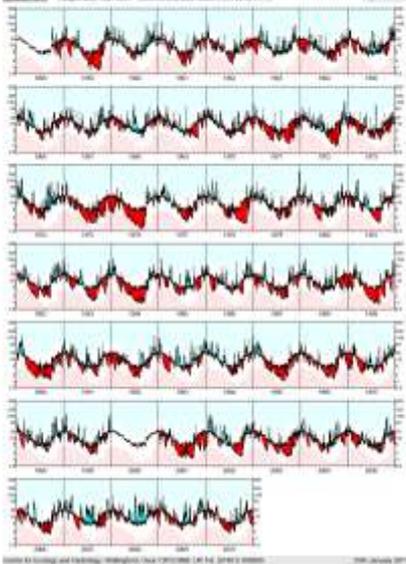
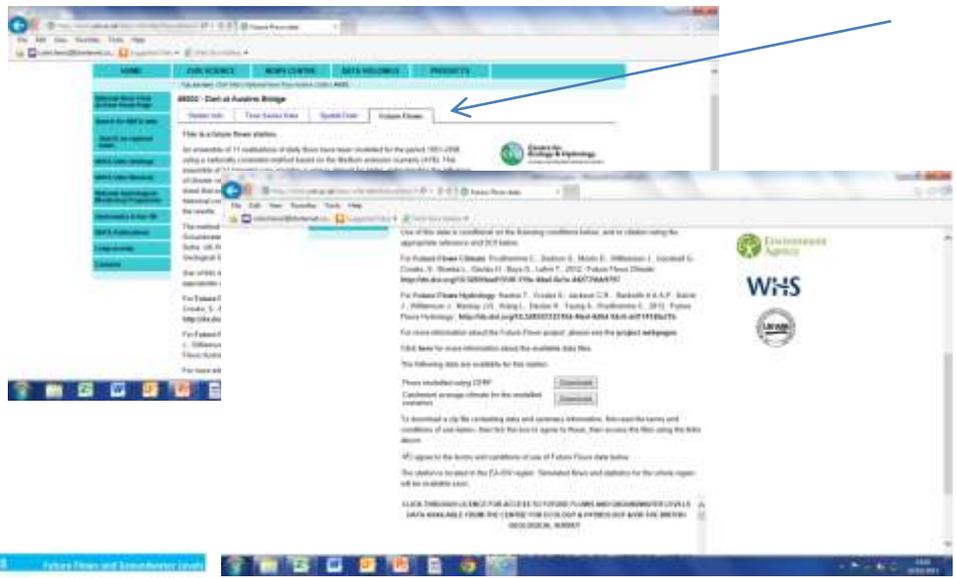
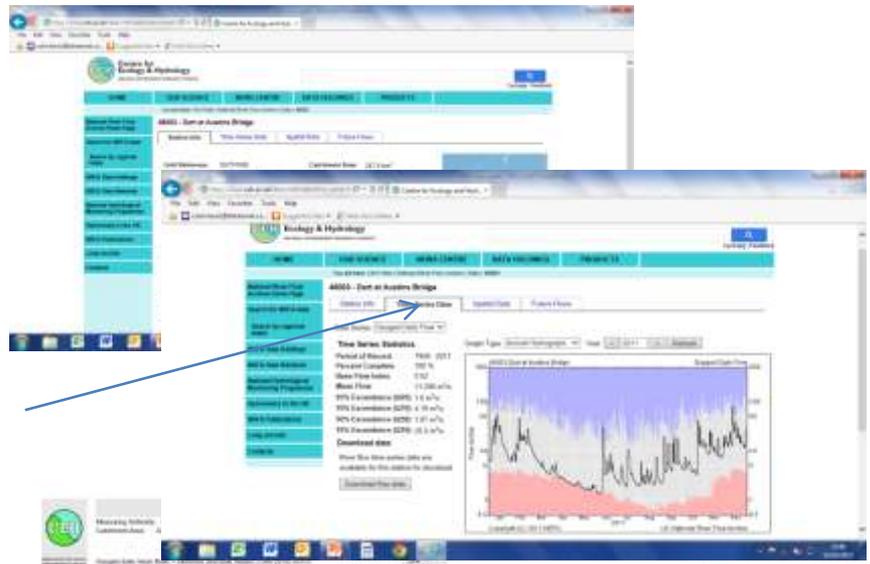
NRFA for gauged & naturalised flow data,
NGLA for gw level data



Providing essential data - accessible, downloadable on-line, free
Complementary data from other sources

How NRFA/NGLA data support the needs of the UK water sector:

INFORMING & ENABLING: SITE SPECIFIC DATA....



EVIDENCE FROM THE PAST



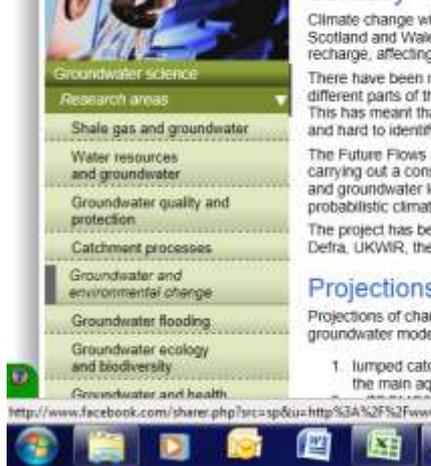
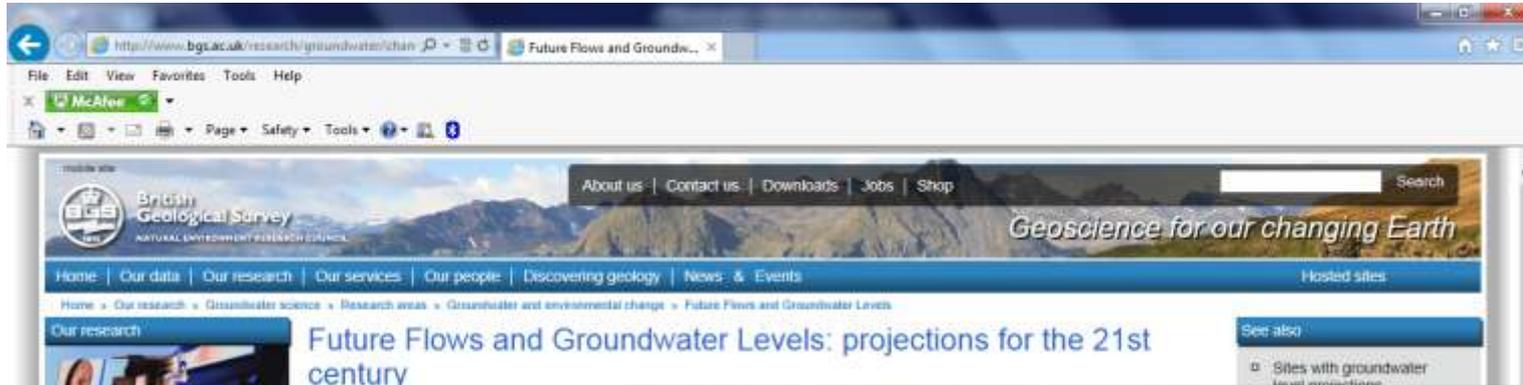
change factors

Catchment:HydroCode	FF-Model1	FF-Model2	FF-Model3	FF-Model4	FF-Model5	FF-Model6	FF-Model7	FF-Model8	FF-Model9	FF-Model10	FF-Model11	
46000 CDFP	01/01/1951	14,002	21,405	21,672	4,301	11,236	10,657	30,255	22.3	10,244	9,904	44,469
46000 CDFP	02/01/1951	10,013	28,003	30,004	4,205	9,698	11,997	24,777	14,863	9,889	11,768	55,838
46000 CDFP	03/01/1951	7,819	33,320	31,826	4,214	7,292	8,308	36,885	10,829	12,213	10,416	50,880
46000 CDFP	04/01/1951	6,818	43,966	31,111	4,660	6,251	24,309	31,726	8,267	11,229	11,849	48,277
46000 CDFP	05/01/1951	26,894	26,113	26,895	1,943	3,122	31,415	29,208	8.7	30,825	24,309	38,118
46000 CDFP	06/01/1951	27,415	27,444	31,876	1,828	22,217	57,467	21,209	6,878	29,125	13,811	33,815
46000 CDFP	07/01/1951	11,941	42,864	31,876	1,743	34,348	4,607	22,818	3,398	3,547	41,696	8,271
46000 CDFP	08/01/1951	20,473	27,796	28,52	1,878	36,254	41,952	15,519	10,504	12,972	10,272	25,524
46000 CDFP	09/01/1951	30,024	40,794	17,642	4,231	22,498	20,148	4,814	8,911	9,209	10,571	16,499
46000 CDFP	10/01/1951	18,011	26,713	11,818	1,809	29,793	17,227	40,821	9,965	8,848	26,816	13,891
46000 CDFP	11/01/1951	10,923	17,403	23,388	1,540	33,488	22,438	43,308	9,867	6,376	17,815	16,202
46000 CDFP	12/01/1951	38,718	11,834	42,00	1,301	27,827	9,403	25,408	6,889	3,552	15,88	15,412
46000 CDFP	01/01/1952	89,072	26,740	29,127	1,340	61,174	7,706	16,500	5,504	9,358	25,948	10,808
46000 CDFP	02/01/1952	11,941	42,864	31,876	1,743	34,348	4,607	22,818	3,398	3,547	41,696	8,271
46000 CDFP	03/01/1952	95,502	11,832	11,829	1,076	29,474	9,900	34,899	6,711	5,900	24,442	1,271
46000 CDFP	04/01/1952	41,902	12,418	30,494	2,74	18,442	1,348	30,868	6,548	5,200	22,842	6,927
46000 CDFP	05/01/1952	28,391	18,812	17,116	1,820	11,801	23,310	24,318	18,801	4,308	11,816	5,922
46000 CDFP	06/01/1952	58,209	28,277	49,19	1,72	8,729	59,404	16,78	10,878	4,601	23,817	1,306
46000 CDFP	07/01/1952	17,605	38,405	25,815	2,637	7,178	34,339	11,890	8,226	4,454	18,242	5,58
46000 CDFP	08/01/1952	38,044	11,800	34,121	2,508	17,111	21,008	10,574	11,512	4,209	36,118	16,517
46000 CDFP	09/01/1952	17,79	71,73	41,612	2,481	12,257	14,295	16,111	1,938	4,892	11,819	30,575
46000 CDFP	10/01/1952	34,579	40,422	66,218	2,470	14,309	10,829	10,594	13,938	4,812	24,567	9,298

daily estimates, 1951 to 2098

PROJECTIONS FOR POSSIBLE FUTURES (FF&GWL, 11 models)

How NRFA/NGLA data support the needs of the UK water sector: GROUNDWATER, TOO....

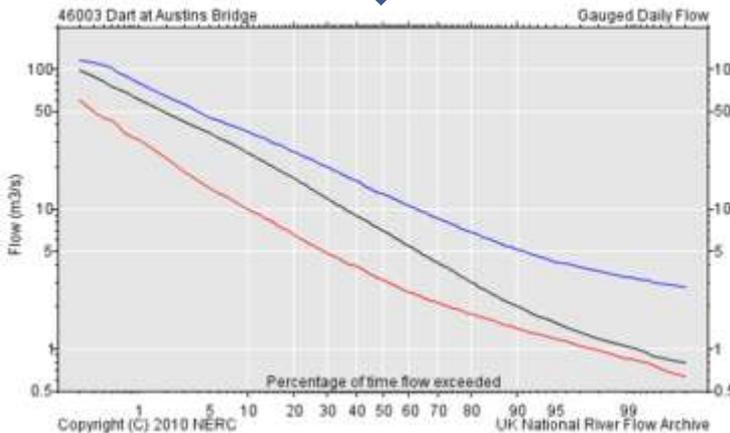
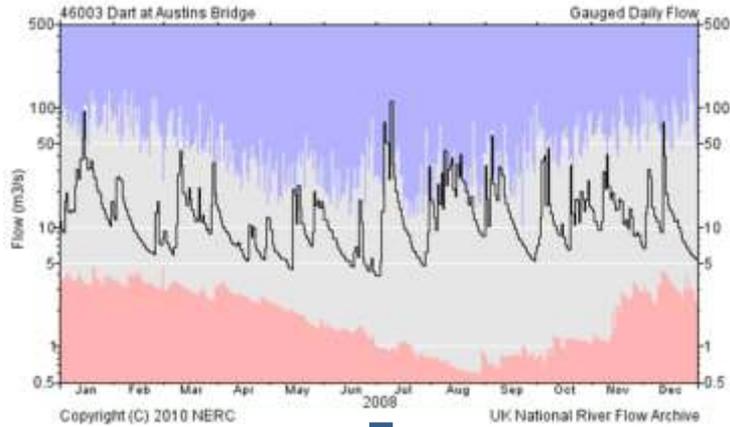


ILLUSTRATIVE APPLICATIONS OF THE USE OF NRFA/NGLA DATA IN THE UK WATER SECTOR

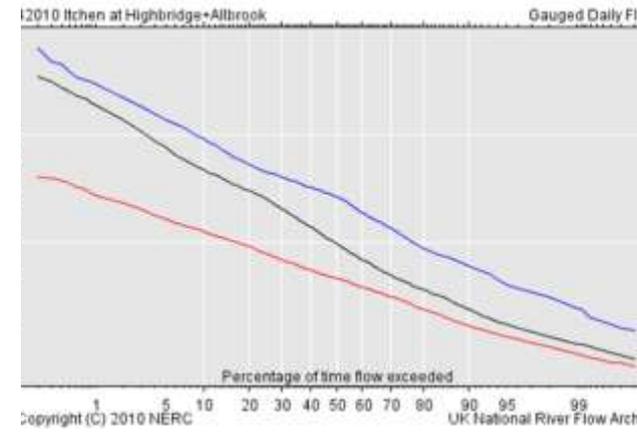
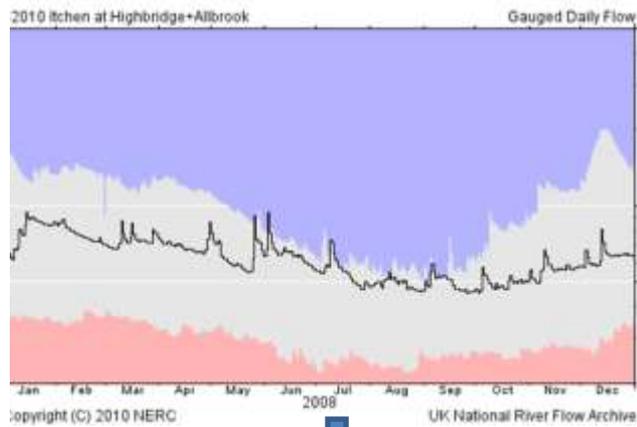
1. Variability
2. Yield (Deployable Output) determinations
3. Environmentally-sensitive abstraction management (AIM)
4. Drought management
5. Water Resources Policies for the future

How NRFA/NGLA data support the needs of the UK water sector:

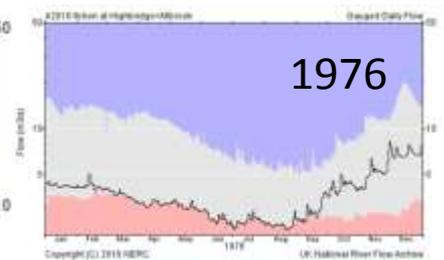
VARIABILITY



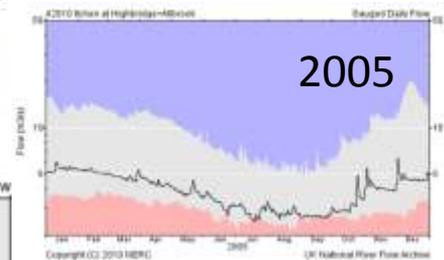
Dart at Austins Bridge



Itchen at Highbridge & Allbrook



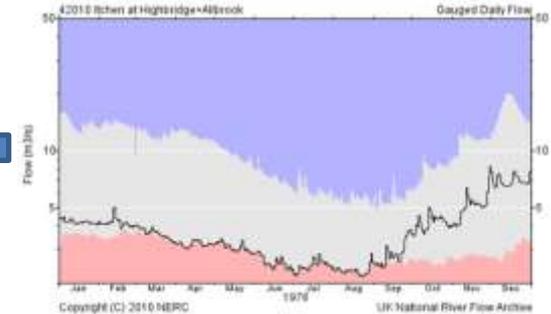
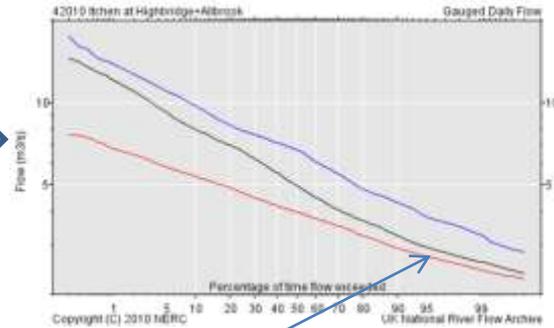
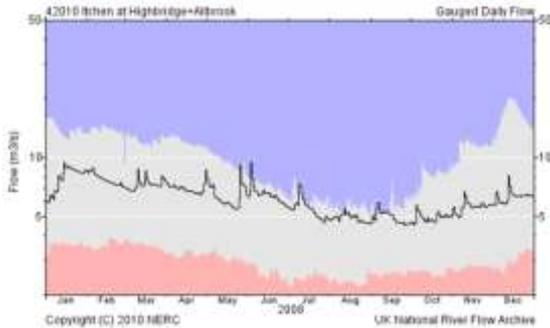
1976



2005

How NRFA/NGLA data support the needs of the UK water sector:

YIELD & DEPLOYABLE OUTPUT DETERMINATION 2



First estimate of hydrological yield (for the source)

DO varies with drought severity – should be reported for a range of Return Periods

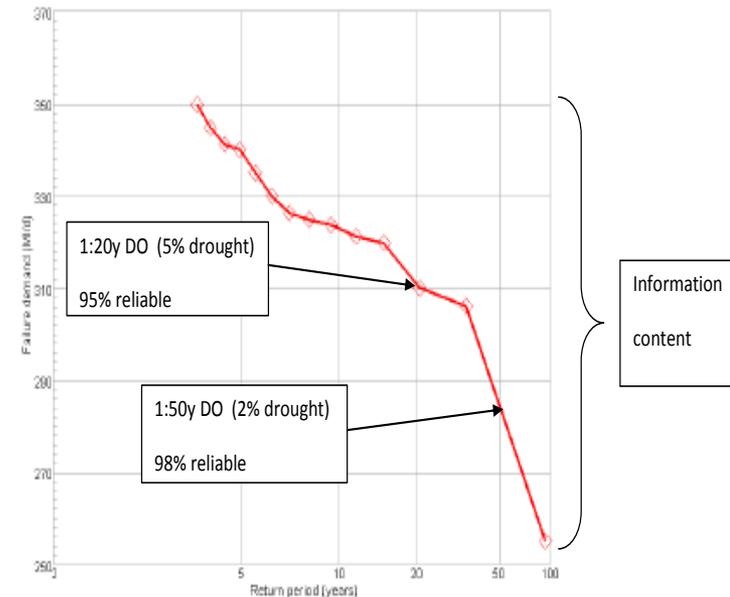
Integrated (conjunctive) DO of all sources in WRZ, across a range of RPs, taking account of system, licence etc constraints, & use of demand restrictions & licence relaxations

Determined by WR system models (Aquator, Miser, WRAPsim)



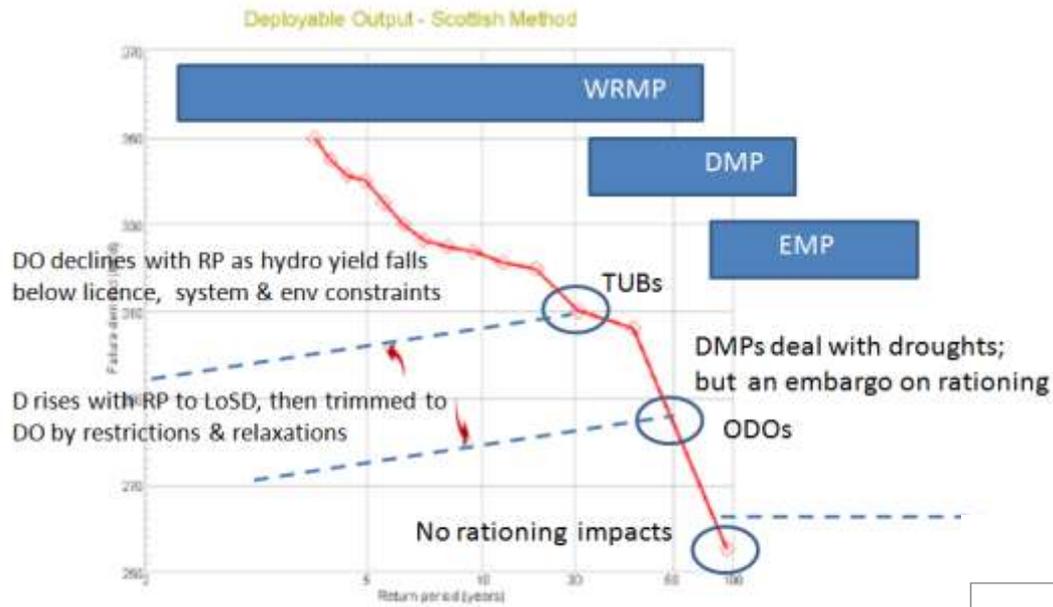
Start:	1955		
End:	2006		
Duration (y):	52		
Return Period of failure	DO	Reliability %	
y	Ml/d	p LT (%)	p GE (%)
5	339.3	20.0%	80.0%
10	332.9	10.0%	90.0%
20	310.5	5.0%	95.0%
30	307.0	3.3%	96.7%
40	296.2	2.5%	97.5%
50	284.4	2.0%	98.0%
60	275.3	1.7%	98.3%
70	267.9	1.4%	98.6%
80	261.7	1.3%	98.8%
90	256.5	1.1%	98.9%

Deployable Output - Scottish Method



How NRFA/NGLA data support the needs of the UK water sector:

DO DETERMINATION

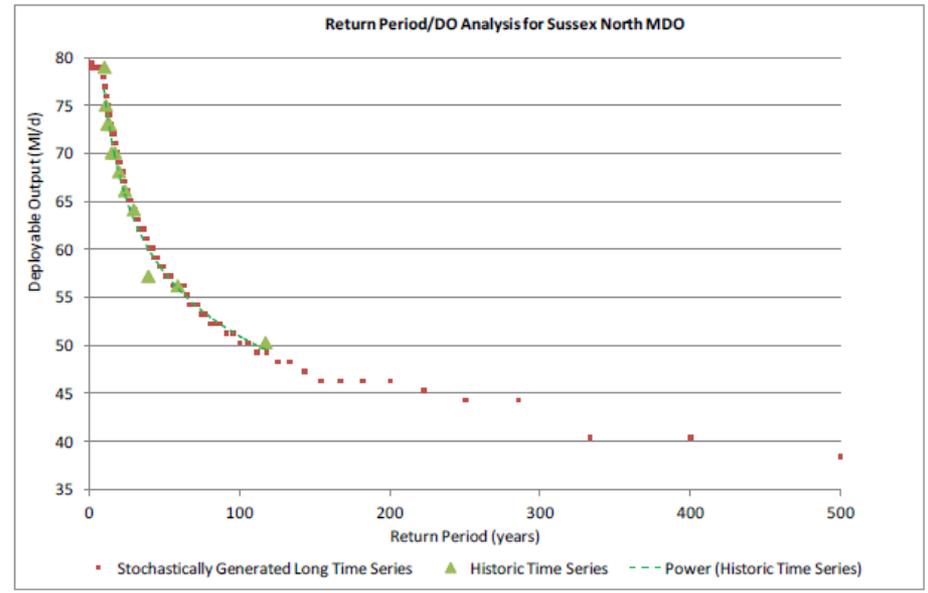


Long run historical data used to determine WR System DO for different RPs and LoS

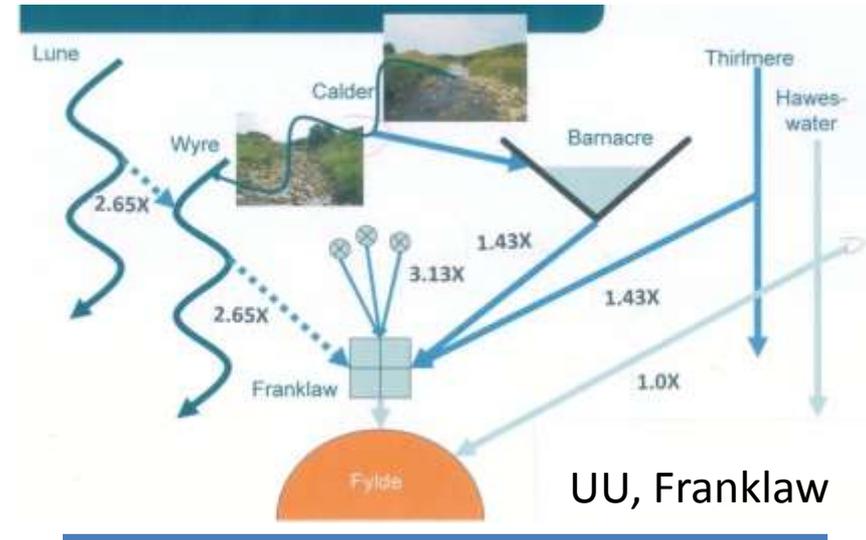
Figure 3.3 Example of historic versus stochastically generated droughts

SOUTHERN WATER, dWRMP 2013

Stochastic analysis of long run historical data used to generate extended series to determine system DO under extreme droughts, for resilience assessment



ABSTRACTION POLICY ANALYSIS: TESTING THE AIM FOR OFWAT



(a) United Utilities:

Franklaw sub-zone of Integrated Zone (Aquator)

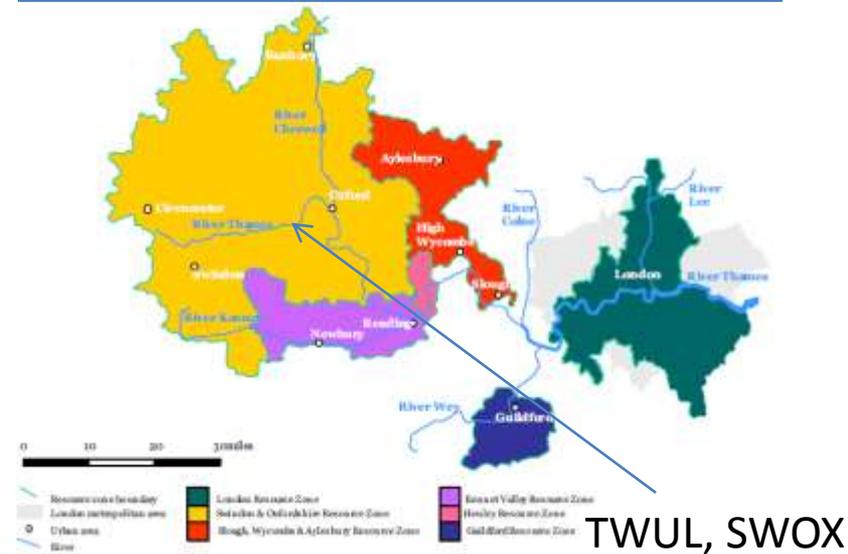
- Wyre @ Garstang, 1927-2010 (84y)

(b) Thames Water:

SWOX RZ (WARMS-VBA)

Aquator platform

- Thames @ Days Weir, 1938-2010 (73y)



TWUL, SWOX

How NRFA/NGLA data support the needs of the UK water sector: SOURCING DATA FOR ABSTRACTION POLICY MODELLING

The screenshot displays the NRFA data portal for station 39002 - Thames at Days Weir. The page features a navigation menu with options: HOME, OUR SCIENCE, NEWS CENTRE, DATA HOLDINGS, PRODUCTS, and CONTACTS. The main content area includes a search bar, a 'Time Series Statistics' table, and a 'Download data' section. A red arrow points to the 'Download flow data' button.

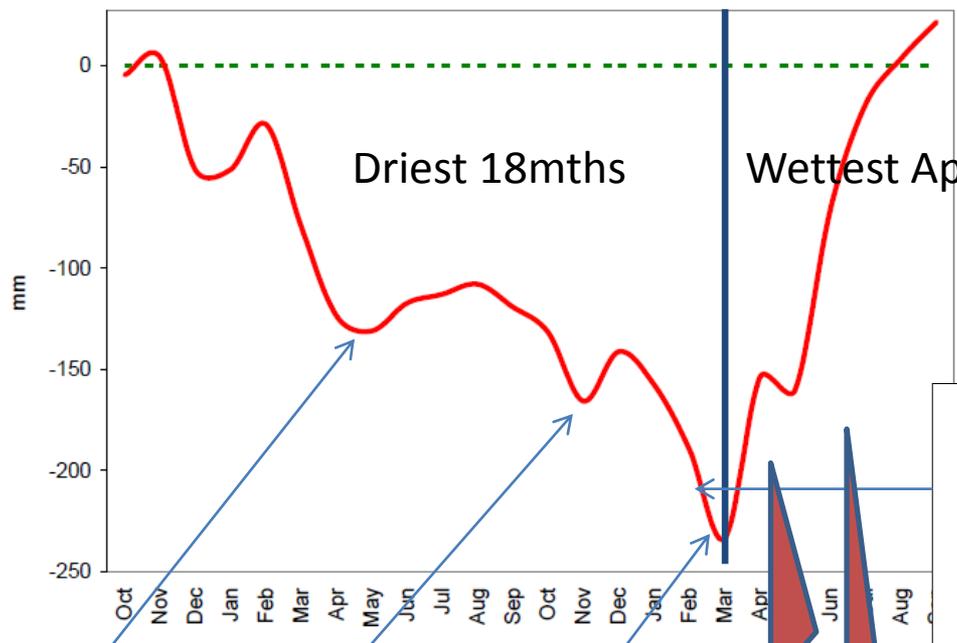
Time Series Statistics	
Period of Record:	1938 - 2012
Percent Complete:	100 %
Base Flow Index:	0.64
Mean Flow:	28.515 m ³ /s
95% Exceedance (Q95):	3.26 m ³ /s
70% Exceedance (Q70):	8.86 m ³ /s
50% Exceedance (Q50):	16.8 m ³ /s
10% Exceedance (Q10):	69 m ³ /s

Download data
River flow time series data are available for this station for download.
[Download flow data](#)

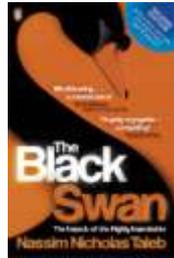
Graph Type: Flow Duration Curve
28052 Thames at Days Weir
Gauged Daily Flow
Flow (m³/s) vs Percentage of time flow exceeded
Copyright (C) 2013 NERC
UK National River Flow Archive

How NRFA/NGLA data support the needs of the UK water sector: DROUGHT MANAGEMENT

Figure 3.5 - Cumulative rainfall deficit plot from October 2010 to September 2012 relative to the 1961-1990 long term average for England and Wales¹



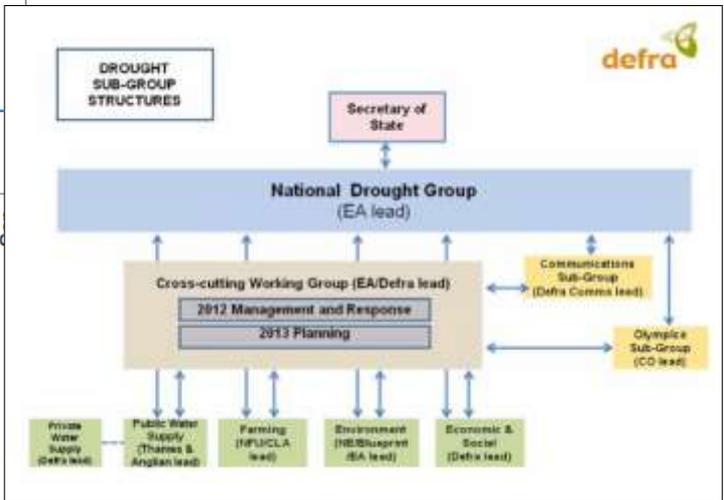
A positive Black Swan for WRM; a negative one for FRM



E&W: 8-12y
MIDS: 15-20y
ANG: 5-10y
TMS: 10-15y
WSX: 20-30y

E&W: 10-15y
MIDS: >100y
ANG: 35-50y
TMS: 15-25y
WSX: 10-15y

E&W: 30-45y
MIDS: >100y
ANG: 70-100y
TMS: 50-70y
WSX: 70-100y



National Drought Group est. Feb 2012

How NRFA/NGLA data support the needs of the UK water sector: WATER RESOURCES ARE UNDER INCREASING PRESSURE

The case for change - current and future water availability

CC @ Q70 for 11RCMs

Pop change

Scenarios

Sector demands

Env Mgt

Prop

Large Diff

Fixed Q

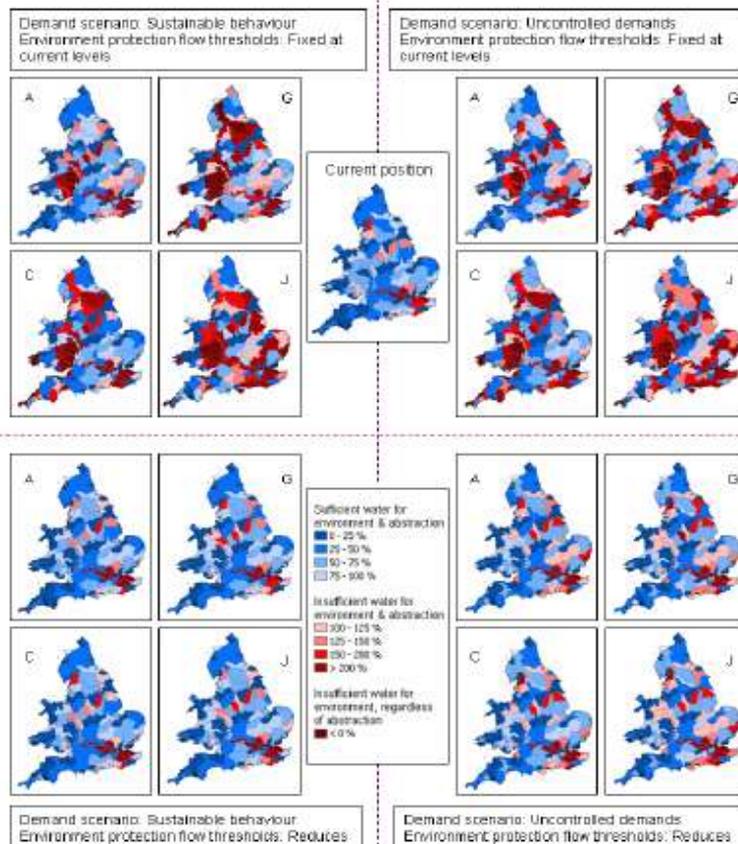
Prop

Env Mgt

Little Diff

Met or Unmet Demand, 2050s, Q70

As sufficiency of water for environment & abstraction



Sus Bhvr (110 lhd)

UnC Dem (165 lhd)

Demand Management

Prospect is: chronic shortage not just acute shortage

How NRFA/NGLA data support the needs of the UK water sector:

WATER POLICIES FOR THE FUTURE: WATER RESOURCES ARE UNDER INCREASING PRESSURE

5

As water becomes more scarce, it becomes more valuable



even in the Hydro-Nation

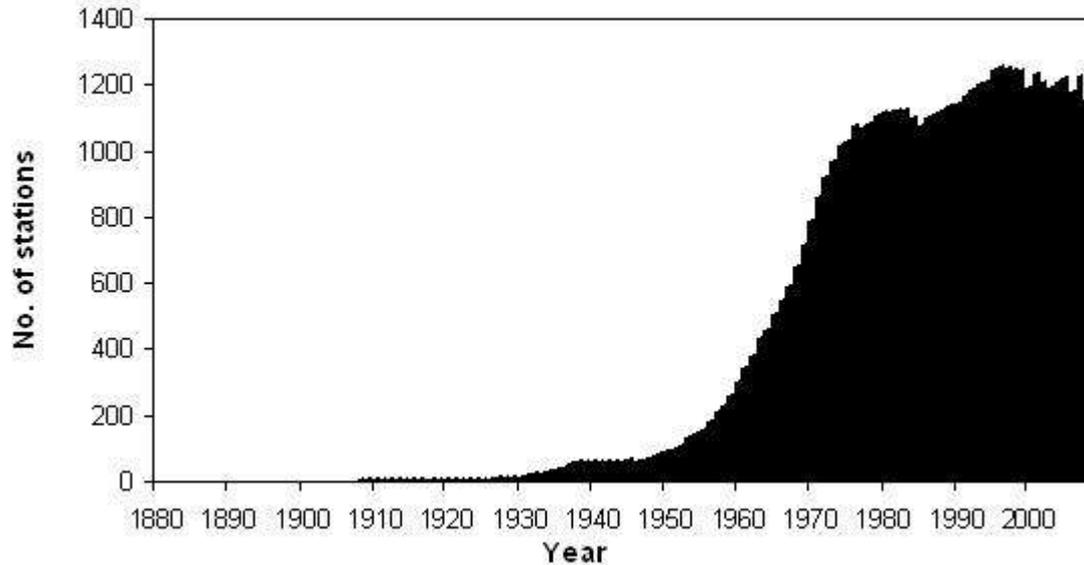


and the need for reliable data becomes greater, in all sorts of ways ...

How NRFA/NGLA data support the needs of the UK water sector:

SUMMING UP PERSONAL OPINIONS

River Flow Gauging Stations Contributing Data To The NRFA



- **THE WATER SECTOR RELIES ON GOOD DATA**
- **WE ARE GOING TO NEED MORE – NOT LESS – TO MANAGE THE CHALLENGES WE FACE**
- **MAKING DECISIONS ON INADEQUATE DATA IS UNWISE – ECONOMICALLY, ENVIRONMENTALLY, SOCIALLY & SCIENTIFICALLY**
- **VOLUNTEERING /CITIZEN SCIENCE DATA HAS A PLACE – BUT CAREFUL DESIGN & VALIDATION IS NECESSARY**

How NRFA/NGLA data support the needs of the UK water sector: **AND FINALLY**

Continuity, longevity and quality all count



Some things improve with age

HYDROMETRIC DATA: THE LONG VIEW

Questions?

Dr Colin Fenn

MD, Hydro-Logic Services LLP

Chair, CIWEM Water Resources Panel; SAGA Committee Member