Water Quality in England Part 3

Amy Jones

December 2022

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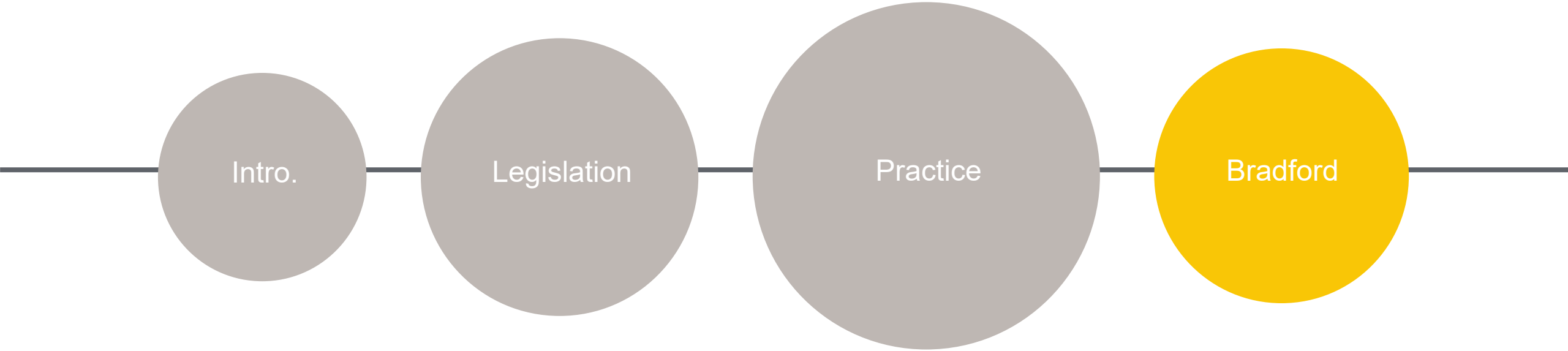
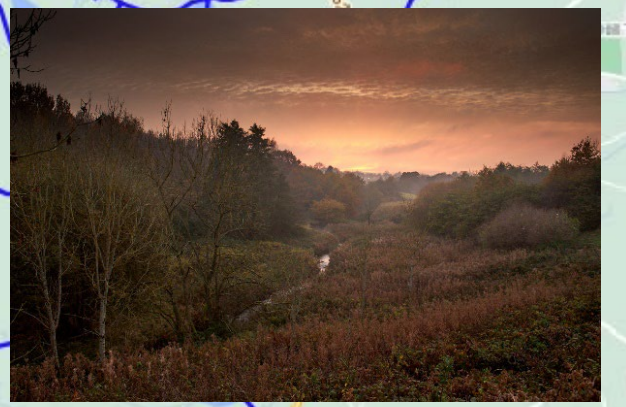
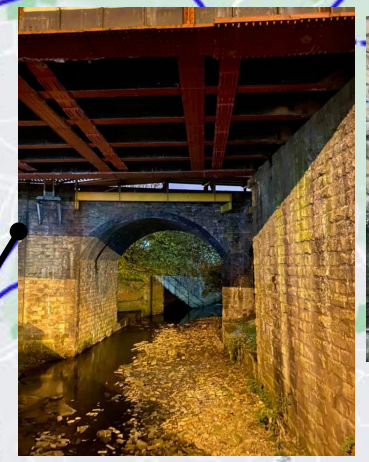


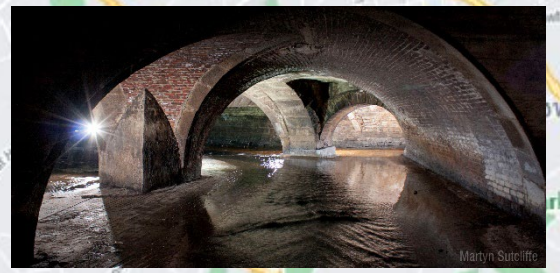
In this section

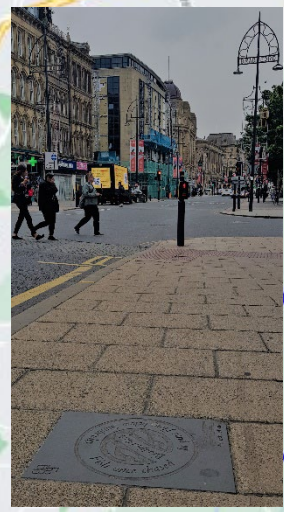
- **Catchment overview**
- **Legislation**
  - How good should water quality be in Bradford?
  - How does water quality compare to standards?
- **Practice**
  - Investigations to date

The Bradford Becks catchment







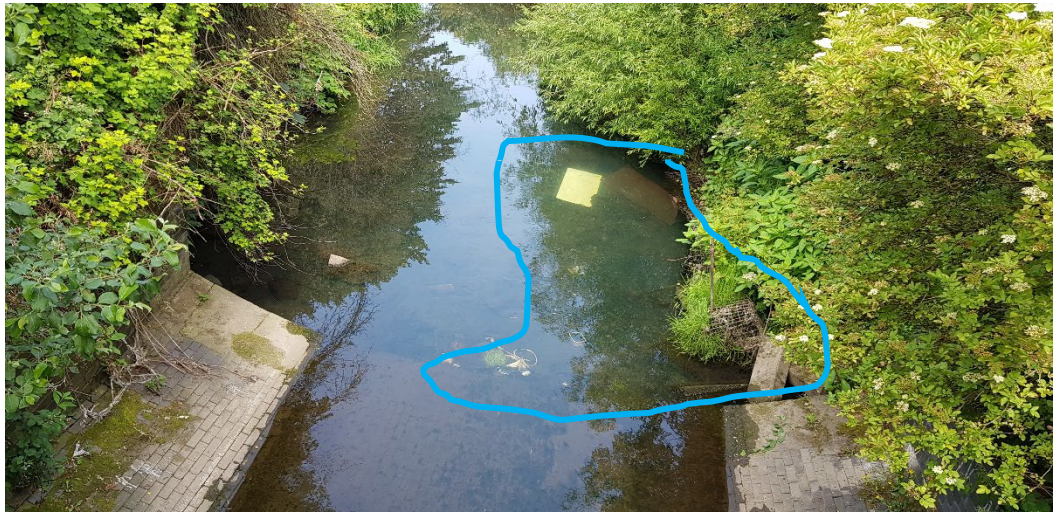


River Aire
Red Beck
Chellow Dean Beck
Pitty Beck
Middle Brook
Bradford Beck
Eastbrook
Bowling Beck
Bull Greave Beck
Clayton Beck
Pinch Beck
High Birks Beck
Hole Bottom Beck
Baildon
Harden
Ryecroft
Bingley St Ives
Hainworth
Damems
SALTAIRE
Bingley Rd
Northcliffe Golf Club
BRIDGE
GREENGATES
Calverley
Lister Park
MANNINGHAM
Peel Park, Bradford
THORNBURY
Allerton
Bradford
SHEARBRIDGE
Thornton
Clayton
HORTON BANK TOP

Visible pollution

‘Regularly see beck turn orange, black or white.’
Sewage fungus (misconnections fixed where found).
The smell …

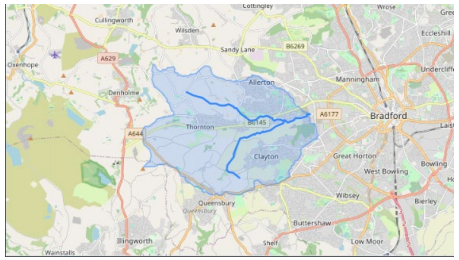
Rags in trees – cloth, not paper?



Litter, including sanitary products

How good should water quality be in Bradford's Becks?

Clayton Beck (Source to Bradford Bk) Water Body

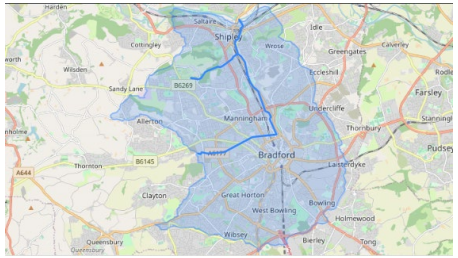


Objectives

Classification Item	Status	Year	Reasons
Ecological	Good	2027	Disproportionately expensive: Disproportionate burdens; Technically infeasible: Cause of adverse impact unknown
Biological quality elements	Good	2027	Disproportionately expensive: Disproportionate burdens; Technically infeasible: Cause of adverse impact unknown
Invertebrates	Good	2027	Technically infeasible: Cause of adverse impact unknown
Macrophytes and Phytobenthos Combined	Good	2027	Disproportionately expensive: Disproportionate burdens
Physico-chemical quality elements	Good	2027	Disproportionately expensive: Disproportionate burdens
Acid Neutralising Capacity	Good	2015	
Ammonia (Phys-Chem)	Good	2015	
Dissolved oxygen	Good	2015	
Phosphate	Good	2027	Disproportionately expensive: Disproportionate burdens
Temperature	Good	2015	
pH	Good	2015	
Hydromorphological Supporting Elements	Supports good	2015	
Hydrological Regime	Supports good	2015	
Supporting elements (Surface Water)	Not assessed	2015	
Specific pollutants	High	2015	
Copper	High	2015	
Triclosan	High	2015	
Zinc	High	2015	
Chemical	Good	2015	
Priority hazardous substances	Good	2015	
Cadmium and Its Compounds	Good	2015	
Priority substances	Good	2015	
Lead and Its Compounds	Good	2015	
Nickel and Its Compounds	Good	2015	
Other Pollutants	Does not require assessment	2015	

https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027062861

Bradford Beck (Clayton Bk to R Aire) Water Body



Classification Item	Status	Year	Reasons
Ecological	Good	2027	Disproportionately expensive: Disproportionate burdens
Biological quality elements	Good	2027	Disproportionately expensive: Disproportionate burdens
Fish	Good	2015	
Invertebrates	Good	2027	Disproportionately expensive: Disproportionate burdens
Macrophytes and Phytobenthos Combined	Not assessed	2015	Disproportionately expensive: Disproportionate burdens
Physico-chemical quality elements	Good	2015	
Ammonia (Phys-Chem)	Good	2015	
Dissolved oxygen	Good	2015	
Phosphate	Good	2015	
Temperature	Good	2015	
pH	Good	2015	
Hydromorphological Supporting Elements	Supports good	2015	
Hydrological Regime	Supports good	2015	
Supporting elements (Surface Water)	Good	2027	Disproportionately expensive: Disproportionate burdens
Mitigation Measures Assessment	Good	2027	Disproportionately expensive: Disproportionate burdens
Specific pollutants	High	2015	
Copper	High	2015	
Triclosan	High	2015	
Zinc	High	2015	
Chemical	Good	2015	
Priority hazardous substances	Good	2015	
Cadmium and Its Compounds	Good	2015	
Priority substances	Good	2015	
Lead and Its Compounds	Good	2015	
Nickel and Its Compounds	Good	2015	
Other Pollutants	Does not require assessment	2015	

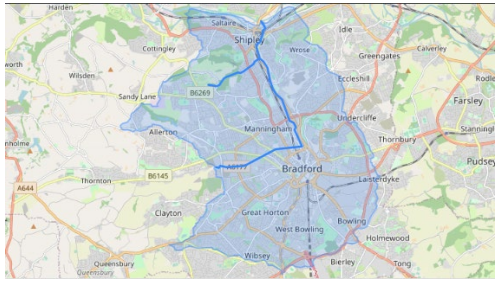
https://environment.data.gov.uk/catchment-planning/WaterBody/GB104027062862

UpStream

MAKING COMPLEX EASY

How good should water quality be in Bradford's Becks?

Clayton Beck (Source to Bradford Bk) Water Body



Altitude: 280mAD upstream end Pinch Beck
~140mAD at downstream end

Alkalinity: pH: 7.83 – 8.31
Alkalinity to pH 4.5 as $CaCO_3$: 54 – 151 mg/l

SAMPLING POINT

Middle Beck-Cemetery Road, Green Side

Description	MIDDLE BECK-CEMETERY ROAD, GREEN SIDE, BRADFORD
Sampling point ID	NE-49401015
Type	Freshwater – Rivers
Status	open
Location	easting northing: 413812 433222 lat lon: 53.795114, -1.791797
Area	Yorkshire
Sub-Area	Aire, Calder, Wharfe
Summary	168 samples taken between 2019 and 2000

Determinands

Determinands identify a property which can be measured on a sample or the sampling environment, together with the units in which the result of that measurement will be expressed.

46 determinands have been measured at this site

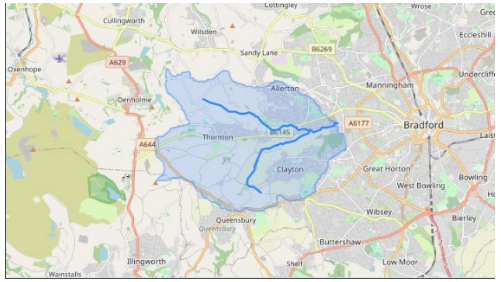
Sampling results

Displaying the twenty most recent samples. You can see all 168 sample results (note that in some cases this may take a considerable time, and use significant data bandwidth).

Samples from 5 Apr 2018 to 4 Mar 2019

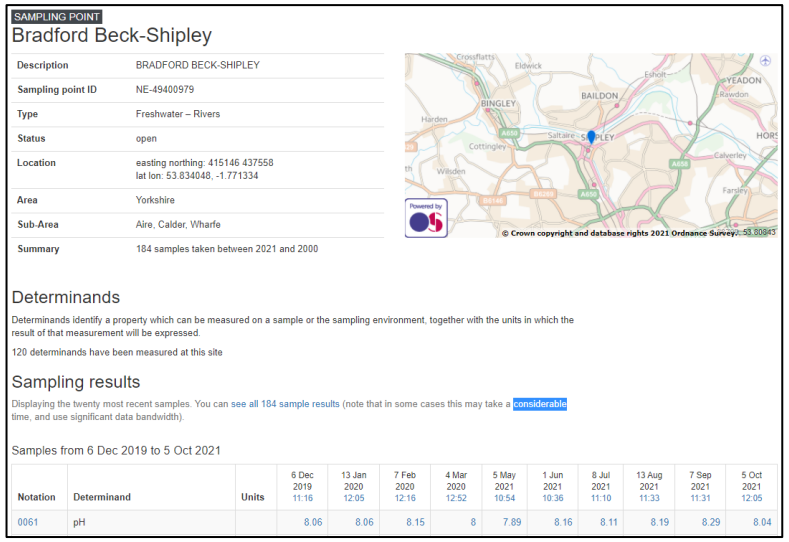
Notation	Determinand	Units	5 Apr 2018 12:00	12 Jun 2018 15:41	10 Jul 2018 13:01	2 Aug 2018 14:55	3 Oct 2018 15:23	13 Nov 2018 13:35	6 Dec 2018 12:46	2 Jan 2019 13:30	8 Feb 2019 14:28	4 Mar 2019 14:28
0061	pH		7.83	8.13	8.31	7.93	8.04	8.05	8.07	8.24	7.96	8.23

Bradford Beck (Clayton Bk to R Aire) Water Body



Altitude: ~140mAD at downstream end
60mAD at Aire confluence, Shipley
Most of catchment is above 80mAD

Alkalinity: pH: 7.89 – 8.29
Alkalinity to pH 4.5 as $CaCO_3$: 99 – 200 mg/l



SAMPLING POINT

Bradford Beck-Shipley

Description	BRADFORD BECK-SHIPLEY
Sampling point ID	NE-49400979
Type	Freshwater – Rivers
Status	open
Location	easting northing: 415146 437558 lat lon: 53.834048, -1.771334
Area	Yorkshire
Sub-Area	Aire, Calder, Wharfe
Summary	184 samples taken between 2021 and 2000

Determinands

Determinands identify a property which can be measured on a sample or the sampling environment, together with the units in which the result of that measurement will be expressed.

120 determinands have been measured at this site

Sampling results

Displaying the twenty most recent samples. You can see all 184 sample results (note that in some cases this may take a considerable time, and use significant data bandwidth).

Samples from 6 Dec 2019 to 5 Oct 2021

Notation	Determinand	Units	6 Dec 2019 11:16	13 Jan 2020 12:05	7 Feb 2020 12:16	4 Mar 2020 12:52	5 May 2021 10:54	1 Jun 2021 10:36	8 Jul 2021 11:10	13 Aug 2021 11:33	7 Sep 2021 11:31	5 Oct 2021 12:05
0061	pH		8.06	8.06	8.15	8	7.89	8.16	8.11	8.19	8.29	8.04

https://environment.data.gov.uk/water-quality/view/landing
https://environment.data.gov.uk/water-quality/view/sampling-point/NE-49401015
https://environment.data.gov.uk/water-quality/view/sampling-point/NE-49400979

How good should water quality be in Bradford's Becks?

Table 1: UKTAG waterbody typology

Altitude	Alkalinity (as mg/l CaCO3)				
	< 10	10 to 50	50 to 100	100 to 200	Over 200
Under 80 meters	Type 1	Type 2	Type 3	Type 5	Type 7
Over 80 meters			Type 4	Type 6	

Similar characteristics:

- Macrophytes and phytobenthos
- Fish
- Macroinvertebrates
- Physico-chemistry
- Hydrology
- Morphology

Bradford Beck (Clayton Bk to R Aire) Water Body

Clayton Beck (Source to Bradford Bk) Water Body

Water quality standards

Table 23: 99 percentile standards for Ammonia

Type of standard	Types of river	Old objective	Total Ammonia (mg/l)		Un-ionised ammonia (mg/l)
			90-percentile	99-percentile	
High	1, 2, 4 and 6		0.2	0.5	0.04
		RE1	0.25	0.6	0.04
High	3, 5 and 7		0.3	0.7	0.04
Good	1, 2, 4 and 6				
Good	3, 5 and 7	RE2	0.6	1.5	0.04
Moderate	1,2,4 and 6		0.75	1.8	0.04
Moderate	1,3,5 and 7		1.1	2.6	0.04
Poor	1,2,4 and 6				
		RE3	1.3	3.0	0.04
Poor	1,3,5 and 7	RE4	2.5	6.0	-
		RE5	9.0	25.0	-

Table 22: 99 percentile standards for BOD

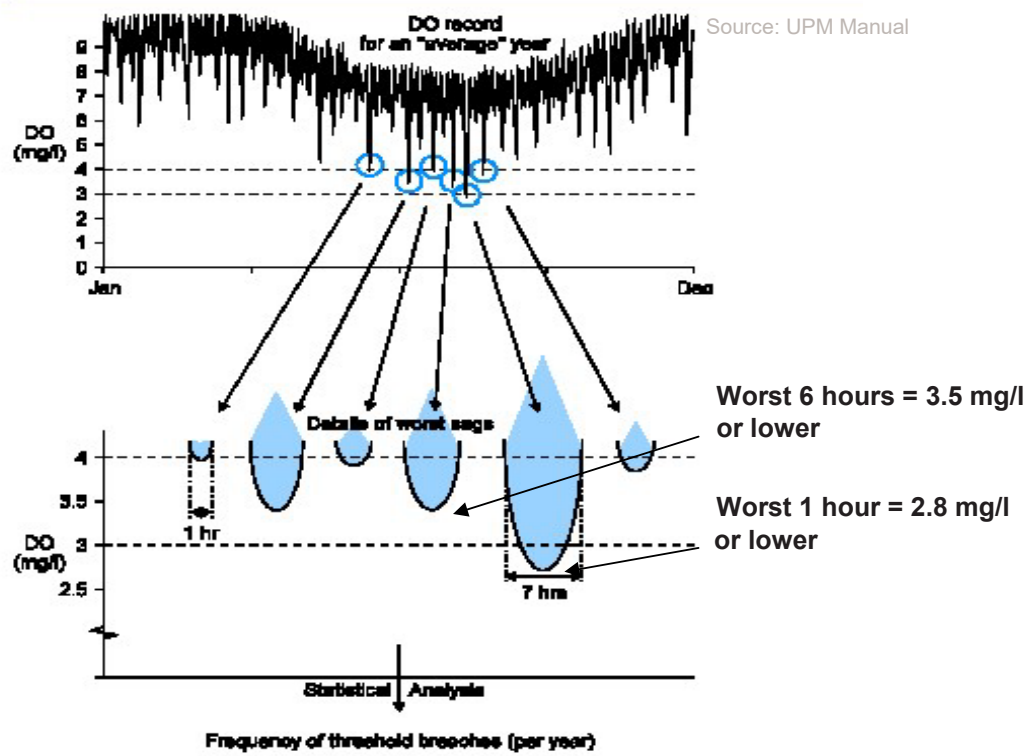
Status	Types of river	Old objective	Biochemical Oxygen Demand	
			90-percentile	99 percentile
		RE1	2.5	5.0
High	1, 2, 4 and 6		3.0	7.0
High	3, 5 and 7	RE2	4.0	9.0
Good	1, 2, 4 and 6			
Good	3, 5 and 7		5.0	11.0
Moderate	1, 2, 4 and 6	RE3	6.0	14.0
Moderate	3, 5 and 7		6.5	14.0
Poor	1, 2, 4 and 6		7.5	16.0
		RE4	8.0	19.0
Poor	3, 5 and 7		9.0	19.0
		RE5	15.0	30.0

https://wfduk.org/sites/default/files/Media/Environmental%20standards/UKTAG%20Environmental%20Standards%20Phase%203%20Final%20Report%2004112013.pdf

Assessing water quality

Standard	
High percentile (90% and 99%)	Count number of timesteps failure applies for. Allowed to fail for 10% / 1% of year Parametric (normal distribution) or non-parametric methods
Fundamental Intermittent Standards (FIS)	Standards vary depending on type of fishery: • Sustainable cyprinid • Sustainable salmonid (fishery or spawning grounds) • Marginal cyprinid Three standard durations – 1hr, 6hr, 24hr Three return periods – 1 month, 3 months, 1 year (See UPM tables 2.2 and 2.3)
*Care required to correctly count number of events causing failure.	

Hypothetical DO profile for a river illustrating meaning of Fundamental Intermittent Standards



Source: UPM Manual

FIS standards for salmonoid fishery

Return Period	1 hour			6 hour			24 hour		
	1 mth	3 mths	1 year	1 mth	3 mths	1 year	1 mth	3 mths	1 year
Dissolved Oxygen Concentrations (mg/l)	5.0	4.5	4.0	5.5	5.0	4.5	6.0	5.5	5.0
Un-ionised ammonia concentrations (mg NH_3-N/l)	0.065	0.095	0.105	0.025	0.035	0.040	0.018	0.025	0.030

https://wfduk.org/sites/default/files/Media/Environmental%20standards/UKTAG%20Environmental%20Standards%20Phase%203%20Final%20Report%2004112013.pdf

Water quality standards

Table 19: Fundamental intermittent standards for Dissolved Oxygen			
Ecosystem suitable for a sustainable salmonid fishery			
Return period	**Dissolved oxygen concentration (mg/l)**		
	1 hour	**6 hours**	**24 hours**
1 month	5.0	5.5	6.0
3 months	4.5	5.0	5.5
1 year	4.0	4.5	5.0
Ecosystem suitable for a sustainable cyprinid fishery			
Return period	**Dissolved oxygen concentration (mg/l)**		
	1 hour	**6 hours**	**24 hours**
1 month	4.0	5.0	5.5
3 months	3.5	4.5	5.0
1 year	3.0	4.0	4.5

Table 20: Fundamental intermittent standards for Un-ionised Ammonia			
Ecosystem suitable for a sustainable salmonid fishery			
Return period	**Un-ionised Ammonia concentration (mg NH_3-N/l)**		
	1 hour	**6 hours**	**24 hours**
1 month	0.065	0.025	0.018
3 months	0.095	0.035	0.025
1 year	0.105	0.040	0.030
Ecosystem suitable for a sustainable cyprinid fishery			
Return period	**Un-ionised Ammonia concentration (mg NH_3-N /l)**		
	1 hour	**6 hours**	**24 hours**
1 month	0.150	0.075	0.030
3 months	0.225	0.125	0.050
1 year	0.250	0.150	0.065
The above limits apply when the concentration of dissolved oxygen is above 5 mg/l. At lower concurrent concentrations of dissolved oxygen the following correction factor applies: For Dissolved Oxygen less than 5 mg/l DO, multiply the standard by 0.0126 and the concentration of Dissolved Oxygen in mg O_2/litre, C, raised to the power of 2.72, that is, 0.0126 $C^{2.72}$.			
The standards also assume that the concurrent pH is greater than 7 and temperature is greater than 5 degrees C. For lower pH and temperatures the following correction factors apply: Where the pH is less than 7, multiply the standard by 0.0003 and by the value of the pH, p, raised to the power of 4.17, that is: 0.0003 $p^{4.17}$. Where the temperature is less than 5 degrees Centigrade, multiply this correction factor by a further 0.5.			

https://wfduk.org/sites/default/files/Media/Environmental%20standards/UKTAG%20Environmental%20Standards%20Phase%203%20Final%20Report%2004112013.pdf

Water quality standards

Table 24: Comparison of current and recommended standards for pH and ANC						
Class	Current standards[3]		Recommended standards			
	All waters		Clear waters		Humic waters	
	pH		pH	ANC	pH	ANC
		(indicative mean)		(annual mean)		
High	6.0 (5-percentile)	5.79	6.60	80	5.10	80
Good	5.2 (10-percentile)	5.37	5.95	40	4.55	50
Moderate	4.7 (10-percentile)	4.91	5.44	15	4.22	10
Poor	4.2 (10-percentile)	4.43	4.89	-10	4.03	5

Recorded water quality Clayton Beck

Reasons for not achieving good (RNAG) and reasons for deterioration (RFD)

Reason Type	SWMI	Activity	Category	Classification Element	More information
RNAG	Suspect data	Not applicable	No sector responsible	Invertebrates	Details
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Phosphate	Details
RNAG	Diffuse source	Poor nutrient management	Agriculture and rural land management	Macrophytes and Phytobenthos Combined	Details

‘Suspected’ RNAG for this catchment

Classification Item	2013	2014	2015	2016	2019
Ecological	Moderate	Moderate	Moderate	Moderate	Moderate
Biological quality elements		Moderate	Moderate	Moderate	Moderate
Invertebrates		Moderate	Moderate	Moderate	Moderate
Macrophytes and Phytobenthos Combined			Moderate	Moderate	Moderate
Physico-chemical quality elements		Moderate	Moderate	Moderate	Moderate
Acid Neutralising Capacity			High	High	High
Ammonia (Phys-Chem)		High	High	High	High
Dissolved oxygen		High	High	High	High
Phosphate		Moderate	Moderate	Moderate	Moderate
Temperature		High	High	High	High
pH		High	High	High	High
Hydromorphological Supporting Elements	Supports good	Supports good	Supports good	Supports good	Supports good
Hydrological Regime	Supports good	Supports good	Supports good	Supports good	Supports good
Specific pollutants	Moderate	Moderate	High	High	High
Copper	High	High	High	High	High
Triclosan	Moderate	Moderate	High	High	High
Zinc	Moderate	Moderate	High	High	High
Chemical	Good	Good	Good	Good	Fail
Priority hazardous substances	Good	Good	Good	Good	Fail
Benzo(a)pyrene					Good
Cadmium and Its Compounds	Good	Good	Good	Good	Good
Di(2-ethylhexyl)phthalate (Priority hazardous)	Good	Good			
Dioxins and dioxin-like compounds					Good
Heptachlor and cis-Heptachlor epoxide					Good
Hexabromocyclododecane (HBCDD)					Good
Hexachlorobenzene					Good
Hexachlorobutadiene					Good
Mercury and Its Compounds					Fail
Nonylphenol	Good	Good			
Perfluorooctane sulphonate (PFOS)					Fail
Polybrominated diphenyl ethers (PBDE)					Fail
Tributyltin Compounds	Good	Good			
Priority substances	Good	Good	Good	Good	Good

Recorded water quality Bradford Beck

Reasons for not achieving good (RNAG) and reasons for deterioration (RFD)

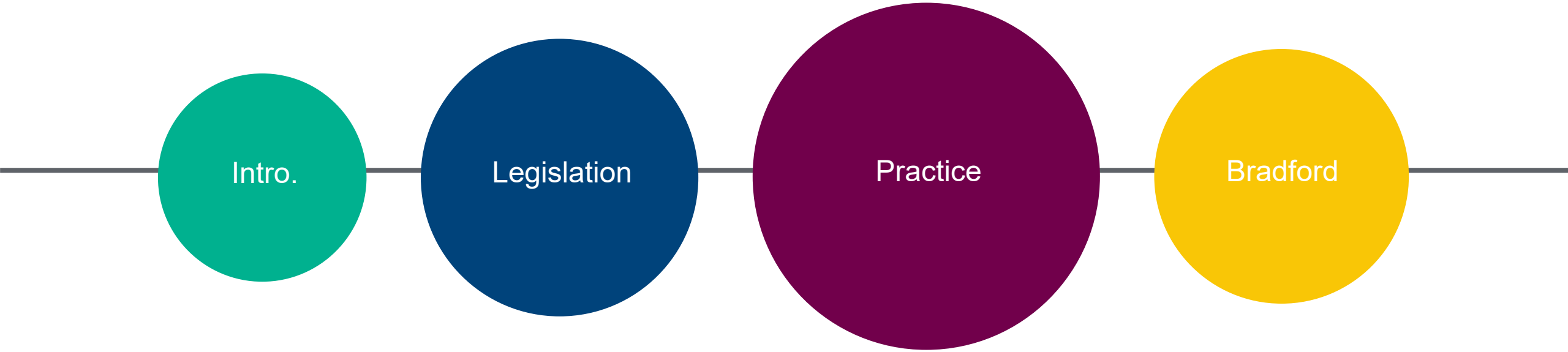
Reason Type	SWMI	Activity	Category	Classification Element	More information
RNAG	Point source	Sewage discharge (intermittent)	Water Industry	Invertebrates	Details
RNAG	Physical modification	Urbanisation - urban development	Urban and transport	Invertebrates	Details
RNAG	Diffuse source	Poor soil management	Agriculture and rural land management	Fish	Details
RNAG	Point source	Sewage discharge (intermittent)	Water Industry	Fish	Details
RNAG	Physical modification	Urbanisation - urban development	No sector responsible	Fish	Details
RNAG	Point source	Misconnections	Industry	Fish	Details

Some ‘confirmed’ and ‘probable’ RNAGs for this catchment

Classification Item	2013	2014	2015	2016	2019
Ecological	Moderate	Moderate	Moderate	Moderate	Moderate
Biological quality elements	Poor	Poor	Moderate	Moderate	Moderate
Fish	Poor	Poor	Good	Good	Moderate
Invertebrates		Moderate	Moderate	Moderate	Moderate
Macrophytes and Phytobenthos Combined				Good	Good
Physico-chemical quality elements			Good	Good	Good
Ammonia (Phys-Chem)			High	High	Good
Dissolved oxygen			High	High	High
Phosphate			Good	Good	Good
Temperature			High	High	High
pH			High	High	High
Hydromorphological Supporting Elements	Supports good	Supports good	Supports good	Supports good	Supports good
Hydrological Regime	Supports good	Supports good	Supports good	Supports good	Supports good
Supporting elements (Surface Water)			Moderate	Moderate	Moderate
Mitigation Measures Assessment			Moderate or less	Moderate or less	Moderate or less
Specific pollutants	Moderate	Moderate	High	High	High
Copper	High	High	High	High	High
Iron				High	High
Manganese				High	High
Triclosan	Moderate	Moderate	High	High	High
Zinc	Moderate	Moderate	High	High	High
Chemical	Good	Good	Good	Good	Fail
Priority hazardous substances	Good	Good	Good	Good	Fail
Benzo(a)pyrene					Good
Cadmium and its Compounds	Good	Good	Good	Good	Good
Di(2-ethylhexyl)phthalate (Priority hazardous)	Good	Good			
Dioxins and dioxin-like compounds					Good
Heptachlor and cis-Heptachlor epoxide					Good
Hexabromocyclododecane (HBCDD)					Good
Hexachlorobenzene					Good
Hexachlorobutadiene					Good
Mercury and its Compounds					Fail
Nonylphenol	Good	Good			
Perfluorooctane sulphonate					Fail

A study following UPM is underway …

Contents



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