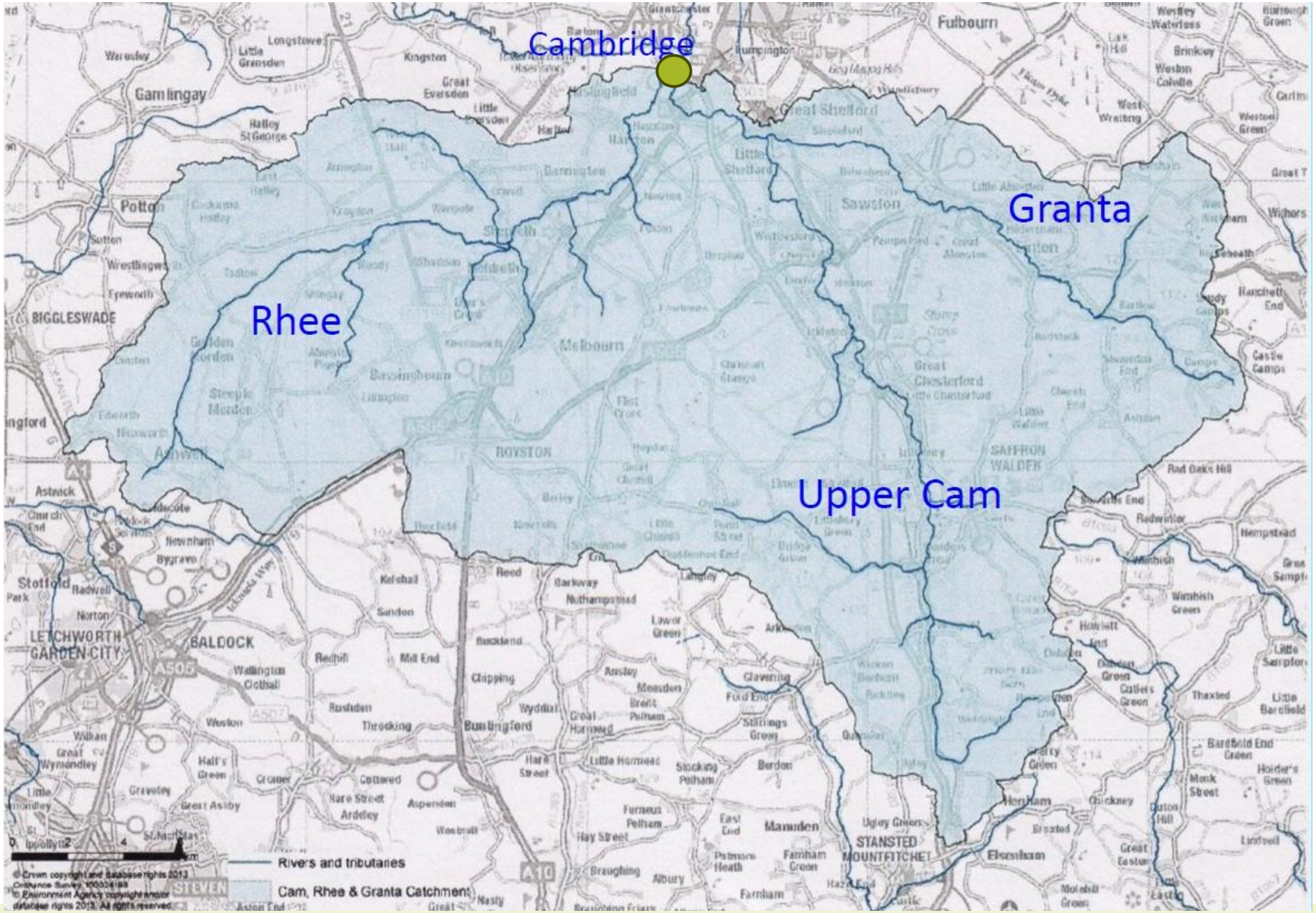
Cam Valley forum

Why are the Rhee and Cam murky?

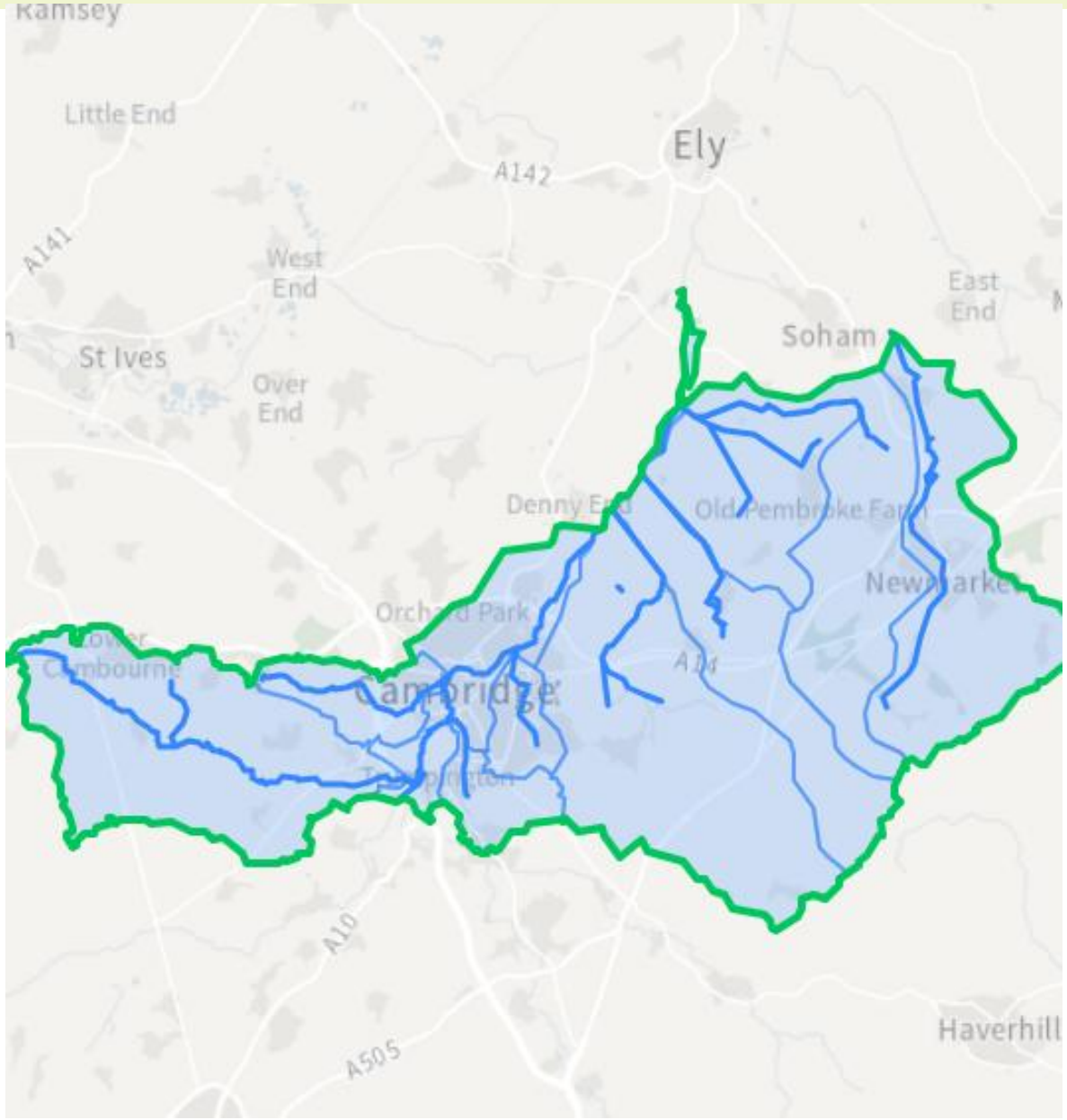
Can we clean them up?

Mike Foley, Cam Valley Forum

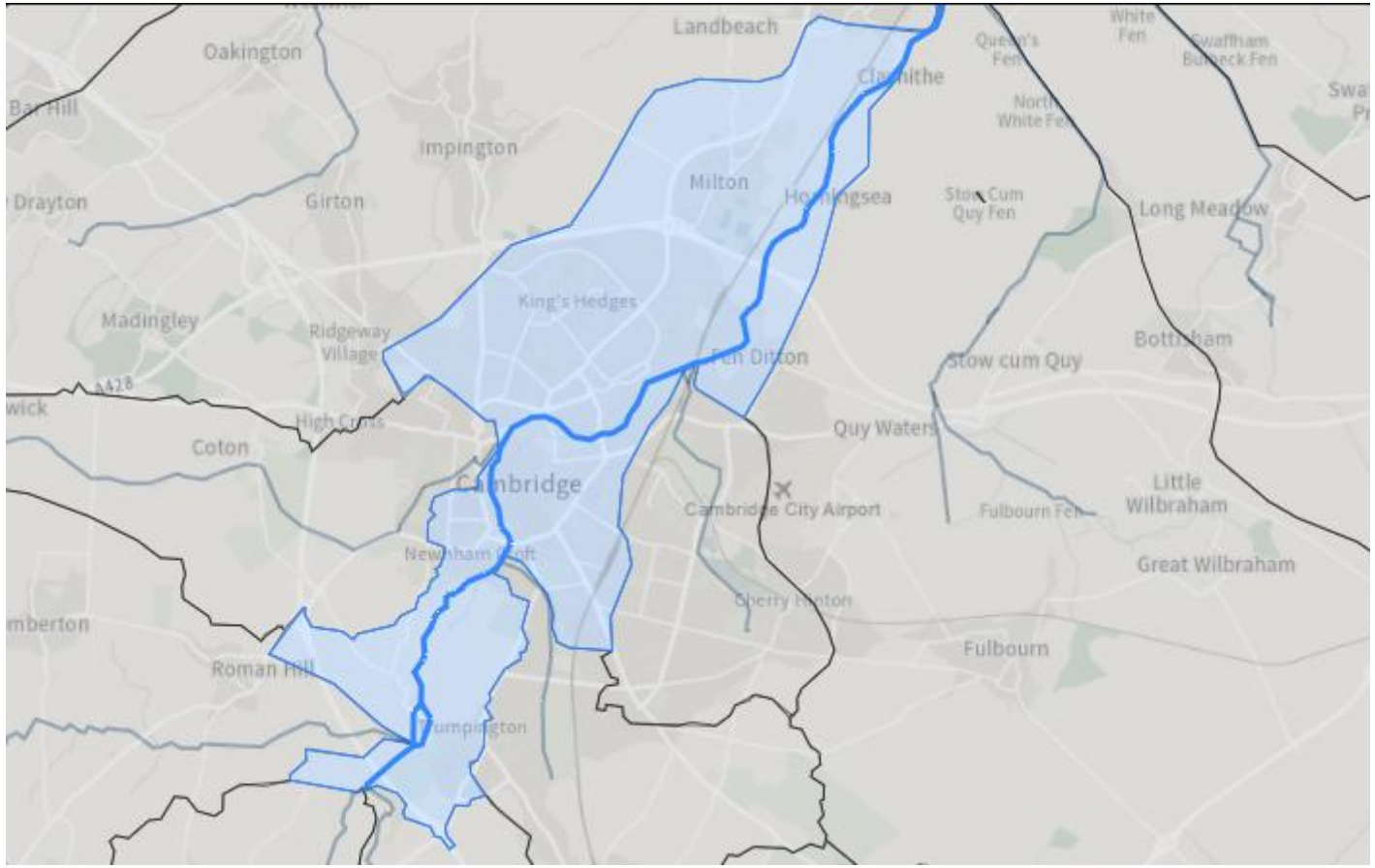
- “Hauxton Junction”



Lower Cam operational catchment



Cam


Landbeach
Oakington
Impington
Milton
Girton
Drayton
Madingley
Ridgeway
Village
King's Hedges
Fen Ditton
Stow cum Quy
Quy Waters
Coton
Cambridge
Cambridge City Airport
Fulbourn Fen
Little
Wilbraham
Great Wilbraham
Fulbourn
Roman Hill
Long Meadow
Stow Cum
Quy Fen
White
Fen
Swaffham
Bulbeck Fen
A428

EA Cam Classification

Classification Item	2019	2022
Ecological	**Moderate**	**Moderate**
Biological quality elements	**Good**	**Good**
Invertebrates	**Good**	**Good**
Macrophytes and Phytobenthos Combined		
Macrophytes Sub Element	**Poor**	**Poor**
Physico-chemical quality elements	**Moderate**	**Moderate**
Acid Neutralising Capacity	**High**	**High**
Ammonia (Phys-Chem)	**High**	**High**
Dissolved oxygen	**High**	**High**
Phosphate	**Poor**	**Poor**
Temperature	**High**	**Good**
pH	**High**	**High**
Hydromorphological Supporting Elements	**Not high**	**Not high**
Hydrological Regime	**Supports good**	**Supports good**
Supporting elements (Surface Water)	**Moderate**	**Moderate**
Mitigation Measures Assessment	**Moderate or less**	**Moderate or less**
Specific pollutants	**High**	**High**
Dimethoate	**High**	**High**
Linuron	**High**	**High**
Chemical	**Fail**	**Does not require assessment**
Priority hazardous substances	**Fail**	**Does not require assessment**
Benzo(a)pyrene	**Good**	
Dioxins and dioxin-like compounds	**Good**	
Heptachlor and cis-Heptachlor epoxide	**Good**	
Hexabromocyclododecane (HBCDD)	**Good**	
Hexachlorobenzene	**Good**	
Hexachlorobutadiene	**Good**	
Mercury and Its Compounds	**Good**	
Perfluorooctane sulphonate (PFOS)	**Fail**	
Polybrominated diphenyl ethers (PBDE)	**Fail**	
Priority substances	**Good**	**Does not require assessment**
Cypermethrin (Priority)	**Good**	
Fluoranthene	**Good**	
Other Pollutants	**Does not require assessment**	**Does not require assessment**

Mind map for the river condition

Turbid
Murky
Coloured
Brown
Green
Sewage
Sediment

Milky
Cloudy
Poor
Slow moving / fast moving
Effluent
Flooding
Runoff

Eroding
Crayfish
Dogs
Boating
Cattle
Sewage works
Hazy

Faeces
Summer problem
Winter problem
Algal blooms
High phosphate levels
A pond
Soil

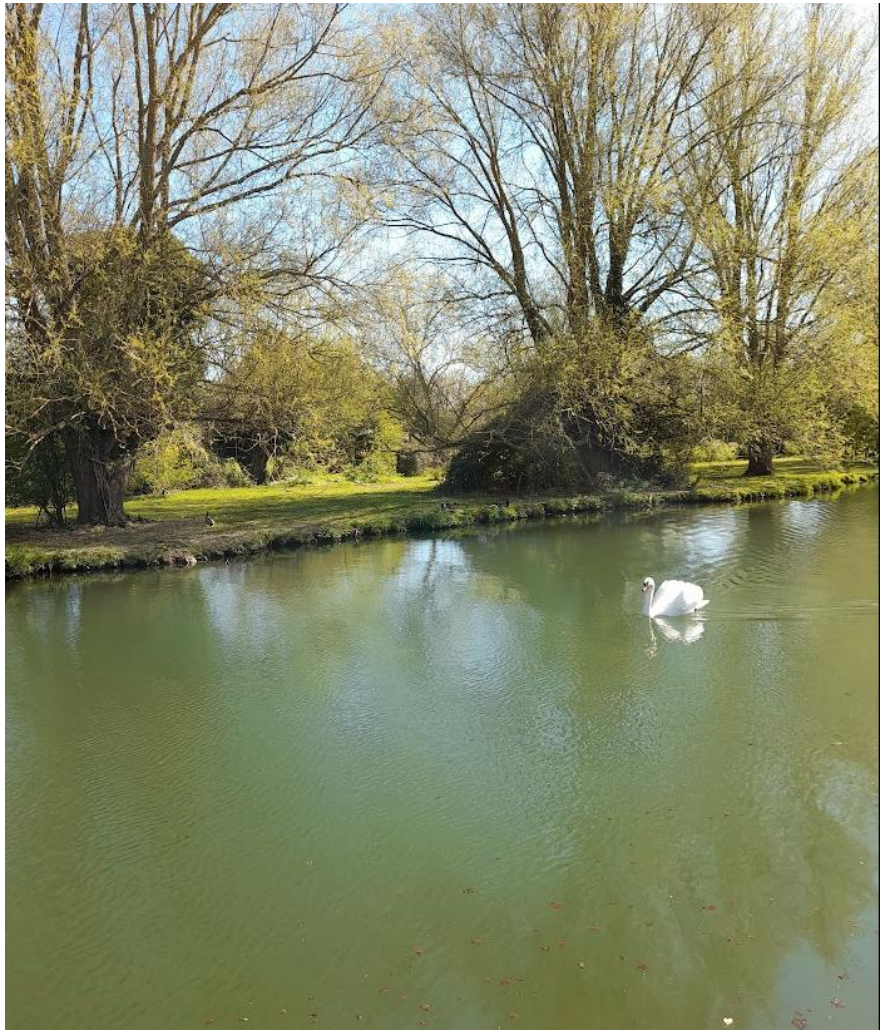
Turbidity defined

Turbidity is the measure of the cloudiness or haziness of a fluid, caused by the presence of suspended particles like silt, clay, algae, and other matter.

It is an optical measurement of how much light is scattered by these particles when shone through a sample at a nm wavelength. It is quantified in Nephelometric Turbidity Units.

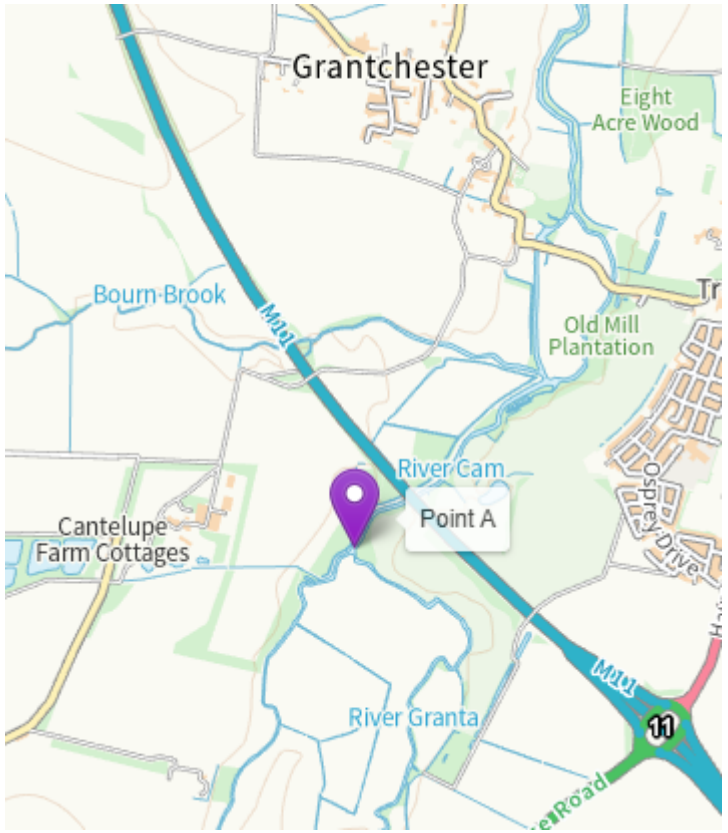
Changing colours of the Cam (Sheep's Green)

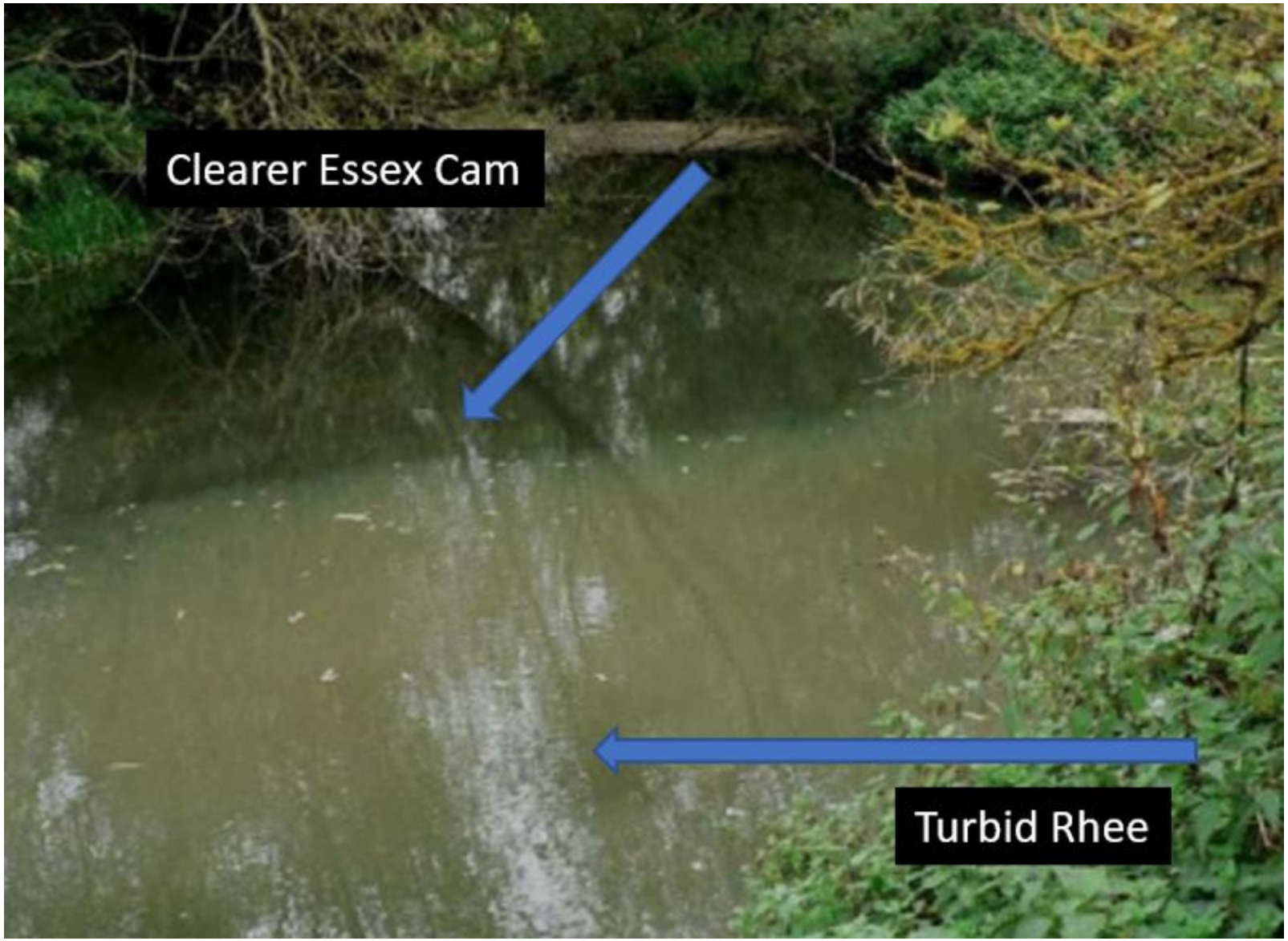
A few seconds later, in a different direction



Byron’s Pool stretch

Hauxton Junction



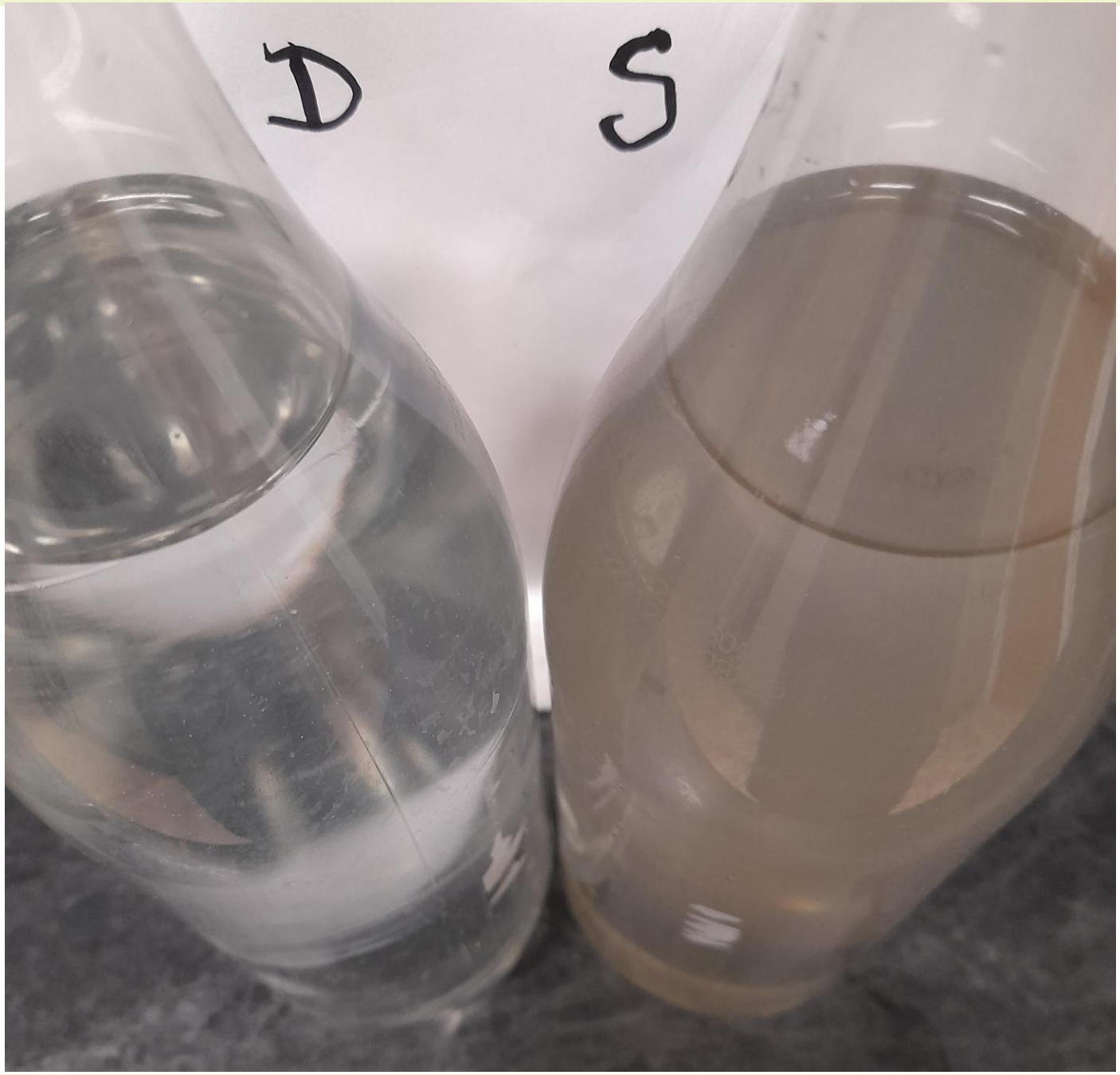


Credit: Alan Coulson (2015)

Upper Rhee – high turbidity at Potton Road, near Guilden Morden, 03/08/22 Note the colour of the bank soil, and the severe erosion.

Rhee - turbidity high at Boot Lane footbridge, Barrington, below Barrington weir, 06/10/22

Sample S - after settling
Sample D – tap water



Mill River, near Wendy

Gentle wriggling of rake into bed. Sediment of a Gault Clayey colour, slow to settle

Ashwell STW effluent discharge outfall into Rhee

Effluent sampling reveals it can be very clear

Jesus Green weir – further slowdown of suspended sediment as sediment settles to bed in low flows

Deep river at Clayhithe at low flows, very clear

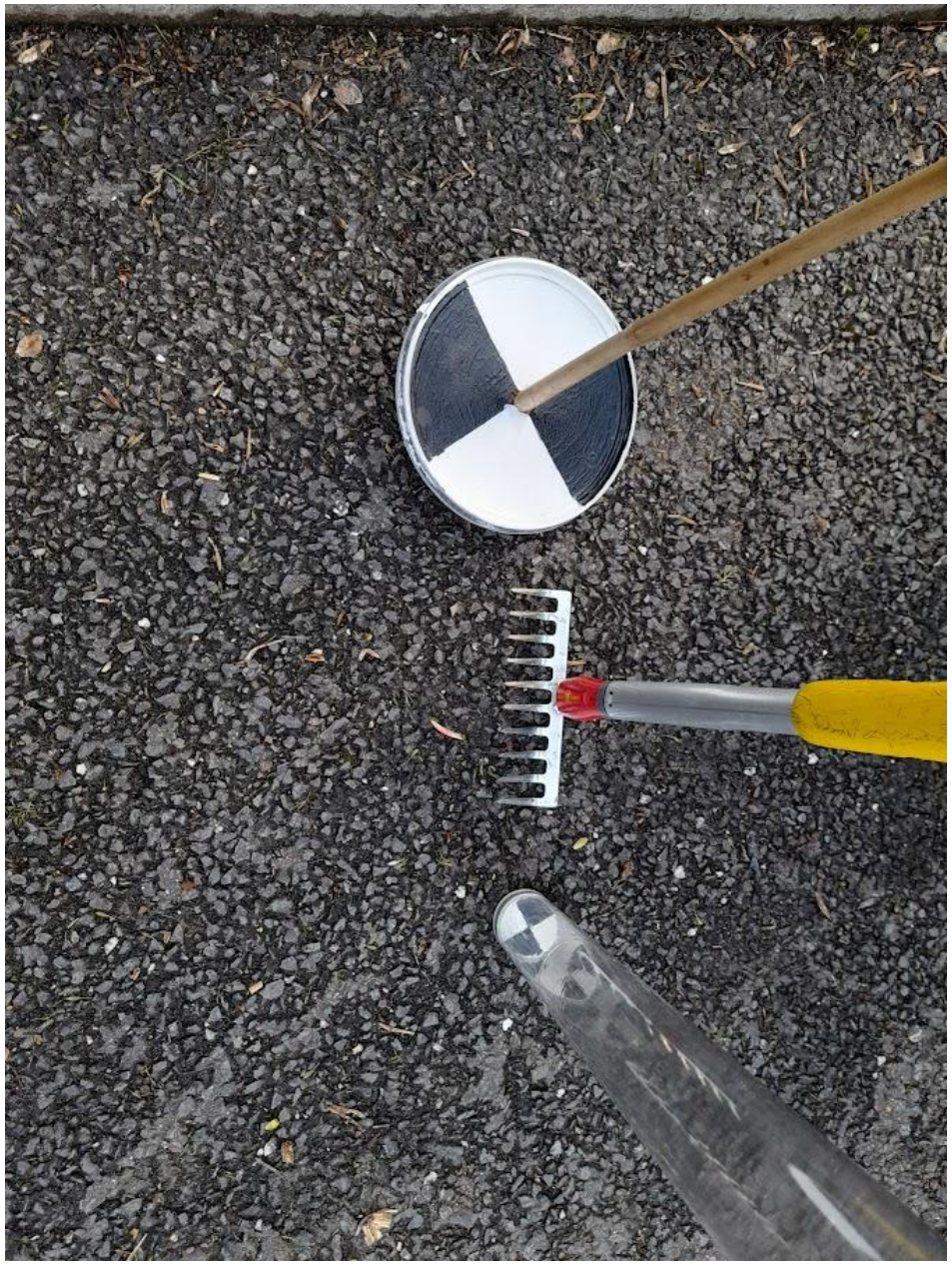
Secchi disk, unsuitable testing shallow water

Hanna HI-93703

£1300

The rake head is surprising good for comparing similar sites.
Last resort!
Often water is too shallow to use.

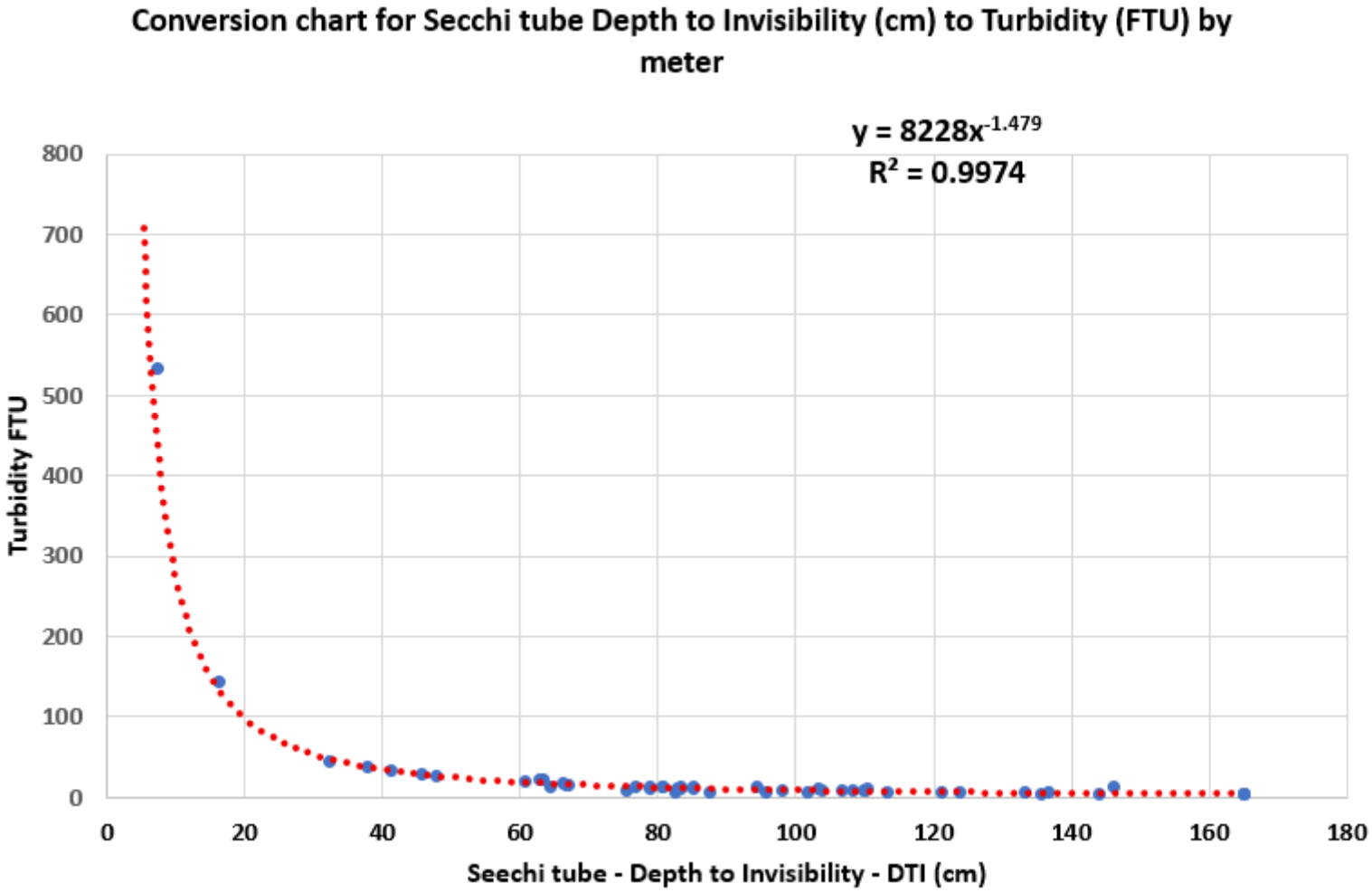
Small Secchi disk in long tube very useful

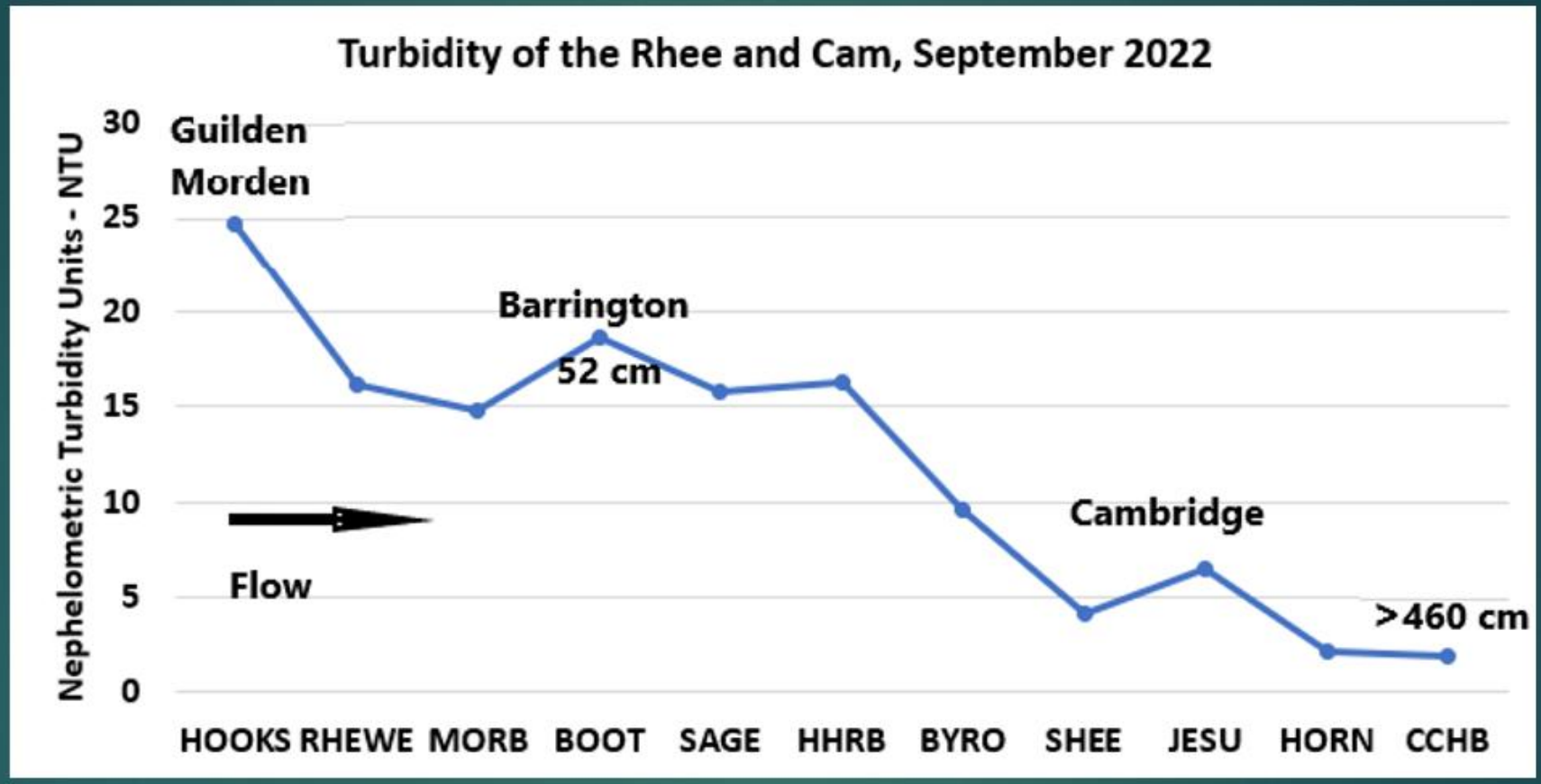


Hanna HI-98594
Multiprobe

~£3600


Columbia


Conversion chart for Secchi tube Depth to Invisibility (cm) to Turbidity (FTU) by meter
y = 8228x-1.479
R2 = 0.9974
Turbidity FTU
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
160
180
Seechi tube - Depth to Invisibility - DTI (cm)

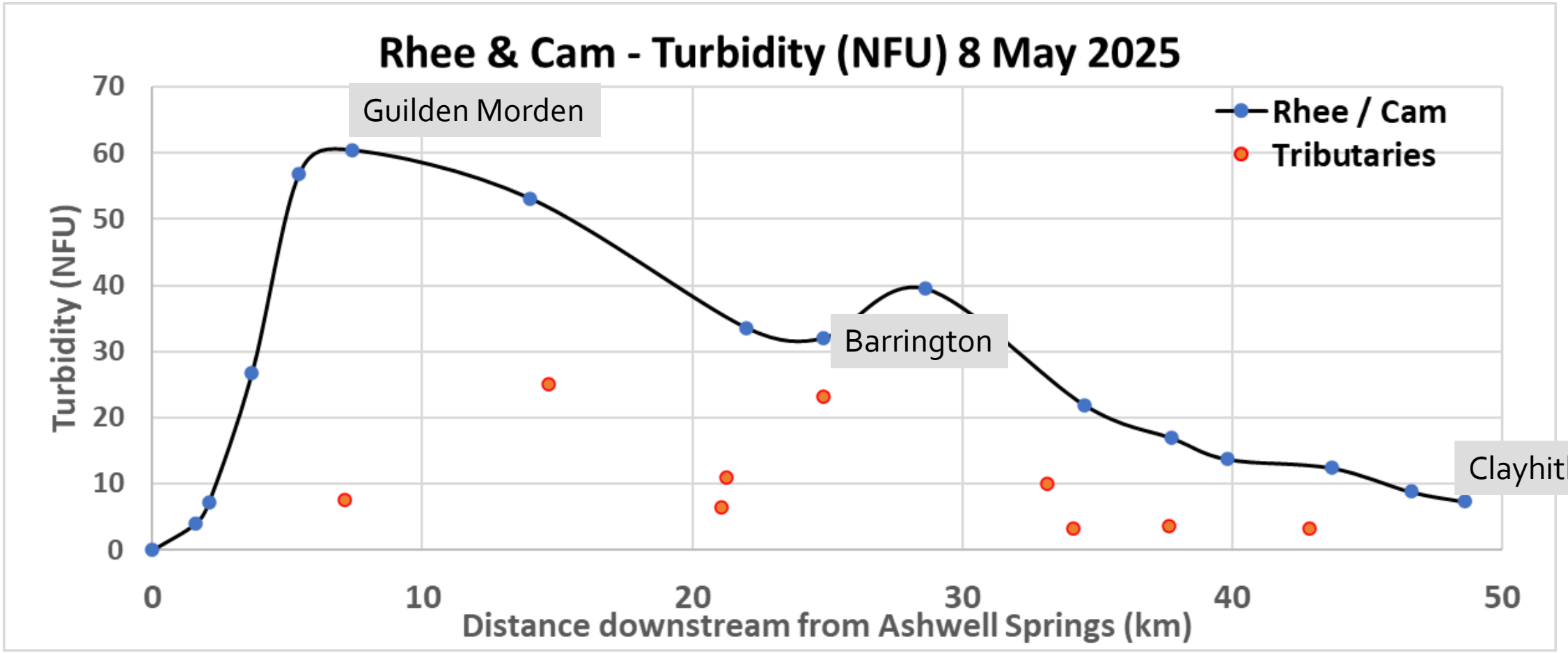


Thanks to the Cambridge Vet School for the use of their nephelometer

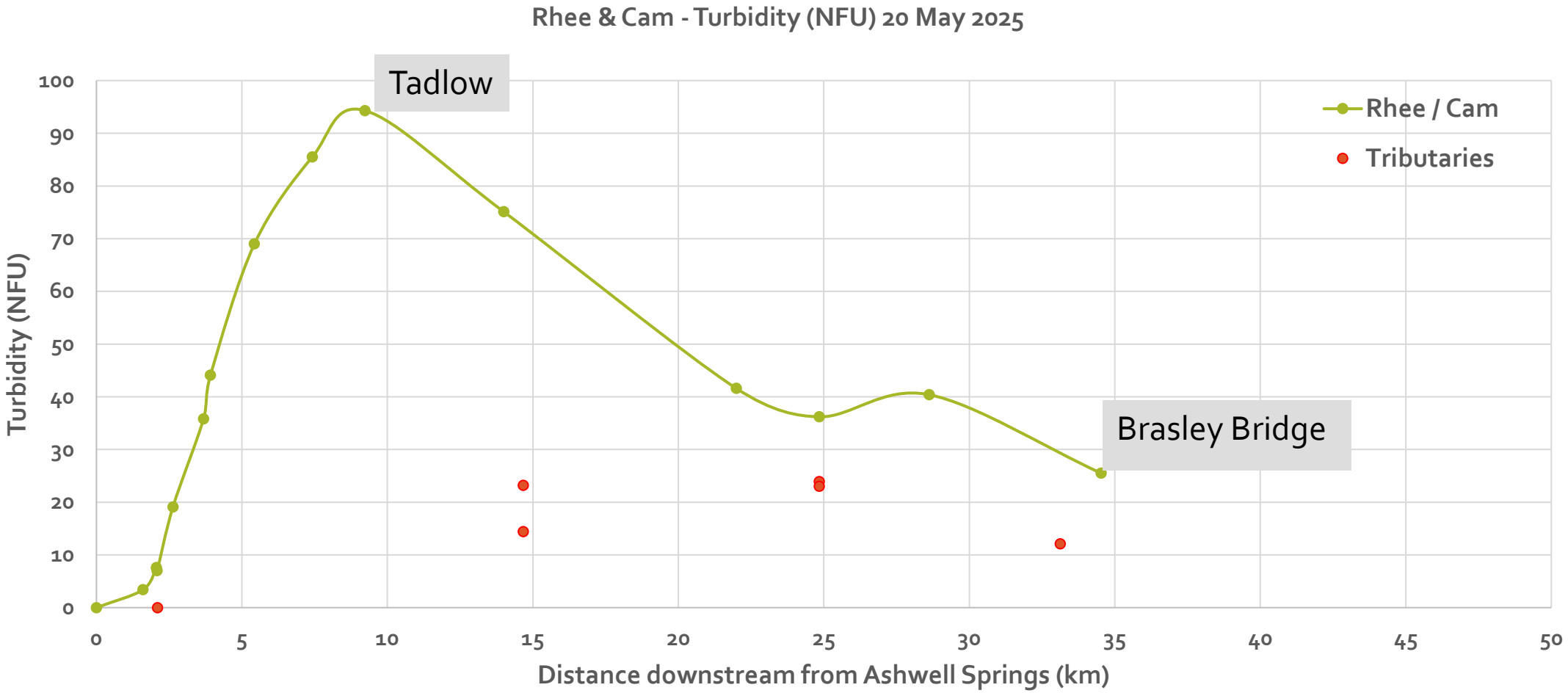
2025

Hanna HI-98594 Multiprobe in action.

This can be both lab and field based

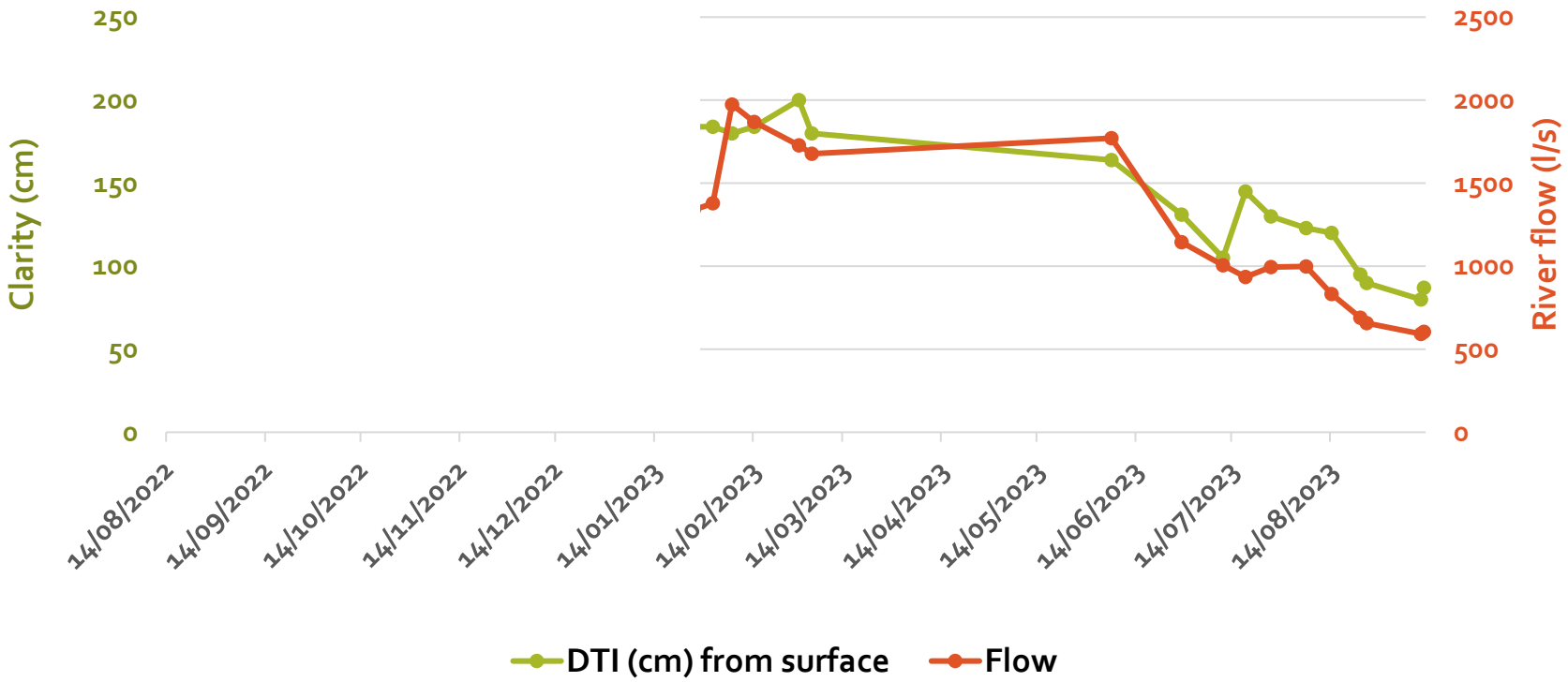


Although not specified in this chart some tributaries are Chalk streams and two have become turbid as they approach the junction with the Rhee



A similar pattern to 8 May 2025

Depth to invisibility (DTI) when river flow <2000 l/s, e.g. in summer 2023 clarity decreases with decreasing flow



Left half of chart obscured to better describe the changes in clarity as the Cam flow falls in summer 2023

Why turbidity matters to aquatic life

(Measured as "Time to Lethal Hypoxia" due to sediment-induced oxygen depletion.)

No Riverfly data for Rhee (One site at fish pass at Byron's Pool)

(Measured as "Time to Lethal Hypoxia" due to sediment-induced oxygen depletion.)

Species / Group	Egg/Spawning Stage Max Sediment (mg/L)	Juvenile Stage Max Sediment (mg/L)	Adult Stage Max Sediment (mg/L)	Egg/Spawning Stage Max Turbidity (NTU)	Juvenile Stage Max Turbidity (NTU)	Adult Stage Max Turbidity (NTU)	Time to Lethal Hypoxia
Brown Trout (*Salmo trutta*)	< 5	< 10	< 10	< 2	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile: < 8 hrs Adult: < 12 hrs
Bullhead (*Cottus gobio*)	< 10	< 15	< 15	< 5	< 7	< 7	Egg/Spawning: < 6 hrs Juvenile: < 8 hrs Adult: < 12 hrs
Stone Loach (*Barbatula barbatula*)	< 5	< 10	< 10	< 2	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile: < 8 hrs Adult: < 12 hrs
Mayflies (Baetidae family)	< 3	< 5	< 5	< 2	< 3	< 3	All stages: < 4–6 hrs
Caddisflies (Trichoptera)	< 3	< 5	< 5	< 3	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile/Adult: < 8 hrs
Stoneflies (Plecoptera)	< 3	< 5	< 5	< 2	< 3	< 3	All stages: < 4–6 hrs
Freshwater Shrimp (*Gammarus pulex*)	< 5	< 10	< 10	< 3	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile/Adult: < 8 hrs
Aquatic Snails (*Planorbis* spp.)	< 10	< 15	< 15	< 5	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile/Adult: < 10 hrs
Smooth Newt (*Lissotriton vulgaris*)	< 5	< 10	< 10	< 3	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile/Adult: < 8 hrs
Common Frog (*Rana temporaria*)	< 5	< 10	< 10	< 3	< 5	< 5	Egg/Spawning: < 6 hrs Juvenile/Adult: < 8 hrs

(Measured as "Time to Lethal Smothering" due to sediment coverage.)

Reduced light levels will also be one strong factor

Species / Group	Seedling Stage Max Sediment (mg/L)	Mature Stage Max Sediment (mg/L)	Seedling Stage Max Turbidity (NTU)	Mature Stage Max Turbidity (NTU)	Time to Lethal Smothering
Chara spp. (Stoneworts)	< 3	< 5	< 1	< 2	Seedlings: < 12 hrs Mature: < 24 hrs
Ranunculus spp. (Water Crowfoot)	< 7	< 10	< 3	< 5	Seedlings: < 12 hrs Mature: < 24 hrs
Potamogeton spp. (Pondweeds)	< 7	< 10	< 3	< 5	Seedlings: < 12 hrs Mature: < 24 hrs
Myriophyllum spp. (Water Milfoil)	< 7	< 10	< 3	< 5	Seedlings: < 12 hrs Mature: < 24 hrs
Najas flexilis (Water Nymph)	< 2	< 3	< 1	< 2	Seedlings: < 12 hrs Mature: < 24 hrs
Callitriche spp. (Water Starwort)	< 3	< 5	< 2	< 3	Seedlings: < 12 hrs Mature: < 24 hrs

Rhee – high turbidity at Malton Farm, 01/08/22 – brutish plants starting to dominate

Rhee - Malton Farm bridge
Unbranched Bur-reed

Many holes and unstable lower bank on right hand side

Phosphate?

"One common feature of the rivers suffering turbidity issues is sewage pollution and a potential link with high phosphate inputs from STWs." *WASP* (Windrush against Sewage Pollution)

Photos: River Windrush in 2009 and again in 2020 in similar conditions

Phosphate overload creating a eutrophic watercourse

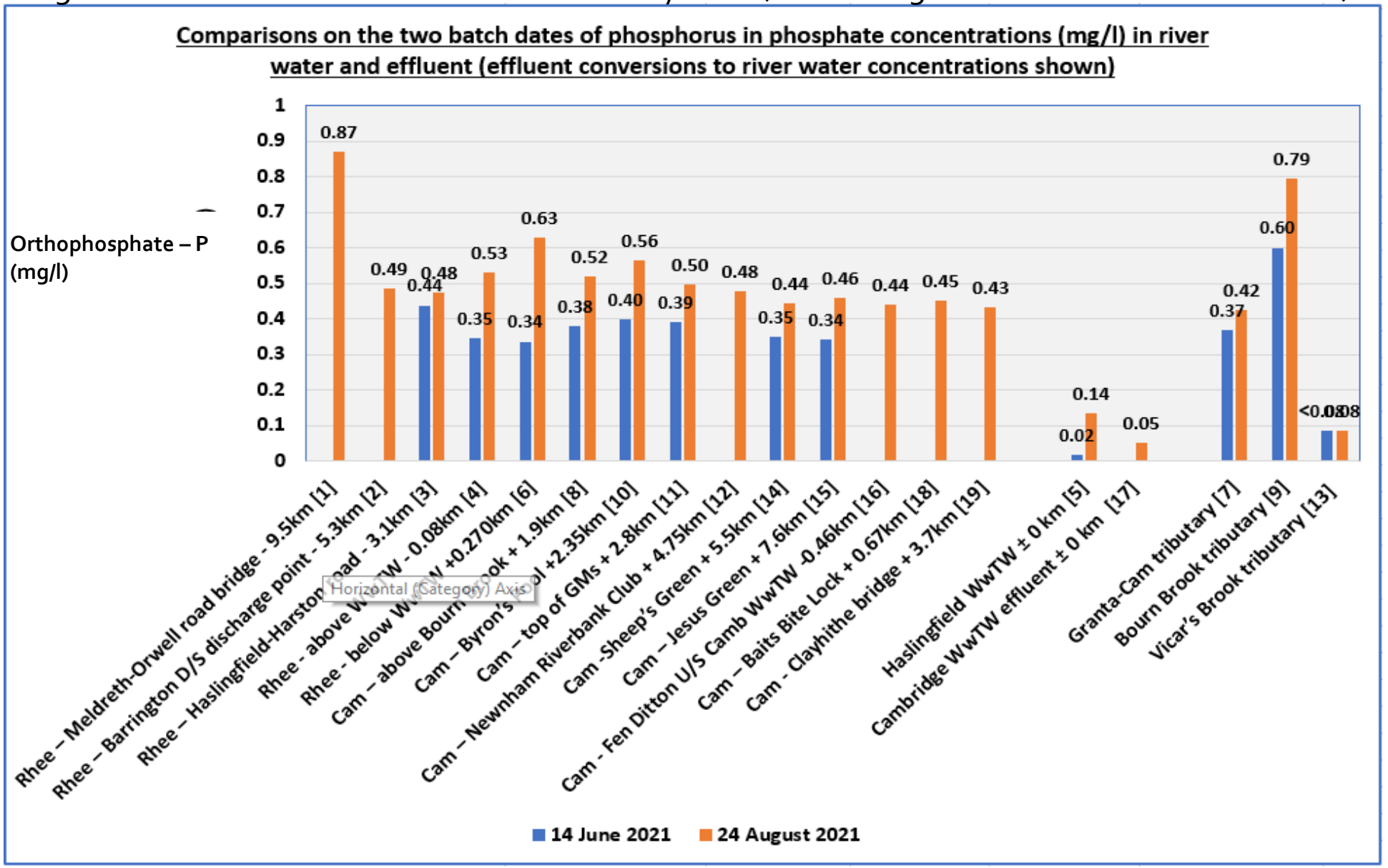
Swaffham Bulbeck Lode, 31st May 2021

Source: Bottisham sewage treatment works (96% phosphate attribution by EA)

Phosphate overload

River bed algal mats: River Cam, Byron's Pool, 27 July 2021

High concentrations from Malton Farm to Clayhithe (in lowering flows between the two dates)



Nutrients at low levels in the Rhee and Cam suitable for Water Crowfoot?
No. Approaching Cambridge there are high phosphate and very high nitrate concentrations

Water Crowfoot – a Chalk stream plant important to other aquatic life

Credit: Wild Trout Trust

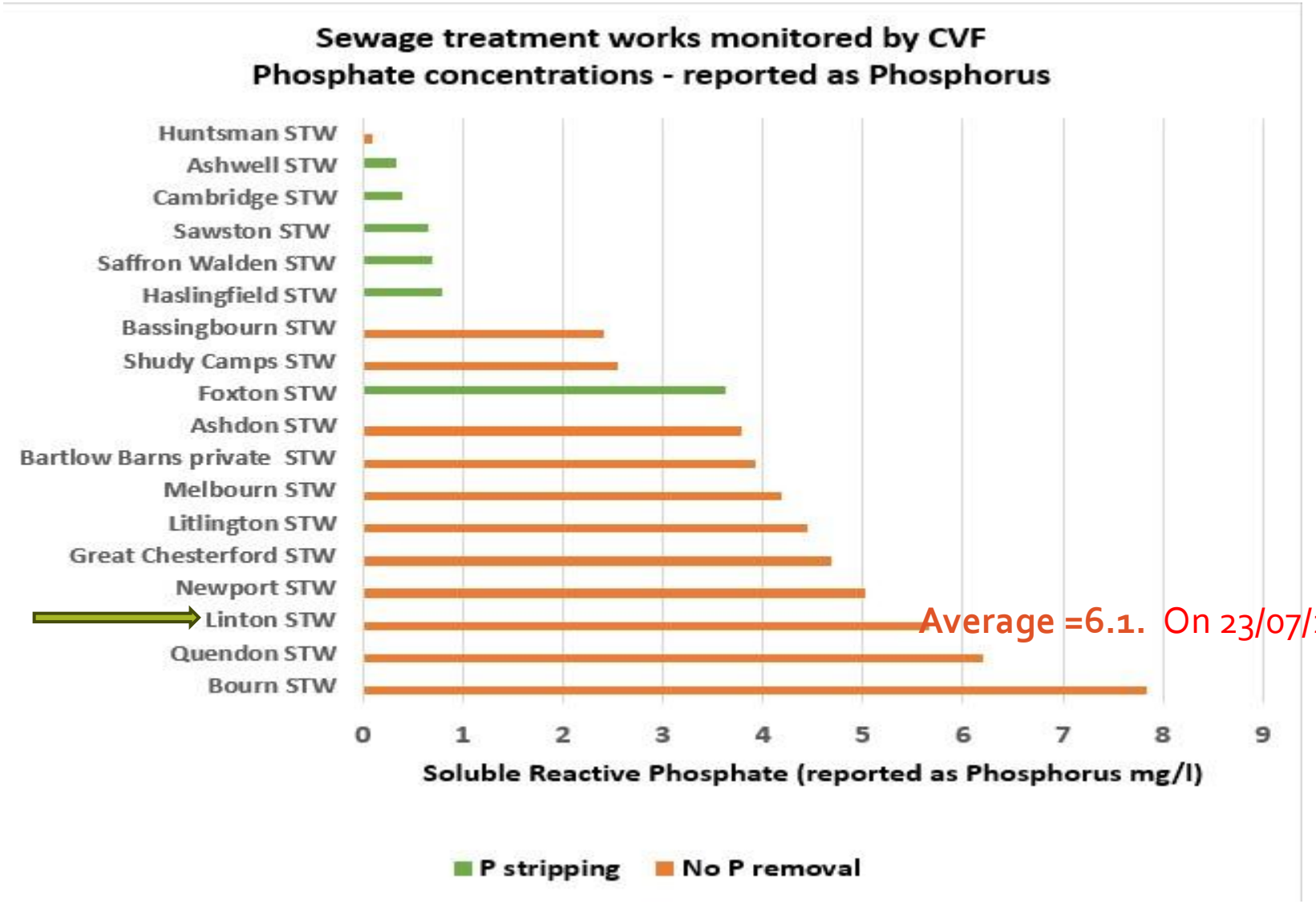
SAGIS - Source Apportionment Geographical Information System

Water Body Name	Sector % Load Contribution							
	Sewage Works	Intermittents	Industry	Livestock	Arable	Highways	Urban	Unsewered Sewage Discharges
Cam	78.04%	0.91%	0.87%	2.45%	6.50%	0.04%	9.47%	1.72%

Agriculture sources versus sewage works treated-effluent?
Phosphate from sewage treatment is overall still a problem
but reducing

LINTON STW – P STRIPPER ADDED DECEMBER 2024

(2022-2023)



Average =6.1. On 23/07/25 - 0.058 Phosphate-P – a 99% reduction

Algal blooms?

River Granta, ponded, unicellular green algae

Turbidity in the upper Rhee was NOT shown to be caused by algal blooms

Turner Aquafluor Chlorophyll *a* and phaeophytin meter (£4,000)

Thanks to Prof. David Aldridge, Dept. Zoology, CU for its use

Zero readings of Chlor *a* in the upper Rhee and Cam

Sample date	Time	Location	IVCH (Chl *a)* by meter (ug/l)
23/08/2024	1811	Rhee Ashwell Bluegates Farm	0.000
23/08/2024	1820	Rhee Ashwell End Dunton Lodge Farm	0.000
23/08/2024	1914	Rhee Whitegates Bridge Eyeworth minor road	0.000
23/08/2024	1958	Rhee Guilden Morden to Potton road 'HOOK'	0.000
23/08/2024	2024	Mill river Wendy bridge	0.000
23/08/2024	2054	Rhee Harston-Haslingfield bridge road 'HHRB'	0.000
21/08/2024	1900	Cam Grantchester Brasely Bridge	0.000
27/08/2024	1345	Cam Grantchester Brasely Bridge	0.000
23/08/2024	1054	Cam Cambridge Sheep's Green 'SHEE' EA site	0.000
27/08/2024	1315	Cam Cambridge Sheep's Green 'SHEE'	0.000
21/08/2024	1305	Cam Clayhithe	0.000

Struvite?

Magnesium ammonium phosphate hexahydrate

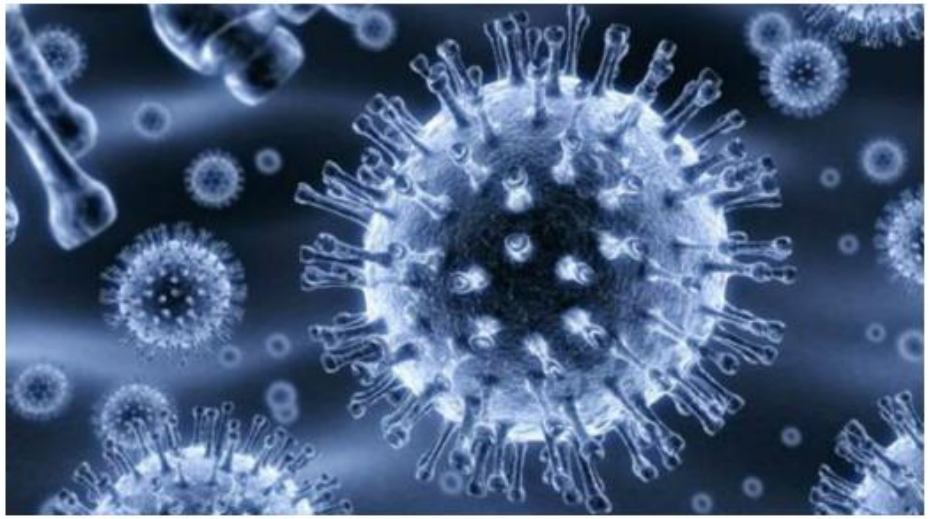
$MgNH_4PO_4.6H_2O$

Informed opinion says there is insufficient magnesium in the rivers

Not associated with sewage effluent as huge amounts would need to be discharged continually and turbidity measurements of effluent show it to be too clear.

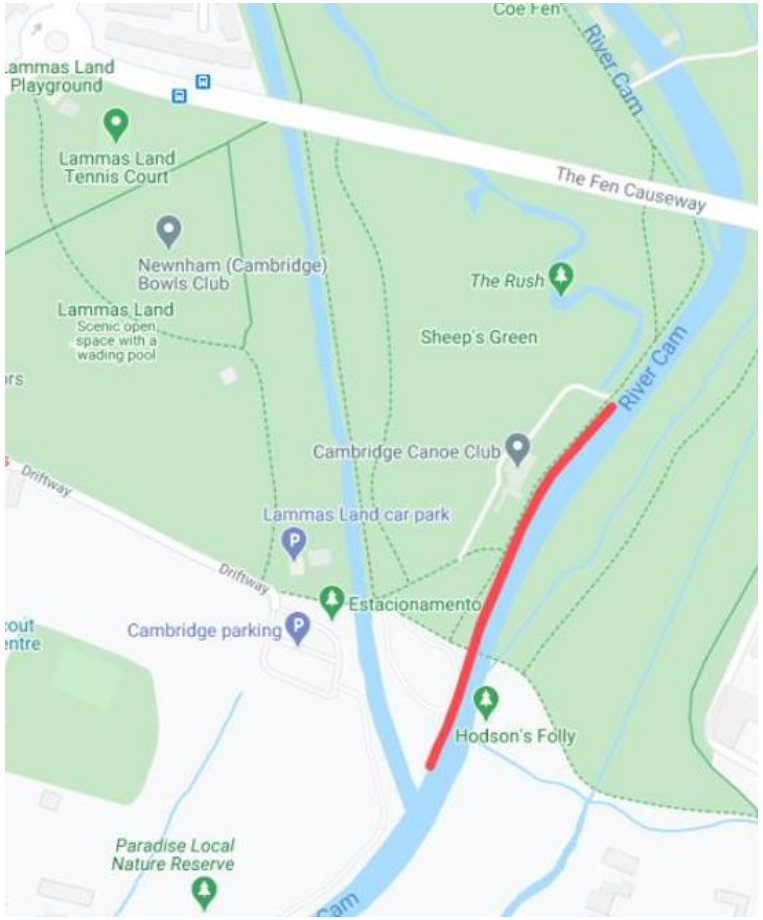
Faecal contamination

in our rivers.



Cam Valley Forum Safer Swim Initiative 2021

Main Cambridge swimming area - Sheep's Green, 1960's

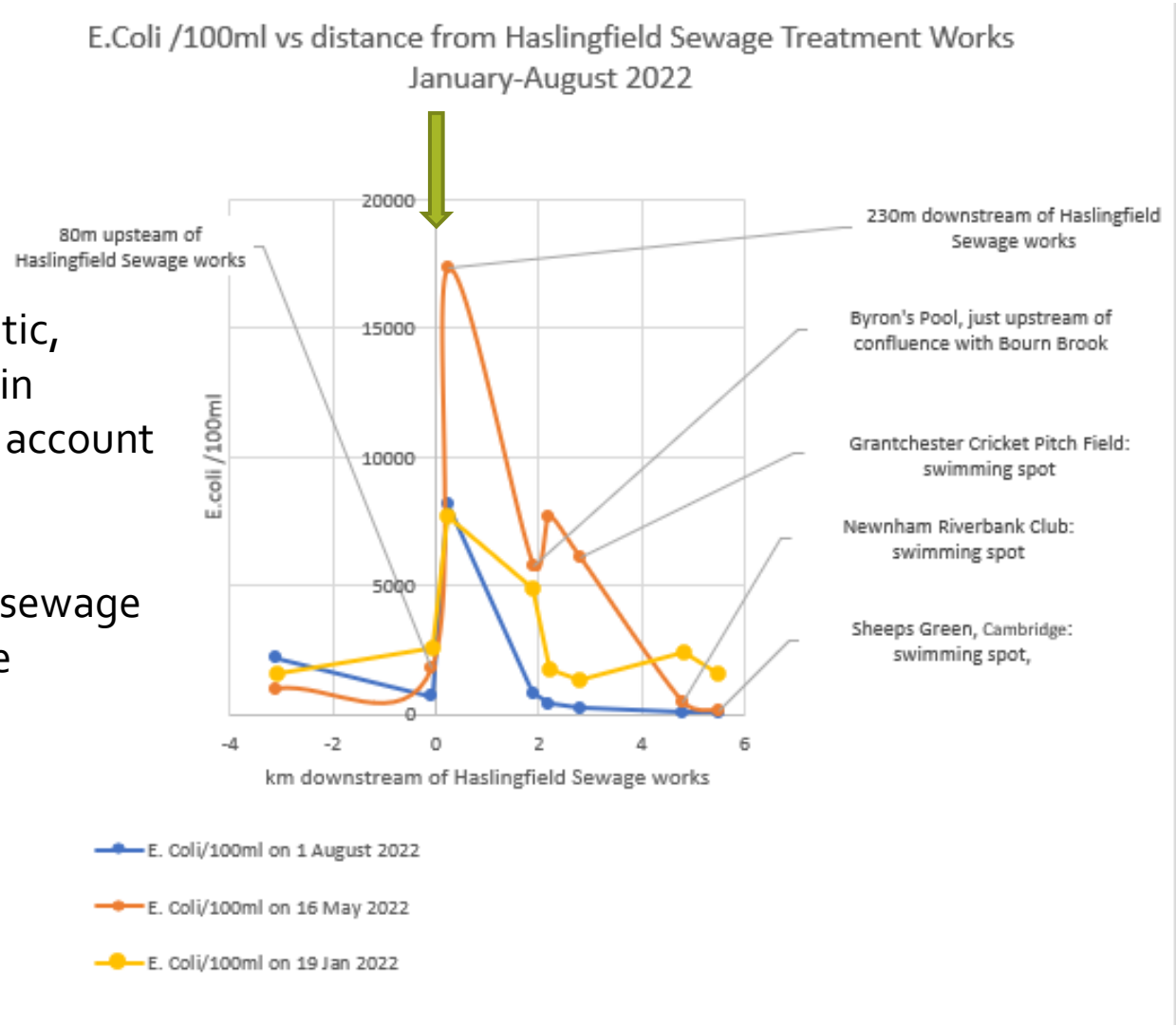


Sheep's Green, potential Defra-designated Bathing Water

Influence of Haslingfield STW on counts of faecal indicator bacteria in river samples

It's not in the nature of aquatic, riverine bacteria to build up in numbers to trillions / litre to account for the river turbidity.

Faecal bacterial numbers in sewage effluent are far too low to be significant



Haslingfield STW during storm overflow

The pure storm overflow had a turbidity of 7.45 FNU which is not high

				Turbidity FNU
13 May 2024	1630	Haslingfield STW	Final treated effluent	14.43
30 April 2024	845	Haslingfield STW	Treated final effluent, rect. outflow at OSM/UWWTR, tested 4 May	5.15
30 April 2024	845	Haslingfield STW	Treated final effluent, round outflow at OSM/UWWTR, tested 4 May	1.07
30 April 2024	845	Haslingfield STW	Storm overflow, STW, pure, tested 4 May	7.45

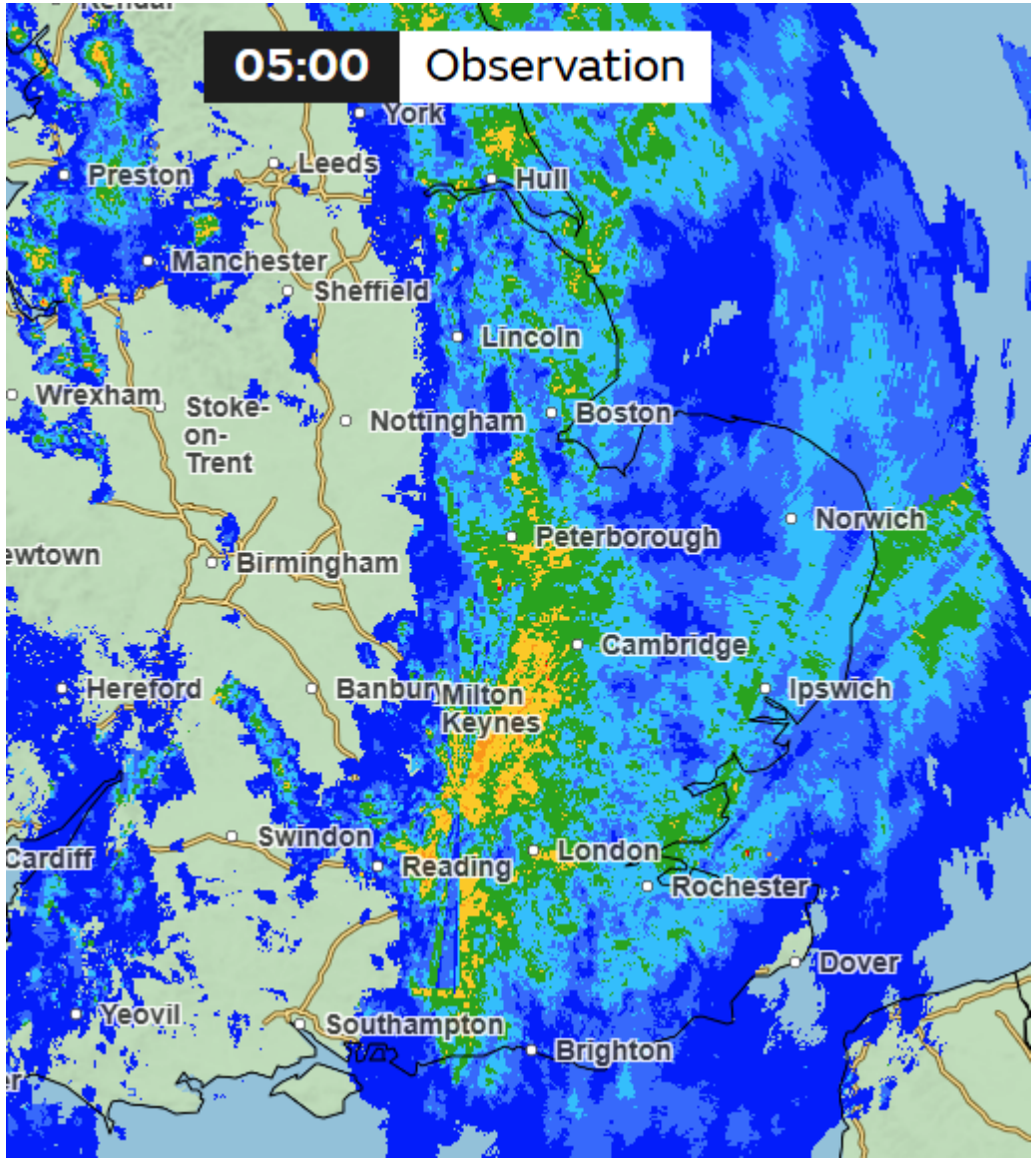
Linton and Melbourn STW effluent: so clear that the Secchi tube was completely filled and disk still visible

Road runoff?

A11 / A505 National Highways road runoff outfall into Granta

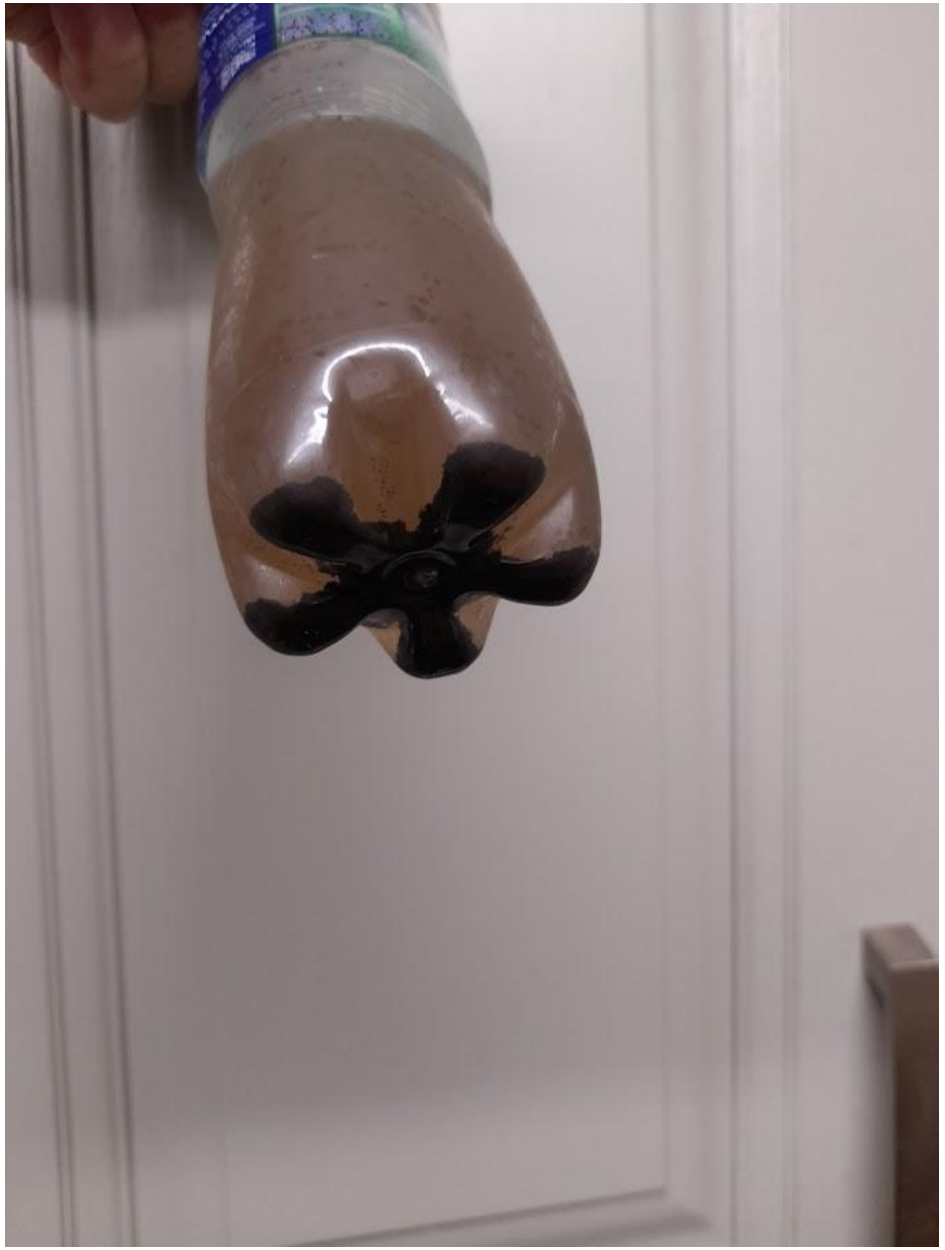
Brasely Bridge outfall, Trumpington to Grantchester road

Cam /M11 bridge 24 May 2025, 0602, about one hour after start of rainfall



M11 outfall points discharging road runoff into the Bourn Brook, mapped by National Highways

Long Road Cambridge,
by Hobson's Brook Chalk stream
- road runoff (puddling along kerb)



Proposed chemical analyses (plus dissolved heavy metals)

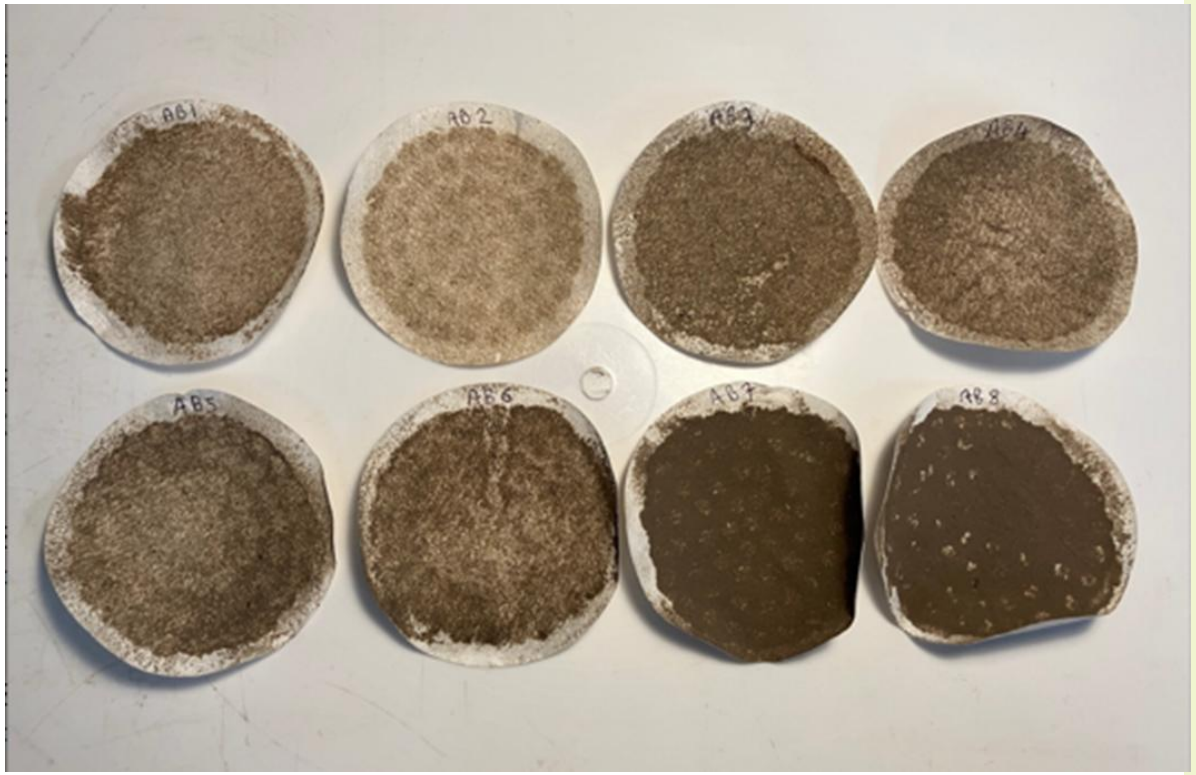
Determinand	Reporting Limit	Units
Aluminium, total as Al (ug/l)		
Cadmium, total as Cd (ug/l)	7.5	ug/l
Chromium, total as Cr (ug/l)	0.07	ug/l
Copper, total as Cu (ug/l)	0.51	ug/l
Lead, total as Pb (ug/l)	1.8	ug/l
Nickel, total as Ni (ug/l)	0.3	ug/l
Zinc, total as Zn (ug/l)	1	ug/l
Polycyclic Aromatic Hydrocarbons	6	ug/l
Benzo(a)pyrene		
Benzo(g,h,i)perylene	0.002	ug/l
Benzo(k)fluoranthene	0.005	ug/l
Chrysene	0.005	ug/l
Fluoranthene	0.005	ug/l
Fluorene	0.005	ug/l
Indeno(1,2,3-cd)pyrene	0.005	ug/l
Naphthalene	0.005	ug/l
Pyrene	0.01	ug/l
Benzothiazoles Phthalates 6PPD (Phenylenediamine) 6PPD-Quinone	0.005	ug/l

Some have Environmental Quality Standards limits

What about straightforward soil?

Experimental approach to determining causes of turbidity in river water

- Sampled 27/09/2024, spate conditions, Granta
- Suspended Solids collected onto weighed filter paper using vacuum pump. Dried at 105 deg C
- Organic matter determined by "loss on ignition, i.e. 950 deg C furnace
- Weighed to one milligram



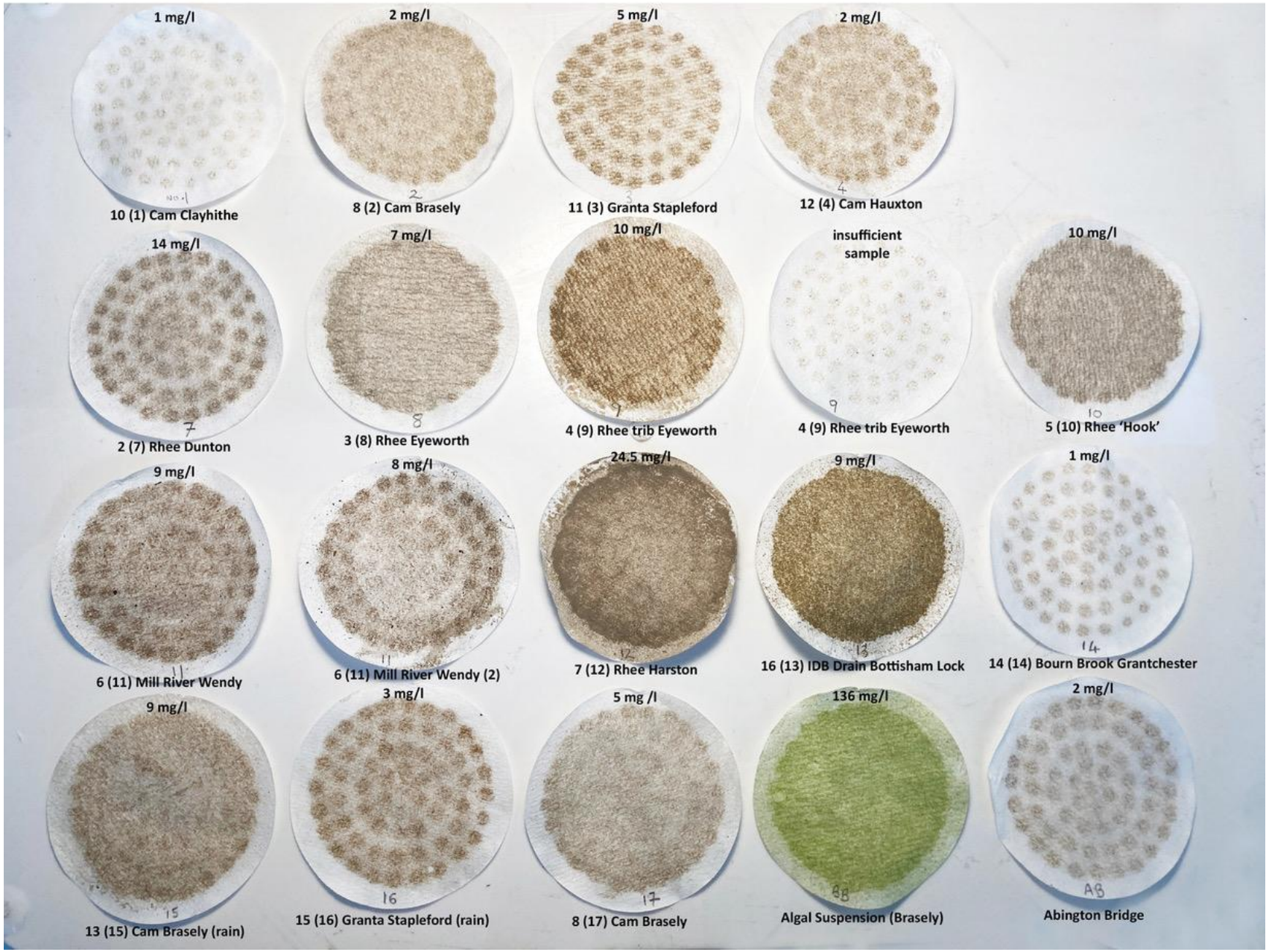
Experimental results

Sites	% organic	% $CaCO_3$	% silicate residue
7+8	21.7	22.7	55.6

Steve Boreham, Wildreach.co.uk

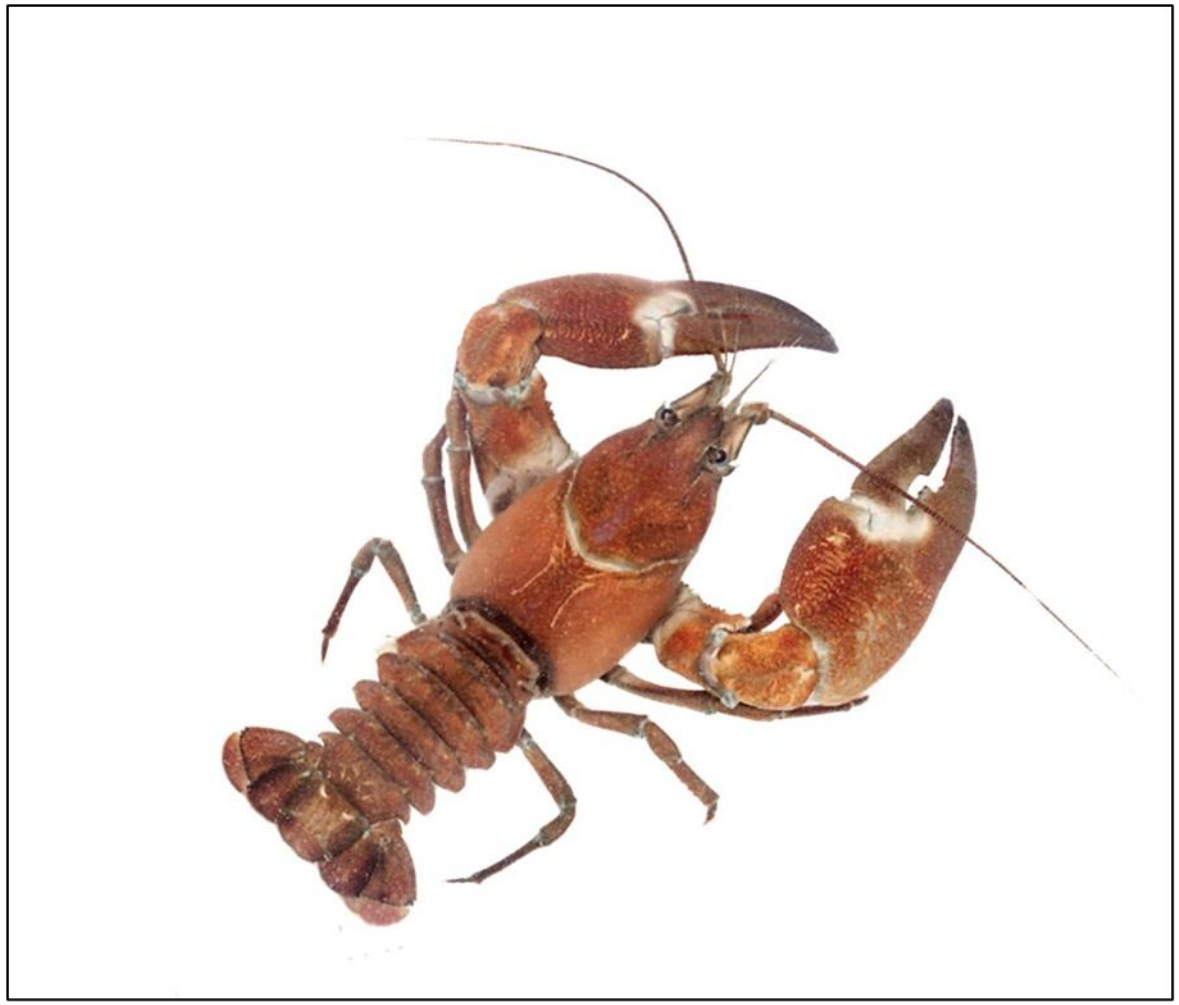
Small amounts of soil runoff from an arable field quickly makes a ditch turbid

Filter Papers from Suspended Solids Analysis of Water Samples from the Cam Valley



Dr Steve Boreham
WildReach

Americal Signal Crayfish?



Exo-skeleton is replaced as crayfish grows

Even claws can be replaced

Fighting between adults creates significant uplift of sediment from the bed

There are four adults in this picture!

1,654 of all ages removed in 10m in three Sweeps. A headwater site in Wharfe Catchment, Yorkshire.

Daniel David Adrian Chadwick, University College London. PhD thesis (studies In 2016)

Credit: Nottinghamshire Biodiversity Action Group

Many sites from Cambridge up to Wendy

Crayfish burrows cause Bank erosion even collapse.

American Signal Crayfish – key points

- Up to 110 crayfish recorded per square metre by novel three-times sweep method, in rocky upland Yorkshire stream.

- Often reported in literature as 1 to 8 per square metre.

- A minimum of one female and one male per 1000 square metres proposed to be the Minimum Viable Population Density, usually undetectable.

- It might take six years for an introduction to a new water to become saturated and the pressure to migrate leads to dispersal.

- One radio tagging study showed movement upstream up to 100m in a night.

- Other taggings (River Wharfe) showed movement either way, up to 328m during the study.

- High flows in winter did not cause death or push individuals downstream. Movement away from a spot was much reduced mid Dec when water temp dropped.

“Burrowing and the associated acceleration of retreat and collapse supplied an additional 25.4 t km^{-1} a^{-1} of floodplain sediments at one site”

<u>Extrapolation to the Rhee (with caveats)</u>
= ONE TONNE of bank soil loss over 15 km PER DAY

Conclusions

- No evidence that the prolonged turbidity is caused by algal blooms
- Not sewage works related
- Not a direct phosphate effect
- Upper Rhee – probably soil alone
- Lower Rhee and Cam – soil + American Signal Crayfish

Action points

- Reduce soil runoff from arable fields into ditches or direct into the rivers
- Discontinue any dredging of the rivers
- Reinforce bank sides
- Need for scientists to devise a control measure for the crayfish