Water Project

By Joe, Raf, Lukas and Oscar

Our Plan

Using your funding, our plan was to visit 4 cities: Cambridge, Leeds, Manchester, Sheffield and test their river water quality. We would do this by taking a sample of each in the centre of the city and again 1 km upstream. We would expect to see the pH and TDS (total dissolved solids) be higher at the centre than 1 km out. Comparing them altogether our prediction is that:

Sheffield- best water quality
Leeds
Manchester
Cambridge-worst water quality

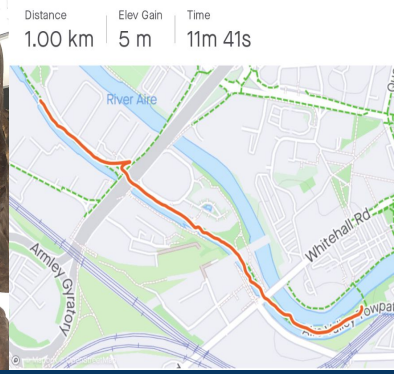
This is based off some research we did, showing that Sheffield invested a lot into making their river- river Don- clean and healthy for the environment. We put manchester as 2nd worst as of its industrial history and cambridge last due to some other studies suggesting that the Cam has other water issues involving toxins.

How it went…

Firstly, we took samples and tested our control of bottled water. This proved that the probe worked, we all knew how to use it and gave us feel for the results of healthy water. We collected each sample in tubes and labeled them to be sure. Before testing we shook the sample for 5 seconds and made sure the probe was dry, cleaning it in between each test. The next day, we got the train into cambridge took samples of the river at the point closest to the centre using google maps and then walked 1 km down the river using strava (tracking app) to be sure. After taking the sample we labeled them and took the train back to lukas' house to test them using the exact same method as we used on the bottled water. The following day we got up early and travelled from Cambridge to Leeds. (we wanted to test all river in a reasonably short time frame in case the weather conditions drastically changed affecting our results.)

Leeds

After arriving in Leeds around midday (lukas' dad drove us) we repeated the process as we did in Cambridge and took a sample as the point closest to the centre. We then walked down 1 kilometer- this was really nice as they had a pathway and we saw more wildlife the further down we went. At 1km we took a sample and heading to the Premier Inn we would be staying the night at. Here we tested the results using the probe and recorded the results using the exact same method as previously. In the evening we went out for a chinese meal, using the money we saved from having breakfast at home and a packed lunch during the car journey.



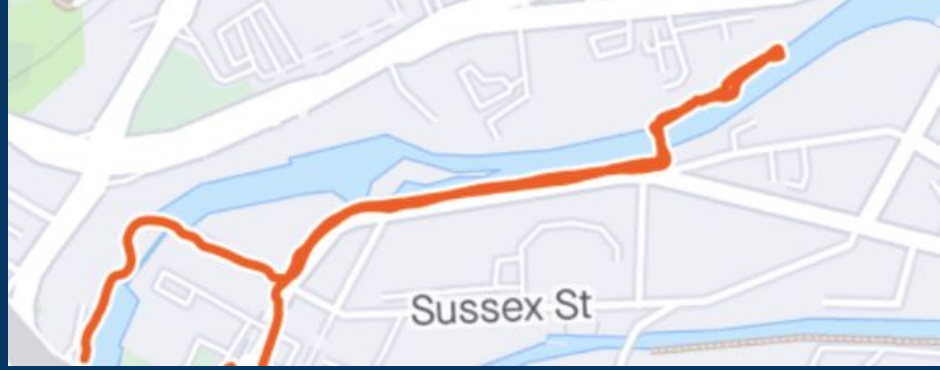
Manchester

Lukas' dad drove us to manchester where we met Bob (oscars grandad). We took samples of manchester river as we did with Cambridge and Leeds however it was a lot harder to get down to the river so we had to go slightly further away from the centre than we would have wanted. We then walked 1 km down and took the sample.

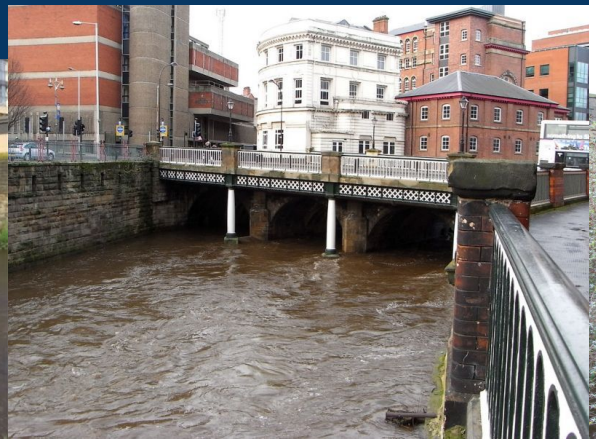
Before arriving in Manchester we did some research and discovered that manchester's river: The Mersey had serious problems with sewage in the past and this affected their rivers massively. Oscar's grandad works for united utilities and manages much of manchester's water. He managed to get us a tour of the sewage plant in between where we took our samples. Fascinated and a little scared we explored this plant the next day before we went to sheffield.

We learnt about the different stages it goes through before it gets sent into the river and how it affects the environment and river if something goes wrong.

Sheffield



After visiting the water plant, we got the train (from the outskirts of manchester where oscars grandparents live) to Sheffield station where we took our samples. Sheffield river definitely looked browner than the other cities we had seen so it's interesting to see that even though it looked dirtier it wasn't necessarily. Although it’s pH was similar to the others, it had an alot higher TDS (total dissolved solids) this could have been why it looked so unhealthy. We had a meal before lukas’ dad drove us home again.



The Results

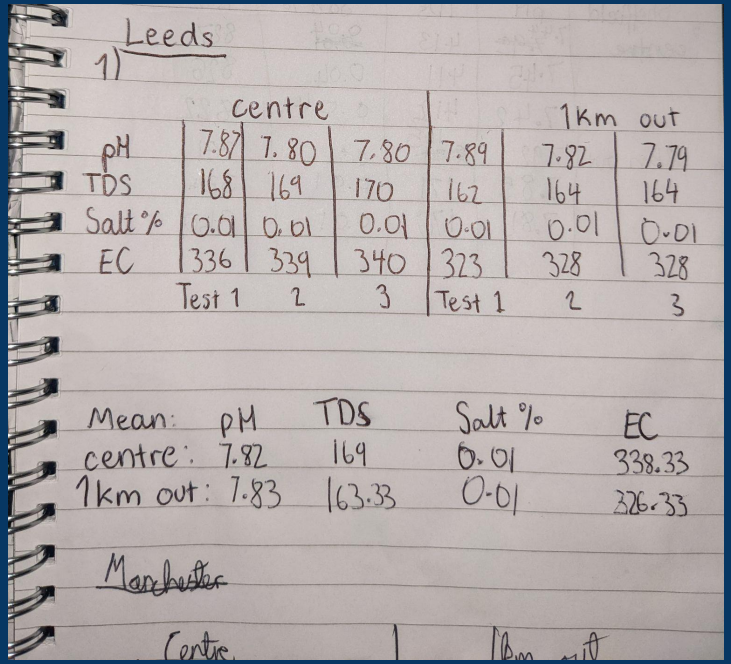
Firstly we ran a controlled experiment of bottled water, although we only wanted the pH and TDS (total dissolved solids), the probe also detected the percentage of salt and the electrical conductivity (EC) to see if there was any further correlation:

pH	TDS	Salt%	EC
7.86	172	0.01	344

This along with our own research (healthy river has a pH of around 7.6 and a tds of around 100) gave us a good baseline for our experiment.

For all cities we tested the sample 3 times and took a mean to ensure a fair test.

Here are some pictures of the full results (the mean of the results is on the next slide)



Leeds

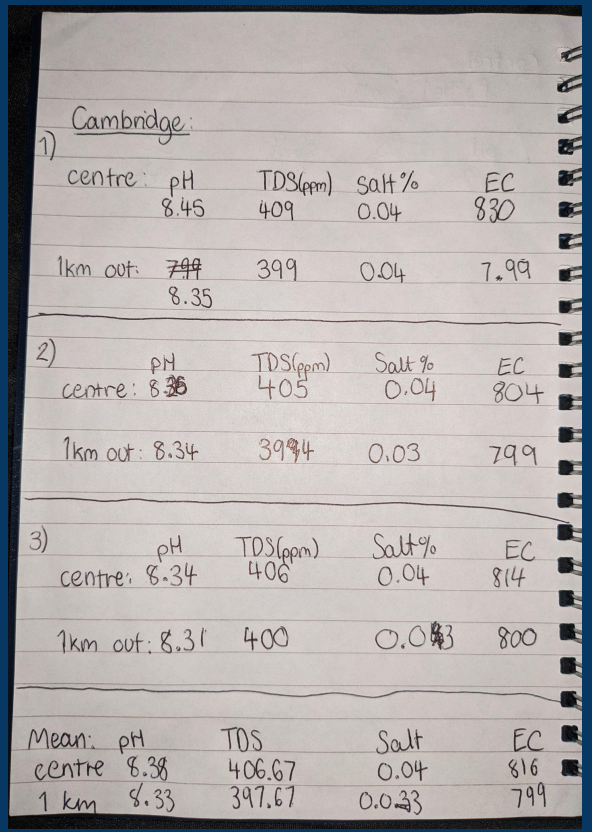
1)

	centre			1km out		
pH	7.87	7.80	7.80	7.89	7.82	7.79
TDS	168	169	170	162	164	164
Salt %	0.01	0.01	0.01	0.01	0.01	0.01
EC	336	339	340	323	328	328
	Test 1	2	3	Test 1	2	3

Mean:	pH	TDS	Salt %	EC
centre:	7.82	169	0.01	338.33
1km out:	7.83	163.33	0.01	326.33

Manchester

Centre | 1km out



Cambridge:

1)

centre:	pH	TDS(ppm)	Salt %	EC
	8.45	409	0.04	830
1km out:	~~7.99~~ 8.35	399	0.04	7.99

2)

	pH	TDS(ppm)	Salt %	EC
centre:	8.~~35~~	405	0.04	804
1km out:	8.34	39~~9~~4	0.03	799

3)

	pH	TDS(ppm)	Salt %	EC
centre:	8.34	406	0.04	814
1km out:	8.31	400	0.0~~3~~	800

Mean:	pH	TDS	Salt	EC
centre	8.38	406.67	0.04	816
1 km	8.33	397.67	0.0~~3~~	799

CAMBRIDGE	Centre	1km out
pH	8.83	8.33
TDS	406.67	397.67
Salt%	0.04	0.033
EC	816	799

LEEDS	Centre	1km out
pH	7.82	7.83
TDS	169	163.33
Salt%	0.01	0.01
EC	338.33	326.33

MANCHESTER	Centre	1km out
pH	7.58	7.58
TDS	137	143
Salt%	0.01	0.01
EC	274	286

SHEFFIELD	Centre	1km out
pH	7.44	7.85
TDS	412	170
Salt%	0.04	0.01
EC	826	334

How the centre of different cities compare

	Cambridge	Leeds	Manchester	Sheffield
pH	8.83	7.82	7.58	7.44
TDS	406.67	169	137	412
Salt %	0.04	0.01	0.01	0.04
EC	816	338.33	274	826

In conclusion…

After calculating a mean for the pH, TDS, Salt% and EC for each of the locations, our group came to the conclusion that the river water in northern England was of a higher quality than in the South.This could be due to the fact that the North is an oceanic climate and experiences more precipitation than in the South.The frequent rainfall would potentially dilute the concentrations of salts, electrolytes and waste in rivers, which could explain why our results show that the quality of river water in the North is much finer.When comparing our results to data obtained from online databases and research constructed by other bodies, we also determined that although water quality in the North of England was of a better standard than in the South, the pollution of rivers in more industrial and dense cities/areas was more sizeable than in those that were not.This can be seen using the EC and pH values of the rivers.A pH under 6.5 and a high EC show that the river water could potentially be toxic/harmful to organisms inhabiting the water or river banks *this is because a high EC can indicate that pollution has entered the river and because more acidic water could leach metals such as copper, iron, lead and manganese, which pose a health risk if consumed*.

Like we predicted in our hypothesis, the river water in Cambridge was of the worst quality.This could be due to industrial pollution and pollution from transport and agricultural sources (pesticides, etc).However, Sheffield (which we predicted to have the best water quality) was found to have a similar salt%, TDS and EC to Cambridge.This was surprising to us as our research prior to the project told us that Sheffield invested a lot into keeping their rivers clean and healthy and that they launched multiple projects aiming to help tackle pollution across the city's rivers.When coming back to the data we collected, our group came to the judgement that the reason behind Sheffield's poor water quality was once again due to industrial pollution from businesses and factories.This suggests that the main cause of poor river quality in England is industrial pollution and waste from humans (littering, sewage, etc).

The Budget

We managed to save some money on food by making packed lunches for the day and spent any left over money on evening meals.

		Budget	Actual	Variance	Distance	Cost per mile	Cost
Travel	Cambridge to Leeds	0	32	-32	158	0.2	31.6
	Leeds to Manchester	30	10	20	52	0.2	10.4
	Manchester to Bob	20	0	20			
	Manchester to Sheffield	50	35	15			
	Bob paid train to sheffield	0	-35	35			
	Sheffield to Leeds	25	0	25			
	Sheffield to Cambridge	0	31	-31	153	0.2	30.6
	Parking	0	25	-25			
Accomodation	Leeds	120	97	23			
Food	**Tue**						
	Breakfast	16	0	16			
	Lunch	16	0	16			
	Dinner	16	60	-44			
	Wed						
	Breakfast	16	0	16			
	Lunch	16	0	16			
	Dinner	16	0	16			
	Thu						
	Breakfast	16	0	16			
	Lunch	16	0	16			
	Dinner	16	70	-54			
Equipment	Water Tester	20	24.69	-4.69			
	Tubes	0	17.75	-17.75			
Total		409	367	**42**			
Personal input		-80					
Awareded budget		329					