Water Quality Data Interpretation

Advice from a novice

Disclaimer: Please note, this is one person's initial interpretation of the data. There may well be other valid interpretations of the same data.

Some Basics

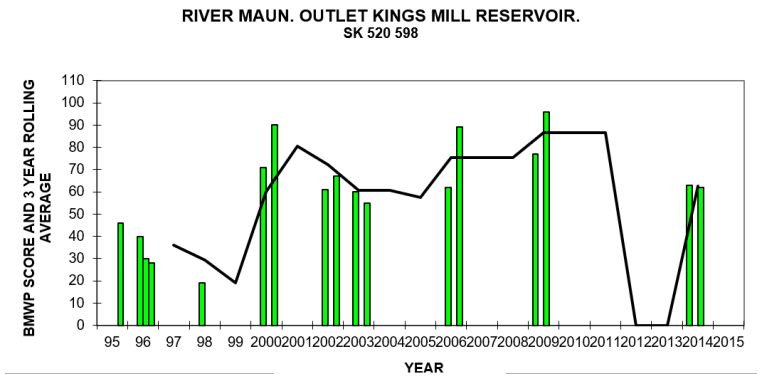
- **Consistency in data collection – same place / same methods / sample frequency etc.**

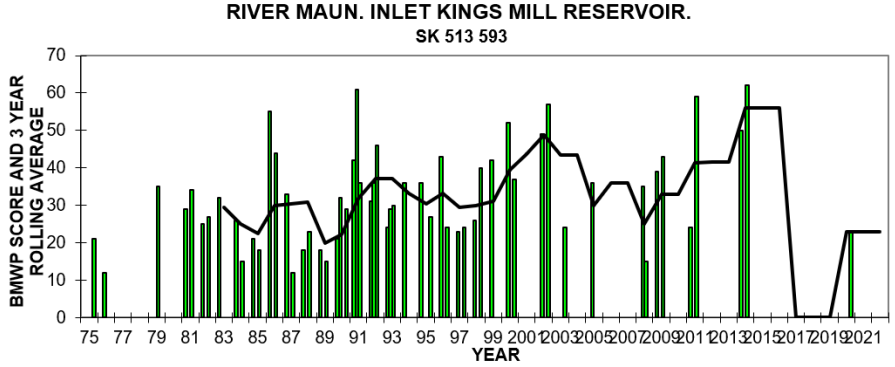
So much is variable that it is important to ‘control’ the human element

- **Don’t get too bogged down in the detail**

Look for **trends** and **anomalies** in the overall pattern as well as specific numbers

- **Long term data = GOOD**





Everyone wants a number.

- **Everyone wants a 'trigger level'** – it's easier to understand.
- **Triggers / standards are set for various reasons –** e.g. human health, WFD classification boundaries.
- **Not always easy to find a 'number'** – it can also be more subtle than just looking at the number.

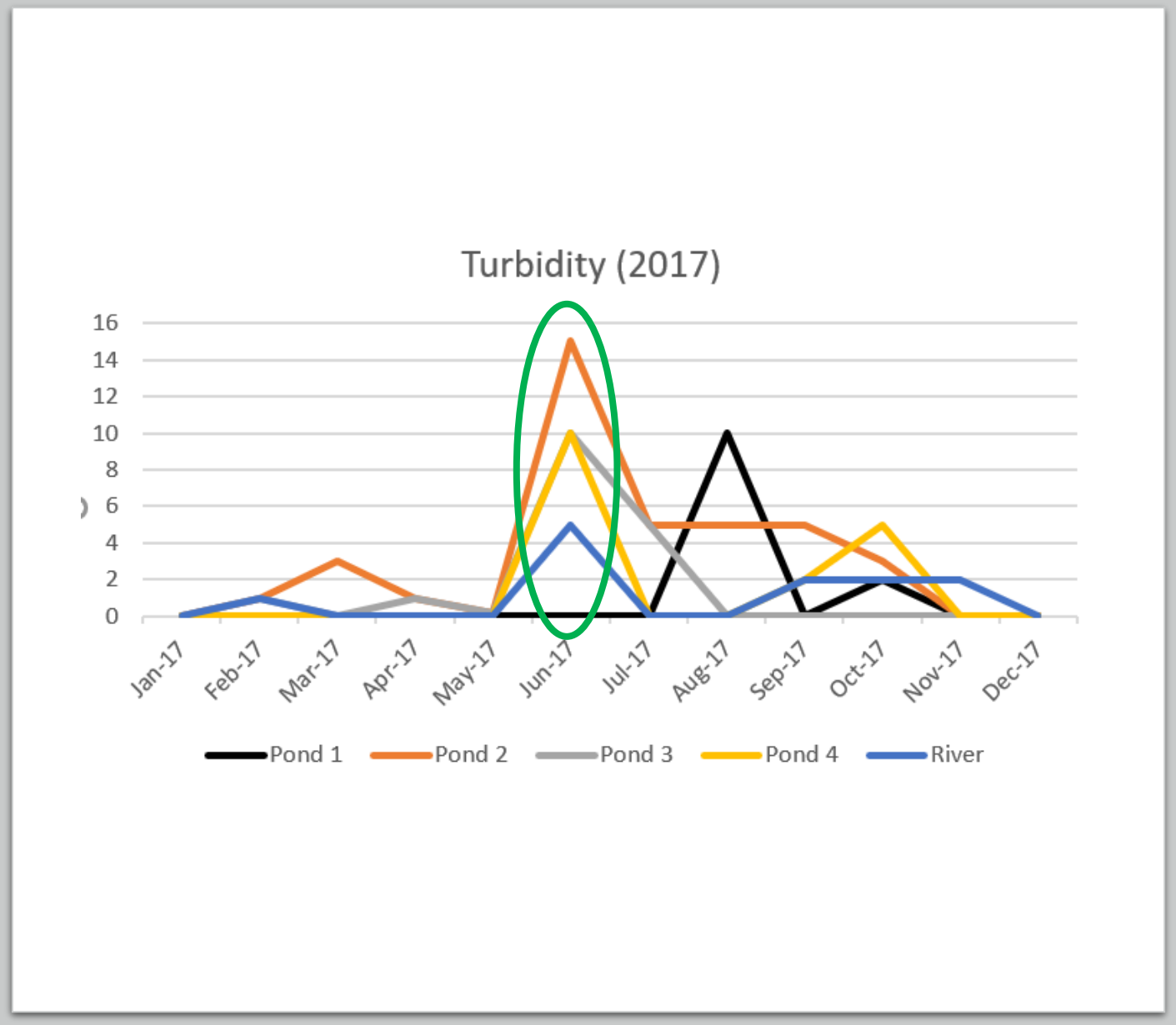
Table 9

Ammonia standards for lakes (lakes categorised by type in accordance with paragraph 2(2) of Schedule 2)				
Total Ammonia as nitrogen (mg/1)				
(90 percentile)				
Type	High	Good	Moderate	Poor
1, 2, 4, and 6	0.2	0.3	0.75	1.1
3, 5 and 7	0.3	0.6	1.1	2.5

Example of WFD classification standards from UK Tag guidance document – available from GOV.UK website.

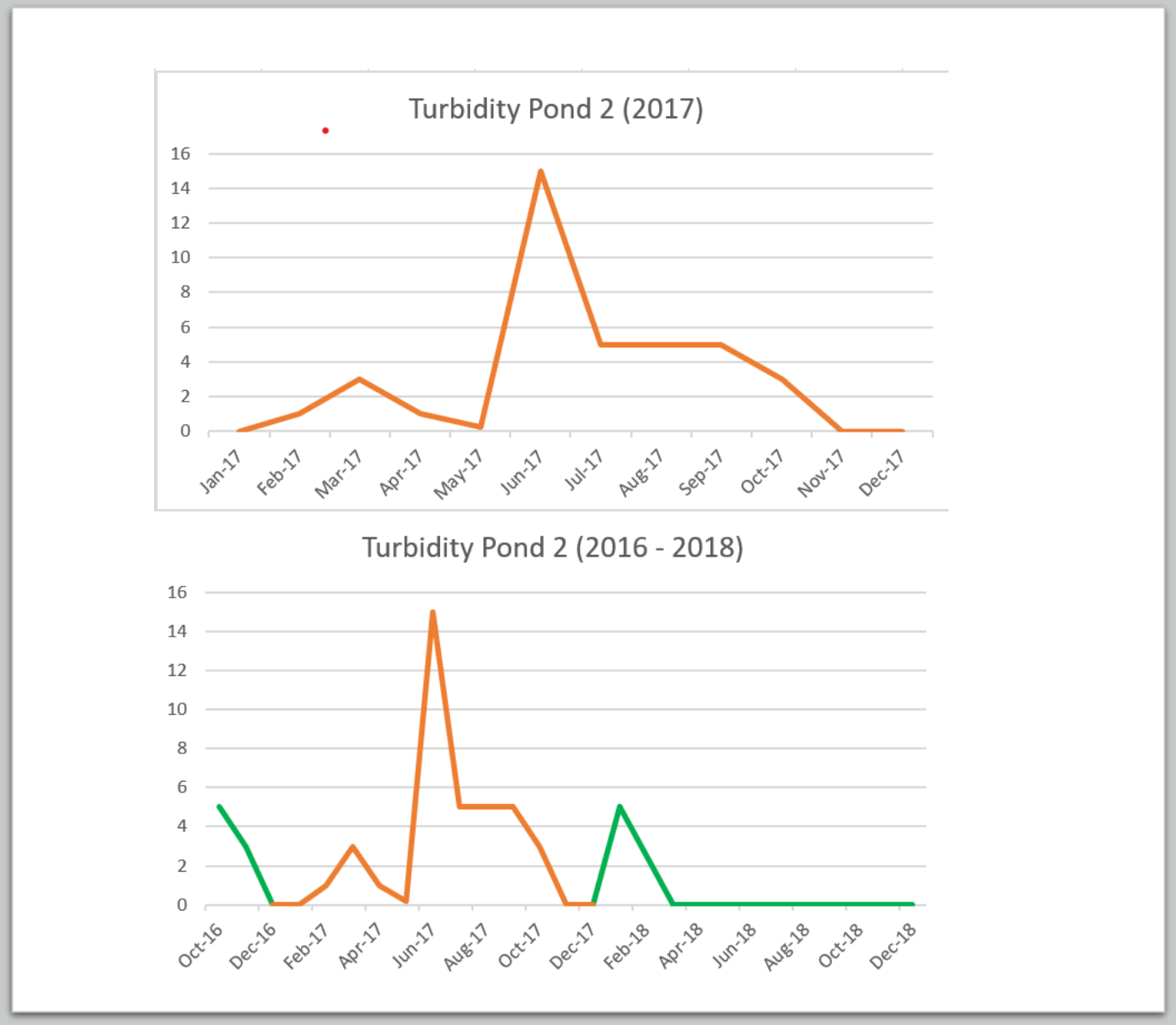
Spotting the trend / anomaly.

- Lots of data which can be quite confusing – even from 1 years data.
- **1** thing should stand out.
- **Consistently high turbidity in June samples**.



Anomaly or not?

- **Remove the noise** – just focus on the bit you're interested in.
- **Look at the long term trend** – the benefit of good sampling over a period of time.
- **The spike still looks like a spike.**



Reasons for the anomaly

- **Human ‘error’**

Who collected the data – are they trained / following the method / right sampling location / using test kits properly.

- **Machine ‘error’**

Are the kits calibrated / in date.

- **An environmental reason – the Sherlock Holmes bit**

Includes (but not exclusively because it’s a game of chess on a moving board):

Pollution – from a point source (e.g. pipe) or diffuse source (surface water run off).

Weather – temperature / rainfall etc.

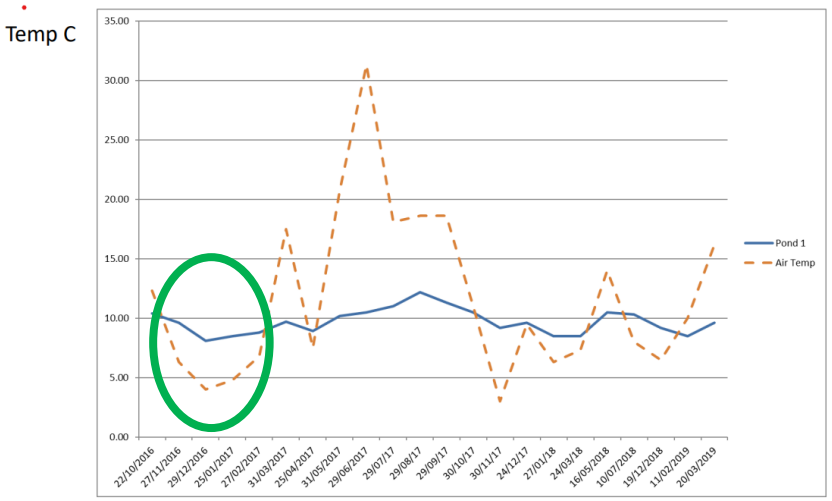
Physical / chemical interactions – the state of one thing affects another (e.g. oxygen concentration is higher at lower temperatures because oxygen is more soluble in cold water)

Biological interactions – (e.g. oxygen concentration is higher when algae / plants are photosynthesising)

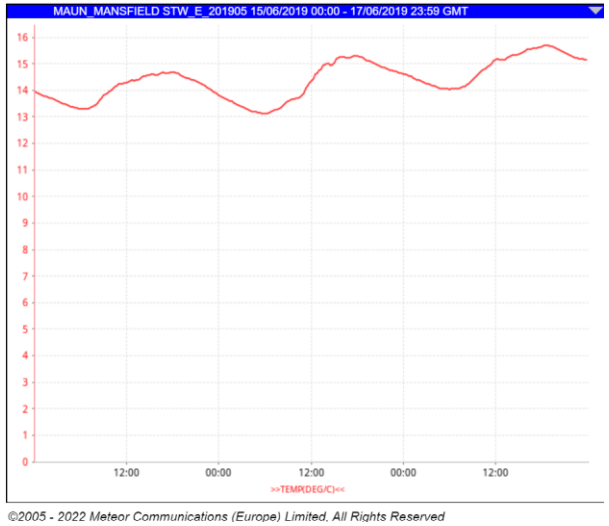
Reasons for the anomaly

- **Timing**

The season and time of day can make a difference.



Temperature is lower in winter
- surrounding environment is colder.



Temperature varies over 24hrs -
surroundings usually warmer during daylight.

REMEMBER:
You are only sampling a point in time with spot sampling – so you don't get the full picture.

Reasons for the anomaly

- **A number of physical environmental factors influence water chemistry:**
- Underlying geology / sediment type – effects ‘natural’ nutrient status.
- Water depth / residence time – effects things like nutrient storage / light penetration / how quickly water passes through.
- Human influence – modification & maintenance / management, direct or indirect inputs from human activity.
- **Good quality shallow lakes tend to be clear with good plant cover.**

Understanding the badger helps (e.g. turbidity)

- **Turbidity = Water clarity** – more suspended solid particles scatter more light making the water look cloudy.
- **Generally more turbid implies poorer quality**
- **Some sources:**
- Run off (diffuse or point sources)
- Erosion
- Biological activity (fish disturbing the sediment)
- High organic / sediment content in pond

- **Some reasons:**
- Rain – increase run off
- Wind – increases blow in and resuspension (particularly in exposed shallow lakes)
- Increased biological activity (fish movement / algal blooms – higher in warm weather)

Getting back to the point.

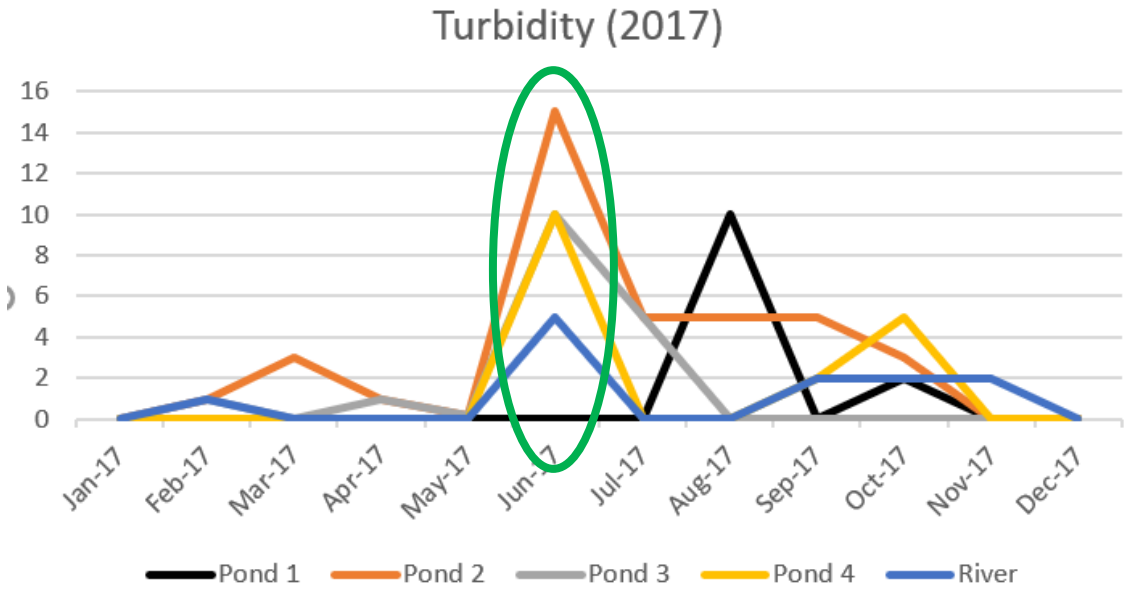
Field notes for June sample record weather conditions as **rainy**.

Most likely reason for higher turbidity is run off due to rain.

Higher turbidity in the river suggests a wider catchment event.

Pond 2 highest because naturally more turbid and erosion has been identified as a problem.

Pond 1 results indicate naturally less turbid – less exposed and spring fed?.



Couldn't find a 'number' for turbidity but usually <10 NTU in base flow conditions.

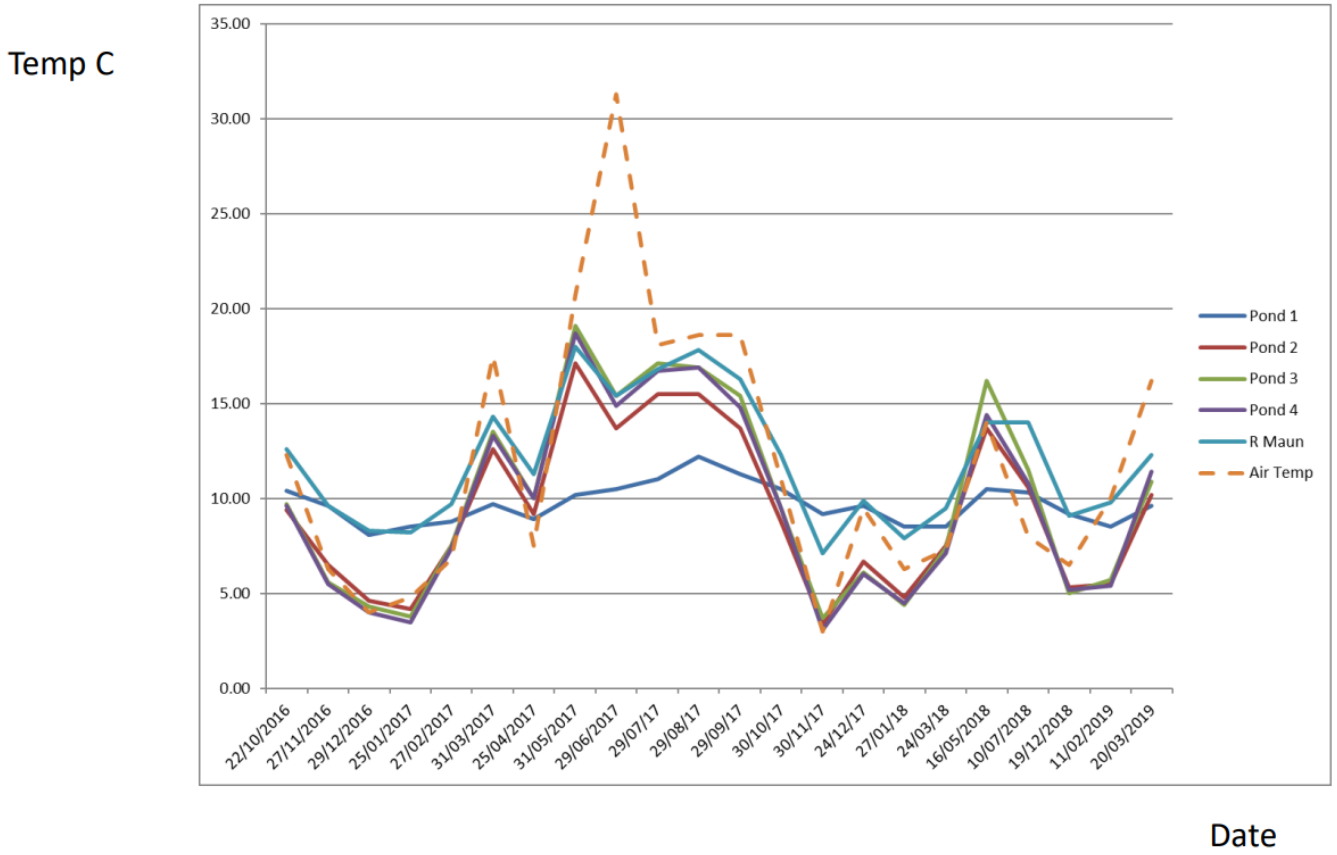
Temperature

- Some things affecting water temperature:
- Weather conditions – air temperature / rain / cloud cover
- Inputs / run off that are warmer or cooler than the water
- Surroundings – tree cover (light penetration) etc.
- Size / depth of lake – larger / deeper = more stable and slower response

- Changes in temperature influence water chemistry (e.g. oxygen dissolves more easily in cold water) and living things (e.g. fish are more active in warmer water)

Temperature in the ponds.

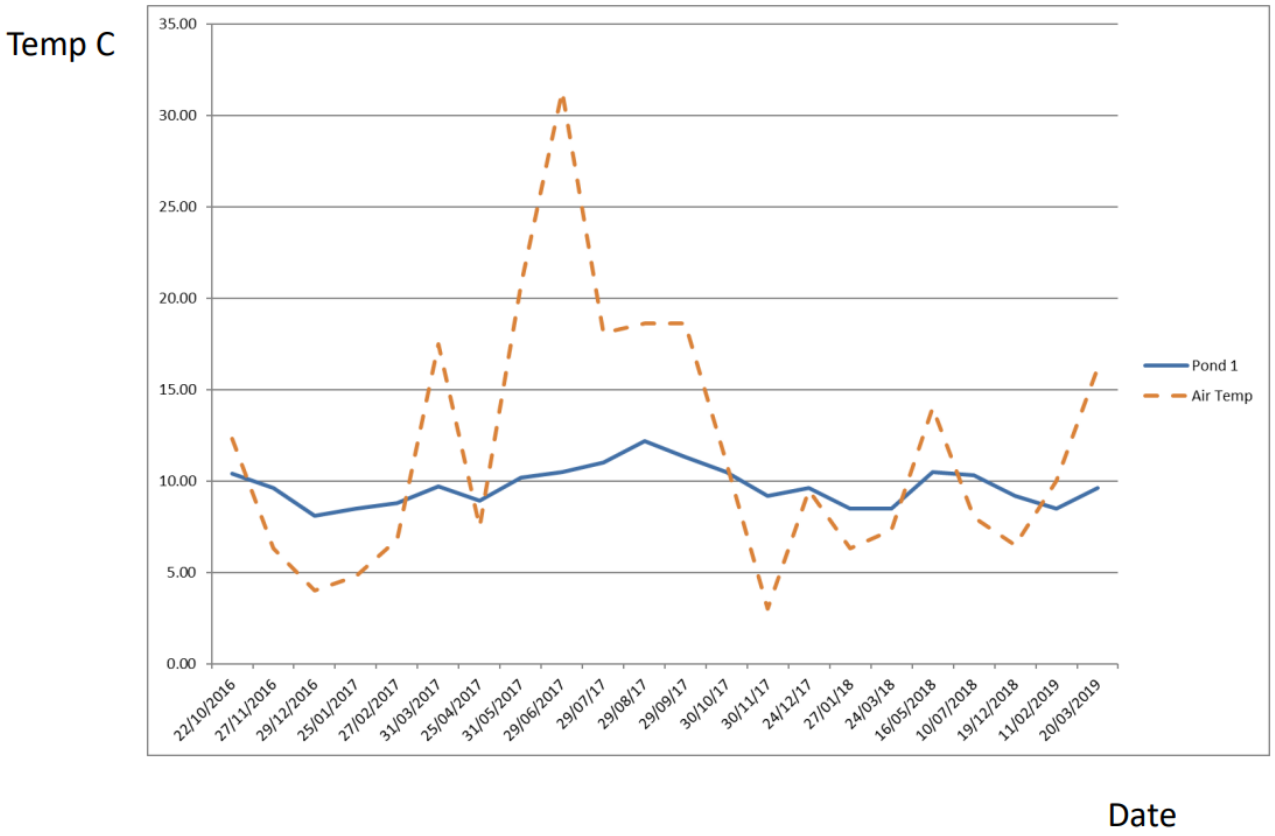
- Pond temperature corresponds with air temperature.
- Might see a change over time if some tree cover is removed and with climate change over a longer period.
- There is another anomaly……



For WFD Good classification mean temperature over 3 years needs to be <23°C – inlet to King's Mill (numbers vary with WB)

Pond 1.

- Water temperature in Pond 1 is far more stable and less responsive to changes in air temperature than other ponds.
- Most likely reason……
- Pond is spring fed.
- Spring water is consistently around 10°C.
- Pond 2 seems to be cooler than 3 and 4 suggesting water warms as it moves through the ponds.
- Opening up the tree cover might not have a massive effect depending on the volume of water which comes from the spring.



Water source might also explain why dissolved oxygen is lower in Pond 1 than others.

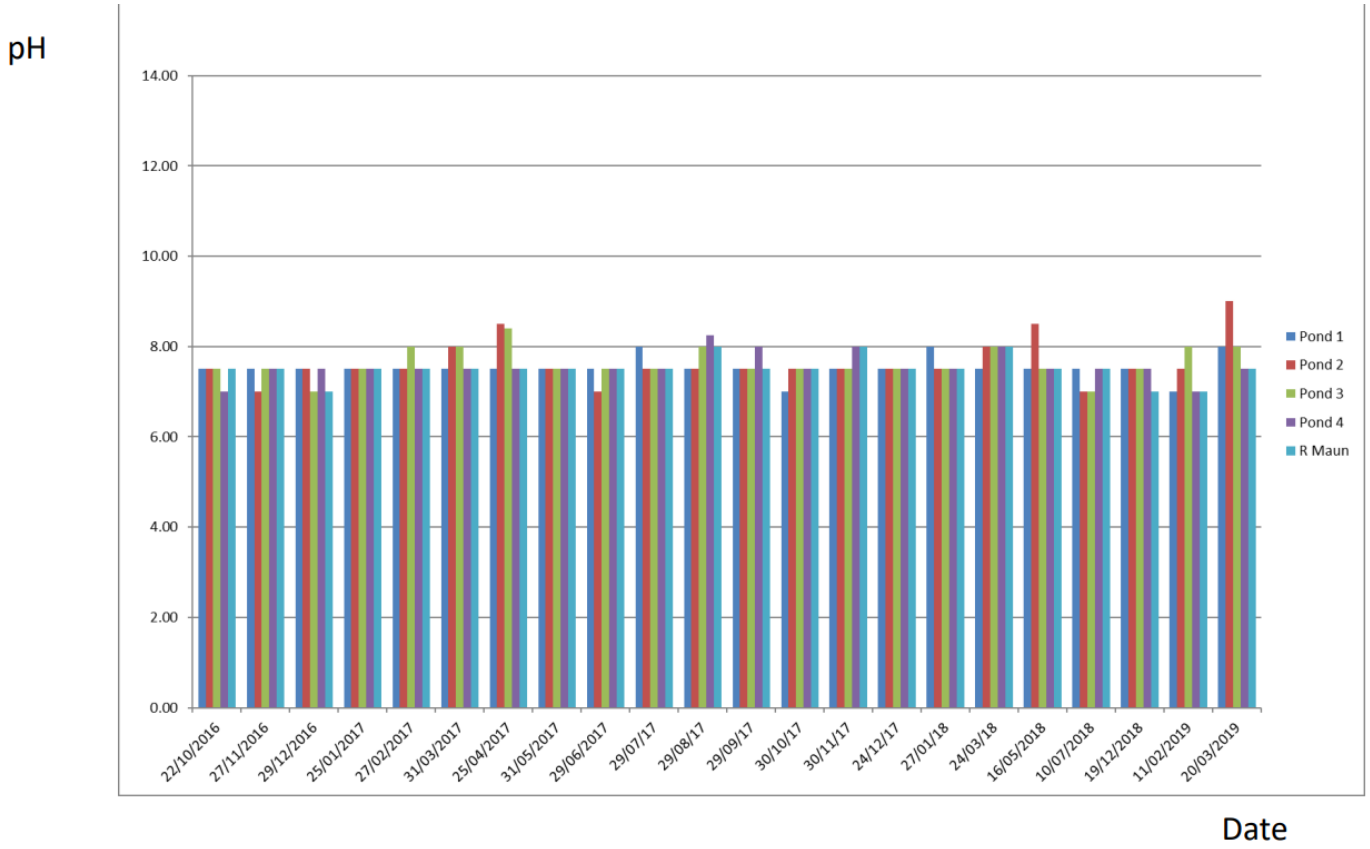
pH

- **Measure of how much like vinegar (acid) or bleach (basic) the water is.**
- **Scale = 1 (acid) – 14 (basic).**
- A small change in pH can be significant because it is measured using a log scale – pH 5 is 10x more basic than pH 4.
- **For High / Good WFD classification (rivers) pH should be between >= 6 - <= 9**
- Some things affecting pH:
- Underlying geology – e.g. Peat increases acidity.
- Inputs – point and diffuse inputs can alter pH in large enough volumes.

- Extreme changes in pH can be directly toxic whilst small changes can alter the toxicity of other chemicals and affect living things (e.g. cause irritation to fish gills).

pH in the ponds.

- Fairly stable and similar in all ponds.
- Has the method change with Waterside Care?
- Do lakes get algae blooms in spring / summer?
- Within range to achieve H / G WFD classification.



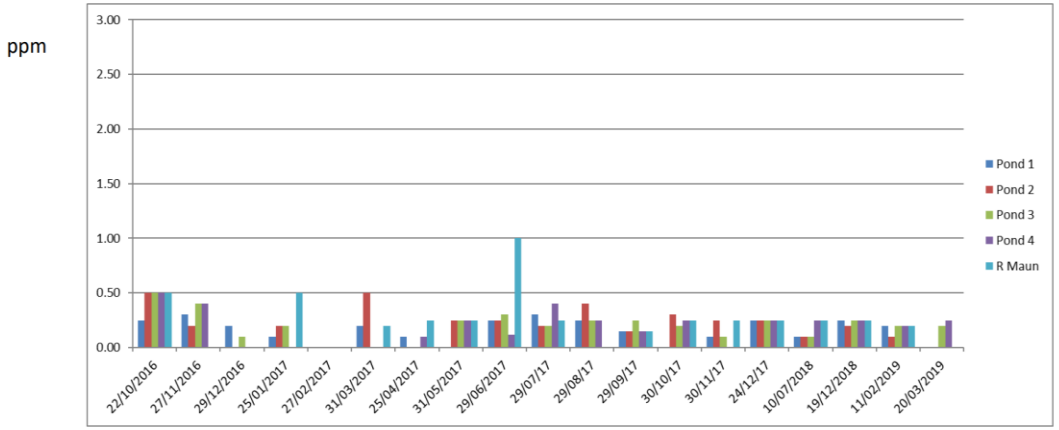
Ammonia

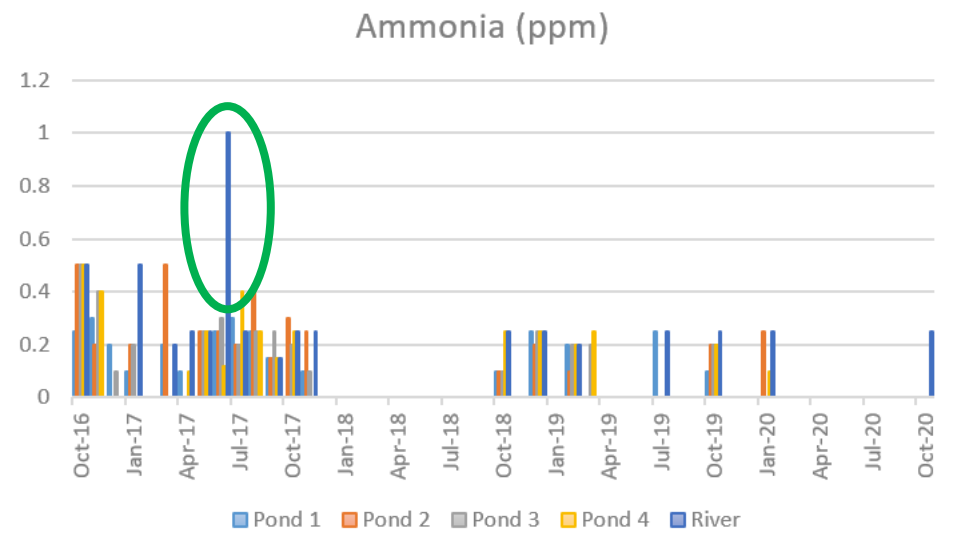
- **A compound of nitrogen & hydrogen that is very soluble in water – slightly alkaline (basic).**
- Exists in 2 forms ammonium (NH4+) and unionised ammonia (NH3) – proportions of each depend on pH and temperature.
- Some sources:
- Decay and breakdown of organic material
- Sewage effluent / agricultural (fertiliser) run off / industrial process products (cleaning agents)

- NH3 is toxic to fish and invertebrates. Toxicity increases as pH and temperature increases. (2 mg/l and 0.02 mg/l).

Ammonia in the ponds.

- Reasonably stable (mainly 0 – 0.3 ppm = WFD H or G classification).
- No specific pattern between ponds but Pond 2 is sometimes higher than the others – related to inputs / leaf breakdown?
- The outlier……
- Higher reading from Maun in Jul 17 (rainy) – possibly run off / inputs from upstream catchment and / or sewage inputs (Mansfield STW).





Nutrients – Phosphate & Nitrate

- **Naturally occurring substances which are important in biological processes**.
- P occurs and is measured in several forms (e.g. TP / SRP / OP).
- Nitrate standard for drinking water = 50 mg/l. P standards for WFD are site specific.

- Some sources:
- Naturally occurring – concentrations depend on geology.
- P low / N high in local sandstone.
- Sewage effluent (washing detergent) / agricultural (fertiliser) run off.

- Excessive nutrient load contributes to eutrophication – rapid plant / algae growth which causes reduction in dissolved oxygen and light levels = stress on aquatic organisms.

Phosphate

- Generally : high when wet = run off. High when dry = point source or biological process.
- Lowest and least variability in Pond 1 – less P / more consistent in input source?
- Highest in Pond 2 – more input sources / leaf breakdown.
- Decreases from Pond 2 to Pond 4 – being used up / locked up.
- Highest in river – Sewage works + wider catchment inputs.

Mean P + lowest and highest readings between start of Monitoring and transition to Waterside Care.

Pond	1	2	3	4	River
Mean P	0.25	0.54	0.46	0.44	1.26
Range	0.04 - 0.37	0.13 - 1.7	0 - 0.9	0.09 - 1.12	0.58 - 1.97

WFD G/M boundary at Whinney Hill = 0.071 mg/l
(most recent classification = Poor). Mean, from 2016 = 0.5 mg/l

WFD G/M boundary at Edwinstowe = 0.076 mg/l
(most recent classification = Poor). Mean, from 2016 = 0.29 mg/l

Nitrate

- N seems to be consistently highest in Pond 1 and then decreases through the other ponds.
- Possibly: source = spring and then N decreases as it is used / locked up in the other ponds.
- N higher again in the river because of point source and diffuse run off.
- At Whinney Hill mean N (from 2016) = 13.4 mg/l.
- At Edwinstowe mean N (from 2016) = 13.7 mg/l.

Results from Nitrate sampling.

	Pond 1	Pond 2	Pond 3	Pond 4	River
Spr 2019	>10	5-10	2-5	1-2	>10
Sum 2019	>10	5-10	<0.2	0.2-0.5	>10
Aut 2019	>10	5-10	1-2	<0.2	>10
Win 2020	5-10	5-10	5-10	5-10	5-10
Aut 2020	5-10	5-10	5-10	1-2	>10
Sum 2022	10	5- 10	1 - 2	0.2	