Fingerprinting Water and Determining its Age to Help Improve the Quality of Our Rivers.

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Ireland

Study Date: 20/1/24-31/1/25

Judges Page

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Abstract

This study uses a new Cavity Ring Down Spectrometric (CRDS) technique to assess the 'age' of water reaching waterways draining into Rosscarbery Bay. Fingerprinting water and determining its age can significantly enhance our understanding of river quality and health.

Each drop of water has an isotopic fingerprint (age) which changes with time. This allows its transit through a catchment to be followed. We expect to get an isotopic wave. The higher the amplitude of the wave the younger the fraction of water is. The younger the water is the more vulnerable it is to pollution, but also, any measures to fight that pollution will have a faster effect. The computer does some complicated calculations to give data which can be displayed on a scattergram. By analysing the chemical signatures and isotopic composition of water samples, we can identify pollution sources, track changes over time, and assess the effectiveness of conservation efforts. This approach will not only aid in the management and restoration of river ecosystems but also inform policy decisions aimed at protecting water resources.

To help interpret our results We used Globe protocols to measure pH, temperature, nitrates and indicator species for three reasons 1) to alert the EPA if any changes occurred 2) to help interpret our water 'aging' data. 3) to determine if nitrate runoff was responsible for summer beach closures.

Sampling took place once a month for 12 months.

Ultimately, integrating these techniques into river management strategies can lead to improved water quality, healthier aquatic habitats, and better outcomes for communities relying on these vital resources.

Introduction

Fingerprinting water and determining its age are innovative techniques that play a crucial role in enhancing our understanding of river ecosystems. By analysing the unique chemical signatures and isotopic markers present in water samples, researchers can trace the sources of pollutants, assess the health of aquatic environments, and monitor changes over time. This information is vital for developing effective conservation strategies and ensuring the sustainability of our rivers. As we face increasing environmental challenges, these methods provide valuable insights that can lead to improved water quality and healthier habitats for both wildlife and communities that depend on these vital resources.

This is an year-long study (Jan '24 to Jan '25) of the four streams feeding into Rosscarbery Estuary. Water samples were collected every month from 13 points along the four waterways. We brought the samples to Trinity College Dublin, Department of Applied Sciences for analysis by the innovative Cavity Ring Down Spectrometer. Results were processed and statistical analysis used to interpret them.

In support of this data, we took part in the Irish Globe Water Ecosystem Campaign 2024. We measured temperature, pH and nitrate levels each time. These gave a snapshot of the physical and chemical parameters of the stream. We also performed kick sampling at one point on each stream to get a picture of the long-term health of the water. We looked for 6 indicator species: mayfly nymph, stonefly nymph and green caddis fly larvae indicate clean water while leeches, snail and water louse indicate polluted water.

Background

Ireland has over 84000km of river channels. Three quarters of these are very small streams. This makes monitoring difficult.

Currently, 2401(75%) of 3192 river bodies are assessed by the Environmental Protection agency (EPA) as part of the European Union Water Framework Directive (WFD).

As **citizen scientists** we can help monitor the other 25%, by gathering data in a scientific way. Globe protocols allow us to do this and so fill in the gaps for the EPA.

This is our locality which we are proud to call home. We are surrounded by agricultural land, mainly used for Dairy and Cattle. Tillage is mainly grass, with some beet, spring barley and maize.

Local Biodiversity

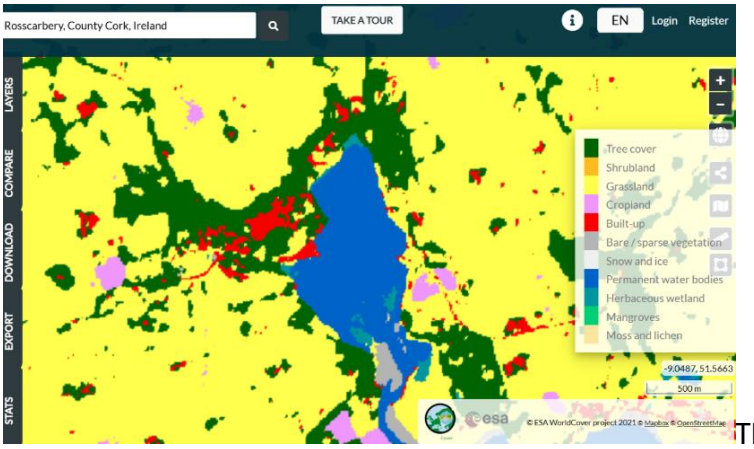
Rosscarbery Estuary is one of the most important sites in Europe for migratory birds. Some of the species we see are Curlews, Brent Geese, Godwits, green winged Teal, lesser Yellow Legs and Green Shank. It is also home to many species of native birds. We have a colony of Cormorants on an island in the lagoon, a heron, a family of swans, and mallard ducks. In the Estuary are little egrets, black-headed gulls and herring gulls.

Nearly half of the global bird population has declined since 1970, but in Ireland a recent study by Birdwatch Ireland found 63% of species are in decline (Lewis, 2024). The Grey Plover which winters here from Siberia and the Dunlin from Scandinavia show almost 30% decline in last 3 generations (20 years). These birds travel to Irish beaches along migration routes called flyways, many of which intersect over Ireland. Their dependence on places to rest and feed along these flyways makes them highly vulnerable to habitat loss or degradation. (McGeehan, 2024))

We are passionate about protecting the Habitat of Rosscarbery Estuary for these species and for future generations to enjoy.

[Mooney Goes Wild | Mooney Goes Wild - RTÉ Radio 1]

Rosscarbery catchment has four streams draining into the estuary. If any of these become polluted, the ecosystem will change and lead to a loss of biodiversity. We met with a local farmer, Donal Tobin, who is part of a local farmers action group. He says farming practices are generally very good around Rosscarbery. Farmers see themselves as guardians of the environment. The EPA installed a monitoring station in the Owenahynchy river on Donal's land and the results were described as 'very good'.



This map shows extensive grassland(yellow) used for cattle and dairy farming in our study area.

In 2022 and again in 2024, the **Rosscarbery Blue Flag beach was closed** due to e-coli in the water. This had a major impact on our tourism economy. Courtmacsherry Bay which is about 12km East of us has had problems for many years. These were shown to be due to the intensive cattle farming causing runoff. For this reason, **we thought that runoff may have been the cause of the Warren beach closure also. We decided to adopt these waterways for a year to monitor and alert Lawpro if we found any worrying changes in pH, Temperature, Nitrates or biodiversity.**

Literature Review

Ireland has over 84000km of river channels. Three quarters of these are very small streams. This makes monitoring difficult.
Currently, 2401(75%) of 3192 river bodies are assessed by the Environmental Protection agency (*EPA.ie*) as part of the European Union Water Framework Directive (WFD). The EU WFD requires all Member States to protect and improve water quality in all waters so that we achieve good ecological status by 2027 at the latest (*lawaters.ie*). As Citizen Scientists, we can monitor the smaller rivers and streams and pass the data on to LAWPRO and the EPA.

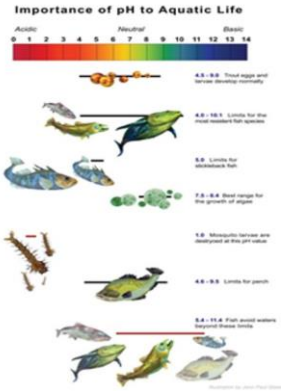
LAWPRO works with farmers where run off from their land is affecting water quality. They give advice on actions to reduce runoff and improve water quality. It can take a long time for these improvements to be seen in the environment. In our study we have monitored temperature, pH and nitrates. These give a snapshot in time. We also took kick samples to look for Benthic Macro-organisms, (bioindicator species) as these give a more long-term picture of the water quality.
These are some of the videos and articles that we learned from in our research.

https://youtu.be/WTxqghqO9bk
Indicators: Benthic Macroinvertebrates | US EPA
How Does pH Affect Water Quality? | Atlas Scientific
https://youtu.be/JOh6lzEX_5I

Nitrate $NO_3$is the oxidised form of nitrogen found dissolved in water. It comes mainly from runoff from fields (EPA.ie). Nitrate is an essential nutrient but high concentrations in rivers can cause eutrophication leading to death of fish and other organisms.
The EPA Water Quality Monitoring Report on nitrogen and phosphorous concentrations in Irish waters 2022 reported on a review of water quality, a condition of Irelands derogation under the Nitrates Directive.

Below is a map showing the potential for pollution of the land in our study zone. It can be seen that the area is extremely vulnerable and therefore needs to be continually monitored.

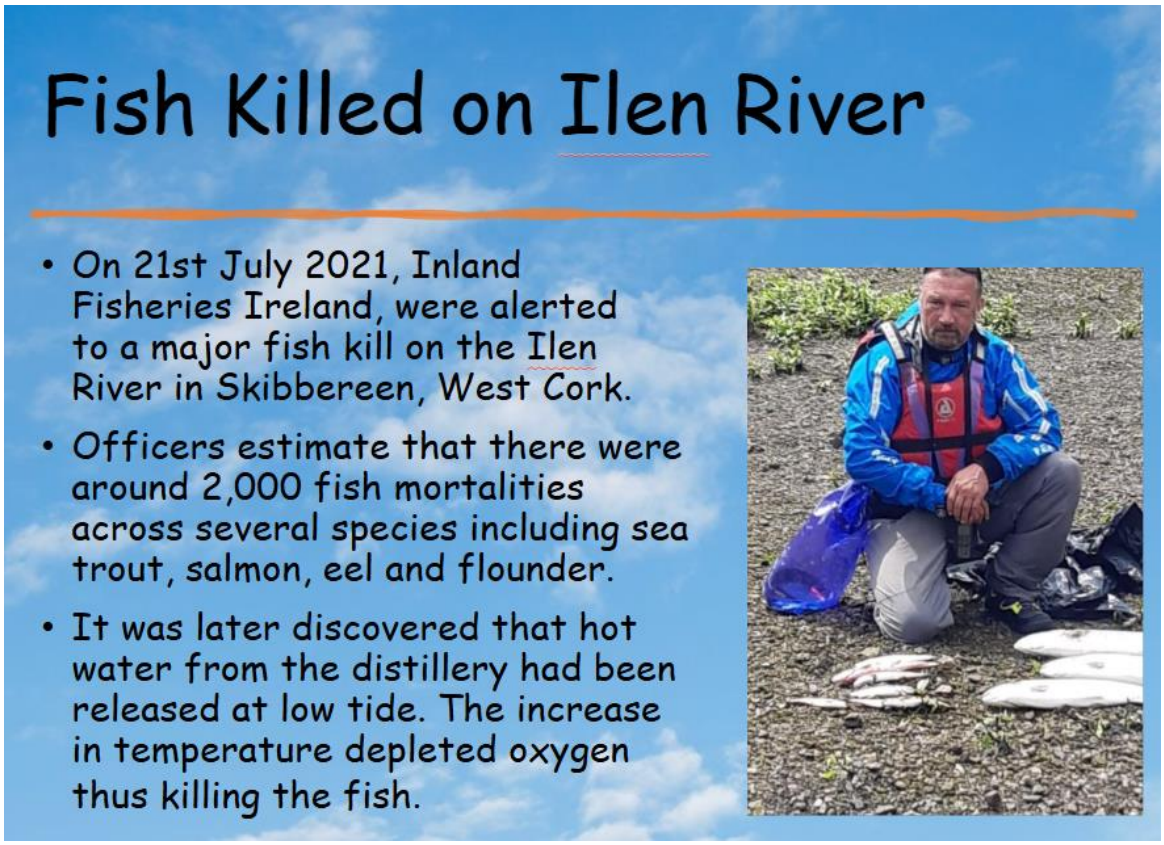
PH is a measure of the concentration of hydrogen ions in solution (Chemistry Live). It is an important parameter for measuring water quality because it can influence the availability of nutrients and minerals. Acid pH can release heavy metals from bedrock and high pH reduce dissolved oxygen (Dewangan et al,



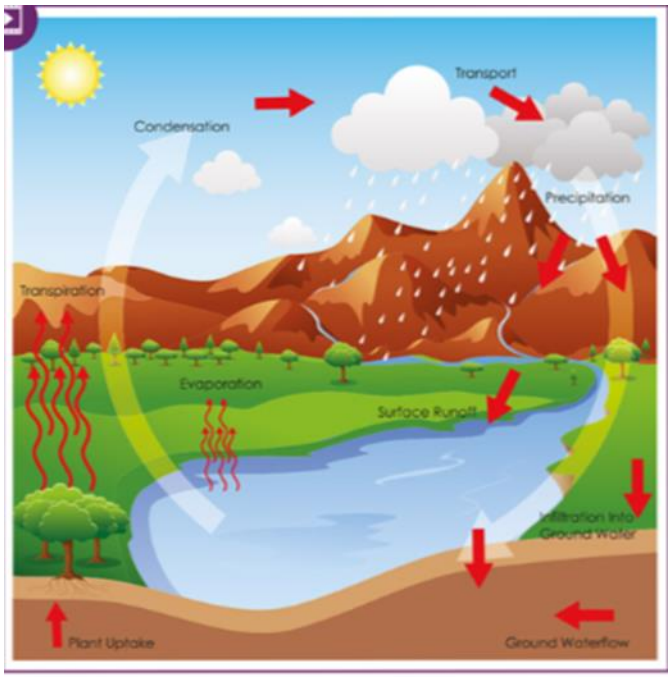
2023)

Water temperature is a master variable because almost all properties of water as well as chemical reactions are affected by it. Water temperature determines

whether a river habitat is suitable for different aquatic species to survive. Warm water holds less dissolved oxygen than cold water. (USGS,2018)
The Ilen river is 14km west of Rosscarbery.



The main part of our study used a new technique, Cavity Ring Down Spectrometry, for assessing the 'age' of the water in our streams. Pollutant transport is regulated by the time it takes for rain to travel through the landscape to reach streams. Therefore, water 'age' is fundamental to predict the fate of contaminants and the time lag between mitigation measures and their outcomes. We felt this is important because Rosscarbery is surrounded by agricultural land (see the landcover map) and runoff into streams is a major cause of water pollution.
We first looked at literature on the Water Cycle. Our Agricultural Science teacher shared a worksheet published by *Sherkin Island Marine Station* which explained the various stages and followed the journey of a raindrop. Infiltration is what slows the passage of water through the environment. Ground water can take days, months, or years to reach streams. Groundwater is older than run-off water.



So, by finding the 'age' of the water in our streams we can tell, if it is young that there is a lot of runoff and if it is older, then it has spent time as ground water. This knowledge would be invaluable to farmers and the EPA as it could help predict when the improvements made will be evident in the streams.

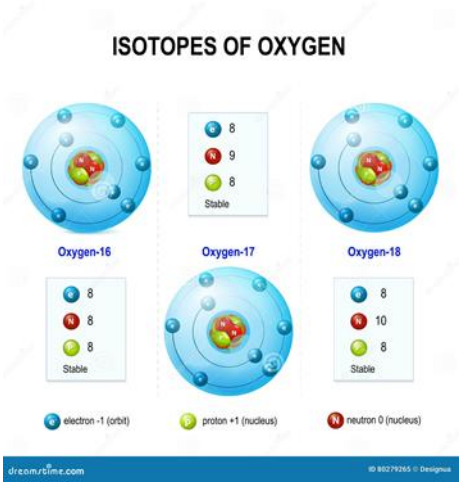
In 2018, a report on *Bandon-Ilen Catchment area* by the '*Catchment Science and Management Unit*' of the EPA, found that both Rosscarbery Bay and Rosscarbery Harbour were 'At Risk' with 'significant pressure' from agriculture (cycle 2). In 2022, *Catchments.ie, there* had been an improvement, but both were still 'at risk' (cycle 3).

Subcatchment code	Water body code	Water body name	Water body type	Risk	Ecological Status 07-09	Ecological Status 10-15	High Ecological Status Objective Water Body Y/N	Significant Pressures	Date to Meet Environmental Objective	Recommended Area for Action Name
20_11	IE_SW_110_0000	Rosscarbery Bay	Coastal	At risk	Unassigned	Unassigned	N	Ag	2027	Rosscarbery
20_11	IE_SW_110_0100	Kilkeran Lake	Transitional	Review	Poor	Poor	N		2027	Kilkeran Lagoon
20_11	IE_SW_110_0200	Rosscarbery Harbour	Transitional	At risk	Unassigned	Unassigned	N	Ag	2027	Rosscarbery

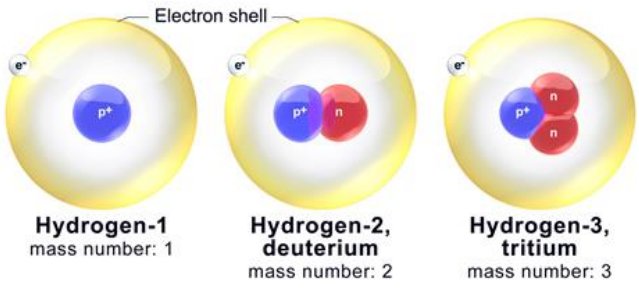
Our yearlong study also involved collection of samples from 13 sample points on the 4 streams feeding into rosscarbery Estuary. These were for testing in TCD using a new technique called Cavity Ring Down Spectrometric (CRDS) isotopic and gas concentration analysis to determine stable isotope signatures (a fingerprint of age) in our water samples .

This is not a new technique, but it is the first time CRDS has been used in Europe to age water.

In 1964, *Dansgard et al* published a paper on *Stable Isotopes in Precipitation*. At this time, several studies had been done on the occurrence of deuterium (H^2) and O^{18} isotope in both seawater and fresh water (*Craig, H, Science 1961*). Analysis was done by mass spectrometry. This instrument was slow to use and took up a huge amount of space. The studies all agreed that there are considerable variations in the isotopic composition of monthly precipitation. The authors hypothesized that obtaining data on Hydrogen and Oxygen isotopes would make it possible to characterize the circulation patterns and mechanisms of the global and local movements of water.
In 2019, Ortega and Gill published an *overview of Isotope Hydrology*. We learned that water from different places has different isotopic signatures or unique 'Fingerprints'. These fingerprints can enable scientists to track water along its water cycle journey: from evaporation, precipitation, infiltration, to run-off and evapo-transpiration.
In 2024, an article explained in simple terms how Isotopes can be used to tell us about hydrological timescales (*Butler et al*). It defined 'age' of water as the time since the water entered the watershed as precipitation. O^{18} and H^2 are stable isotopes which occur naturally in water in varying concentrations. Because stable isotopes do not decay over time the way radioactive substances do; they can be used to trace water as it passes through the environment.
Each rainfall event has its own unique ratio of oxygen and hydrogen isotopes Butler explains. By measuring the ratios of O^{18} and H^2 in water samples, researchers can follow the movement of water and find out how long it takes for water with this unique signature or 'fingerprint' to appear in a waterway. By using data from 26 aquatic sites across America, *Butler et al* were able to use mathematical modelling to estimate mean transit times and the fraction of young water (runoff with transit times of 2-3 months) at each site. Furthermore, they found a huge amount of variation between sites and seasons. Therefore, **every site needs to have at least a year of data to set a baseline for that catchment.**
We checked an old science book (*Science Matters*) to find out what an isotope is. We knew an atom is the basic building block of everything and that an element is made of only one type of atom. An isotope is an atom of the same element having a different number of protons.

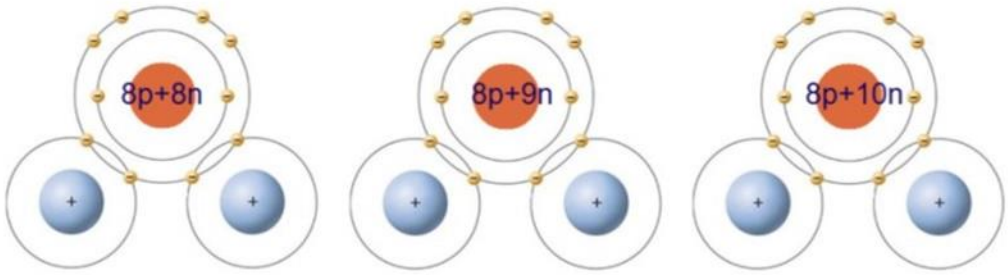


Isotopes of Hydrogen



Oxygen Isotope Abundance in a water molecule

For every 10,000 water molecules we would find:



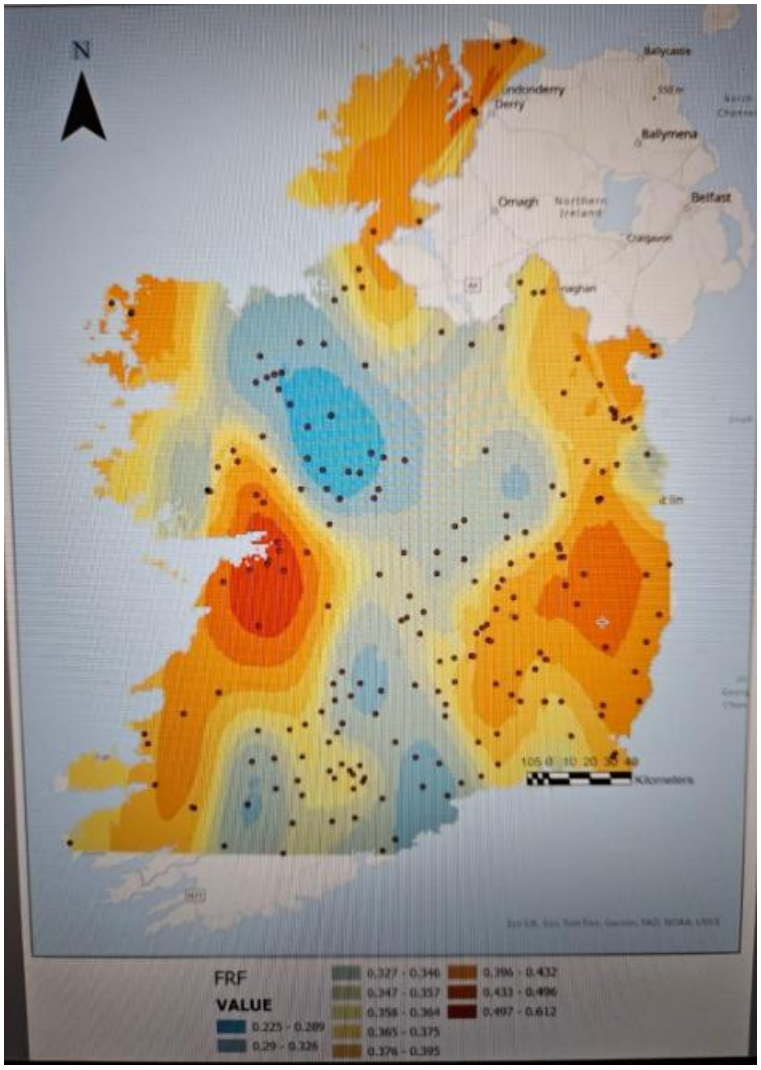
$H_2{}^{16}O$: $H_2{}^{17}O$: $H_2{}^{18}O$

9977 : 3 : 20

From : *Water Isotopes* *(University of Washington Programme on climate Change)*

Ortega and Gill (2019), state that isotopes are the most direct and powerful tools available to estimate the age, vulnerability, and sustainability of water resources.

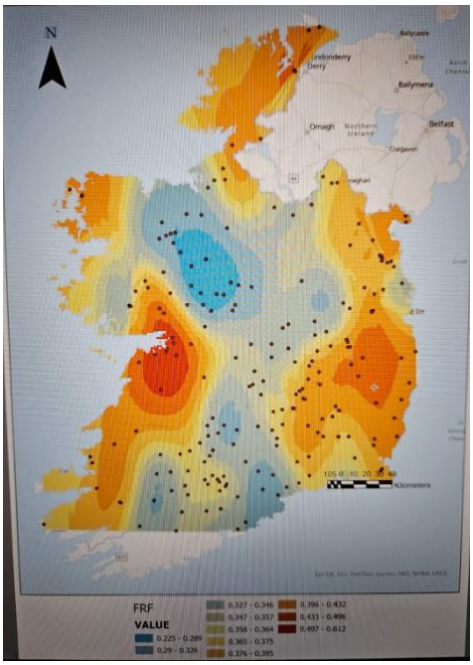
As water evaporates, clouds form with a mix of water molecules giving the rain drop its 'fingerprint. The heavier isotopes will fall as rain sooner than the lighter isotopes, giving scientists a way to determine the origin.
In groundwater, 'old' water means the flow is slow so a well will take longer to replenish. 'young' groundwater means that it will be replenished quickly but also, that pollution quickly affects it too.
Isotopes of Nitrogen have been used to trace the origin –human, animal or fertiliser - of pollutants. The difference in mass of the composition of the two isotopes is different for each pollutant.
A paper written by *Darling et al* and published in *Hydrology and Earth System Sciences* attempts to collect 25 years of geological survey data to construct a 'baseline' of isotopic composition of waters in Britain and Ireland. **Our yearlong study will help to expand the data available to further build this baseline.** Dr Carlos Rocha showed us a map of Ireland with the site they have studied so far. We saw that they have no data for our West Cork region (the white area). When we have analysed all the samples we collected, **they will provide the baseline for West Cork. This will allow more detailed aging information to be calculated without having to take the isotopic signature of rain into account.** This will give invaluable access to information on groundwater status and speed of transit of water in an area. Such information can inform decisions on where to limit fertilisers, where to introduce mitigation actions and how long it will take for them to be seen in streams.

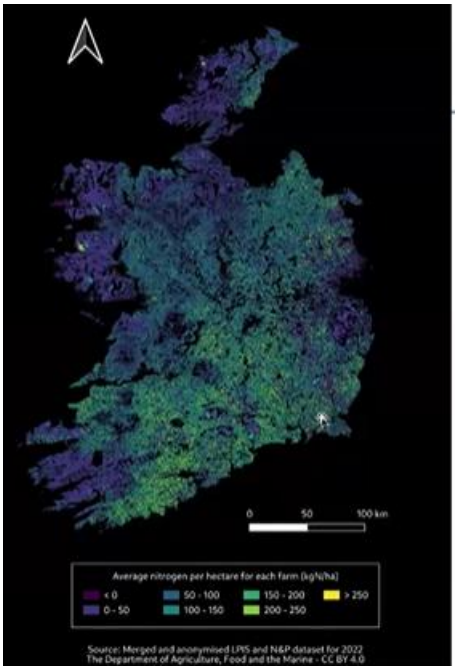


This map is the result of 3 years of data collection by Dr. Rocha. It tells how rainwater gets underground. The red area gets under in less than 3 months, the blue is much slower. So, if a farmer uses fertiliser in the SE for example, it will get into the groundwater quickly, similarly in the west of Ireland. <u>We believe that the government needs to prioritise legislation on fertiliser use and implement mitigation measures in these areas in order to protect the water quality.</u> **The white area in the south is where no data has been collected. Our project will fill in this information gap.**

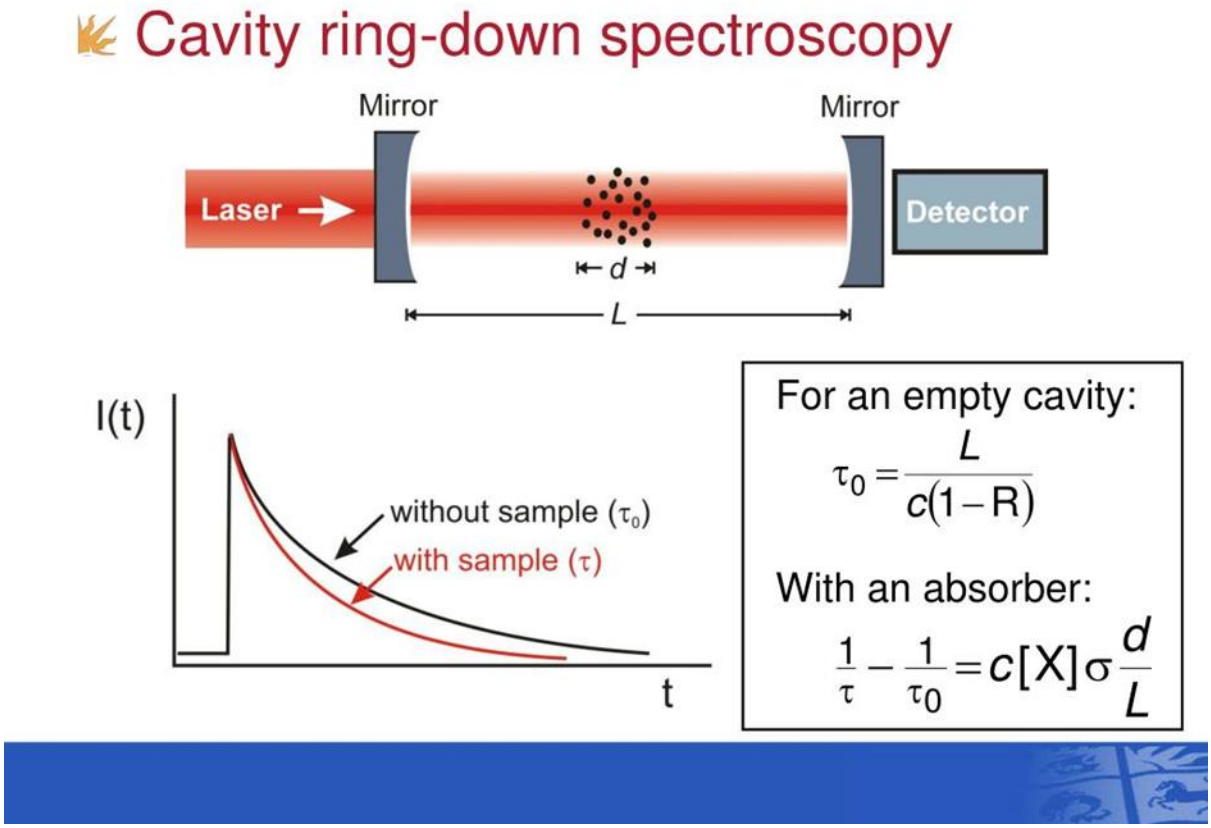
If we compare this map with the map below showing the amount of fertiliser applied to soil all over Ireland. It is clear where fertiliser practices should change. The yellow/green areas have a lot of fertiliser while the blue areas have less.

Another group in our school is looking at the runoff from seaweed, horse manure and biological composts so maybe these would be an alternative to slurry or chemicals.





The earlier studies (*Oretga, Dansgard, Darling and others*) all used mass spectrometry, our study is using a much more progressive technique called Cavity Ring Down Spectrometric (CRDS) isotopic and gas concentration analysis which determines stable isotope signatures (a fingerprint of age) in our water samples .



Cavity ring-down spectroscopy (CRDS) is a direct quantitative absorption technique that utilizes an enhanced light-matter interaction length inside a high-finesse optical resonator for ultrasensitive trace gas monitoring with high-spatial and temporal resolutions *(Molecular and Laser Spectroscopy 2020)*

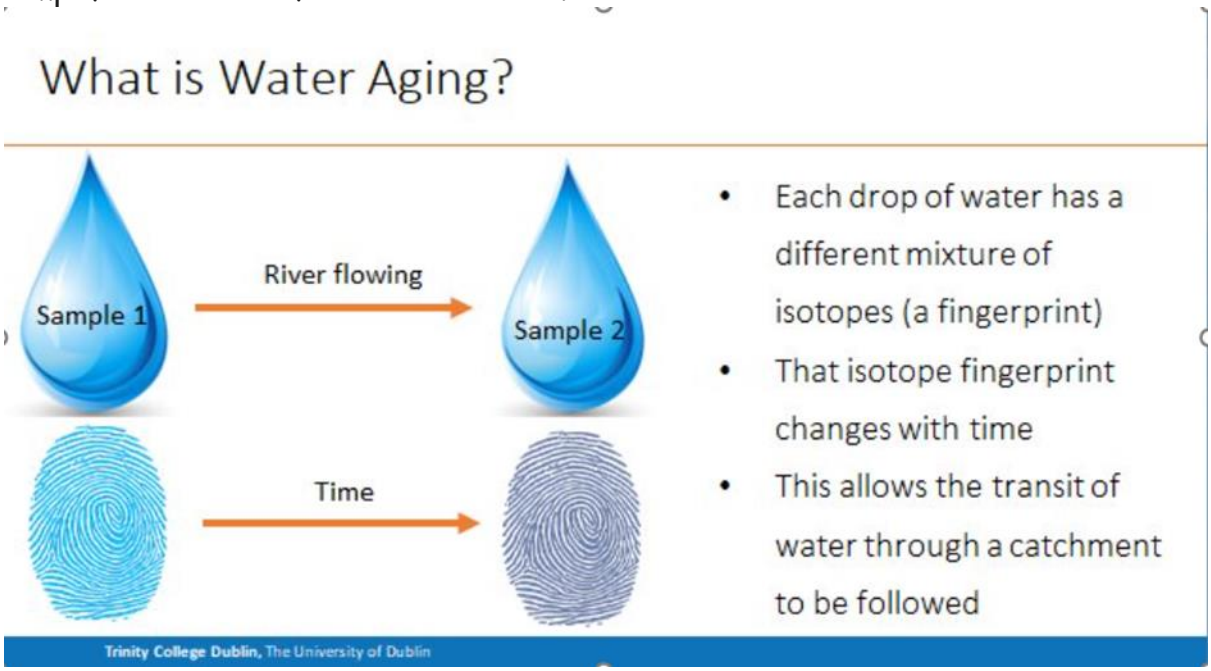
It is based on the principle that if a short-laser pulse is sent into an optical cavity (called "ring-down cavity") consisting of two highly reflective mirrors (> 99.99% reflectance), the pulse gets reflected back and forth inside the cavity at the speed of light. Every time the pulse is reflected by one of the mirrors, only a small fraction is transmitted through the exit mirror at each bounce and is monitored by a cooled IR detector, allowing the determination of the cavity-field decay or "ring-down lifetime".

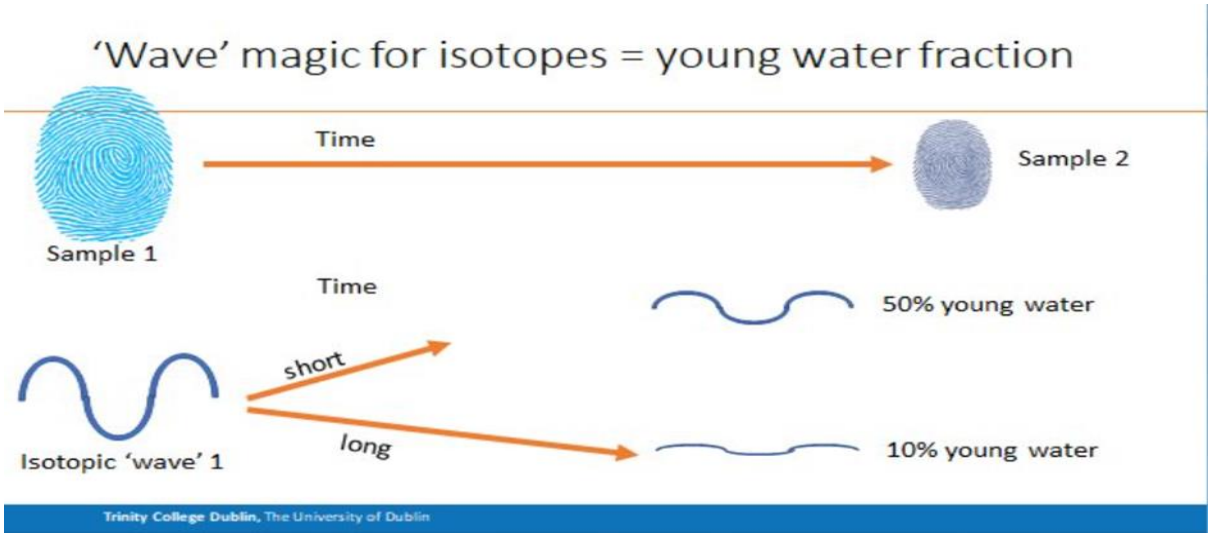
While in an empty cavity, the losses are only determined by the reflectivity of the cavity mirrors but on inserting an absorbing sample inside the cavity, a larger cavity loss results leading to a shorter ring-down time. Thus, by measuring

the decay time after the cavity (instead of the total intensity), the rate of absorption can be determined (*Gupta 2020*).
Depending on the relative ratio of heavy isotopes to light isotopes the light will change, and this is what we measured. If there was a lot of heavy isotopes compared to light, there will be a bigger change than if there is more light isotopes.

The high sensitivity of the technique CRDS_arises from two factors: (1) the very high effective absorption path length. Since the light reflects millions of times between the mirrors, it ends up traveling long distances. For example, a laser pulse making 500 round trips through a 1-meter cavity will effectively have travelled through 1 kilometre of sample; this allows the use of very small sample volumes, and (2) a sensitivity independent of intensity fluctuations of the light source, as the absorption is determined from the time behaviour of the signal. The ring-down waveform decays exponentially so that the CRDS signal can be directly related to the absorption spectrum of the sample. (*Lehmann et al 2009).* The disadvantage is the expense of the instrumentation. The CRDS in TCD cost €750,000 and is one of only 3 in Europe.

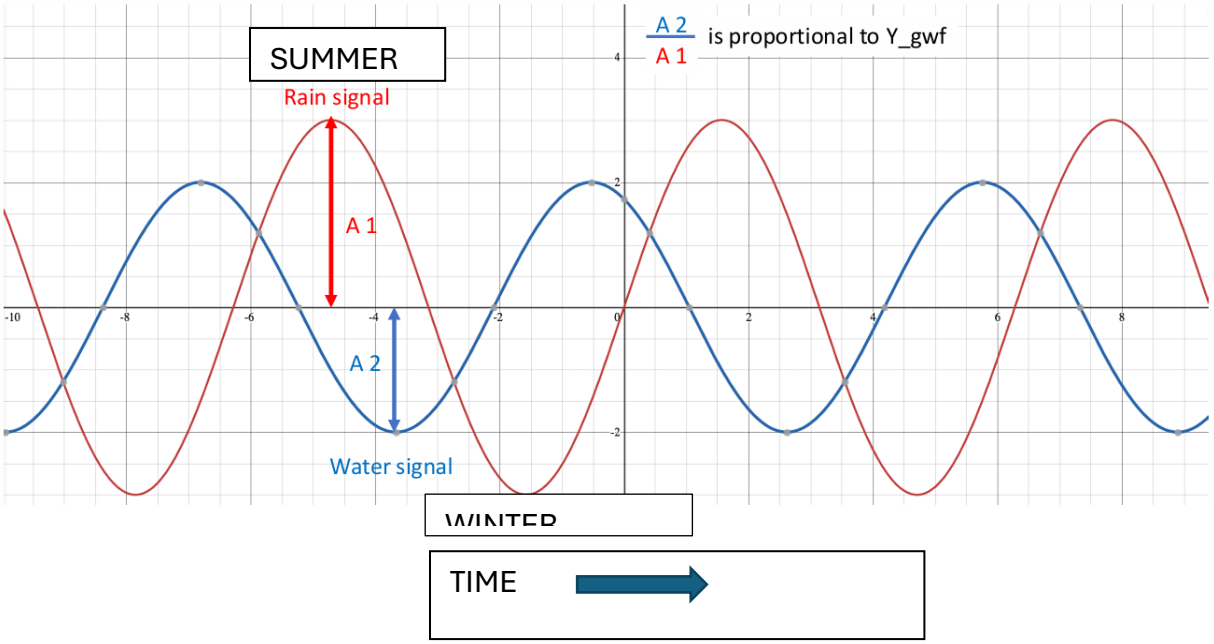
We found some of the literature difficult to understand so here is our simplified version of what we learned.





The higher the amplitude of the wave, the more recently the rain fell. Very high young water fractions mean very high vulnerability to pollution – but also that any measures to fight that pollution will have a faster effect….

The signal changes with the seasons.



The Global Meteoric line was developed by *Craig, H in 1961* and displays the global annual average relationship between ^{18}O and ^{2}H ratios in natural meteoric waters. Our data will be converted to a plot which is related to the Valentia Meteoric Line which is more accurate for Ireland.

Methodology

Safety Considerations

Carry out a risk assessment before going out on survey

Wear gloves and wellies

Be careful not to slip on banks

Use a bucket on a rope to collect samples from deep or fast flowing rivers

Use hand sanitiser to wipe off any skin splash.

Warning: Reagents for Water Quality Testing

May cause irritation, respiratory or skin sensitization.

Check, Clean, Dry all equipment and wellies to avoid introduction of invasive species.

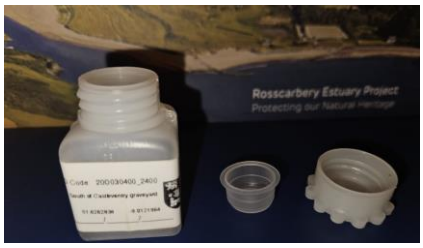
1. A total of thirteen sampling sites were carefully selected across four different streams and rivers, representing three distinct locations along each watercourse: the source, the middle, and the downstream end.

2. The coordinates for each sampling point were precisely recorded using GPS to ensure accurate tracking of site locations.

GPS Location and Codes for the 12 Sampling Sites

Local name	Latitude	Longitude	Lawpro code
Vincents chosen point	51.5937618	-9.0499466	20T020050_2130
Seans chosen point	51.6022274	-9.0531743	20T020050_2300
Ronans chosen point	51.5976551	-9.05267	20T020050_2190
River next to James o Sullivans farm	51.5954399	-9.0318115	20T020050_0600
River next to school	51.5828295	-9.0244475	20T020050_0500
Lisavaird Co-operative	51.5771665	-9.0371071	20T020050_0200
South of O keefes fort	51.607761	-9.037017	20T020050_0700
River by Ryans shop	51.5737675	-9.0015813	20O030400_0100
River by Prendergasts	51.5788185	-9.0035601	20O030400_1100
River behind Padraigs	51.5964205	-9.0065454	20O030400_1150
River by karols	51.6080991	-9.0080702	20O030400_1200
Rorys chosen point	51.6078522	-8.9818007	20O030400_0400
South of Castleventry graveyard	51.6262838	-9.0121964	20O030400_2400

3. Water samples were then collected in 50ml plastic bottles, which were clearly labelled to prevent any mix-up or contamination.



4. To avoid any atmospheric contamination, the bottles were carefully filled by submerging them below the water's surface, ensuring that no air was trapped inside. Microorganisms in the sample would use up the oxygen and give an erroneous result.
5. After collection, the samples were immediately stoppered and transported to the laboratory under controlled conditions.
6. To preserve their integrity until further analysis, the samples were stored in a refrigerated environment at 4°C.
7. The analysis of these samples was conducted in batches using advanced Cavity Ring Down Spectrometry (CRDS) for isotopic and gas concentration analysis, an extremely sensitive technique. The instrument is a Picaro model and costs €750000.

- Cavity Ring Down Spectrometric Isotopic and gas concentration analysis

– Picarro L2140-i.

– High precision and low drift for $\delta^{18}O$ (0.04 ‰) and $\delta^{2}H$ (0.1 ‰) in water

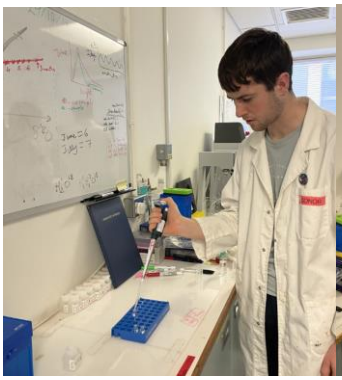
– calibrated against IAEA VSMOW-2 / SLAP-2 standards

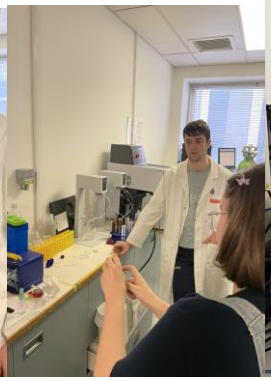
– Will resolve 0-3 yrs timescale, and determine 'young water fraction'

Trinity College Dublin, The University of Dublin 11

This analysis was carried out in the Department of Natural Sciences at Trinity College Dublin (TCD), under the supervision of Dr. Carlos Rocha. He guided us in the preparation of water samples and proper use and calibration of the CRDS machine.

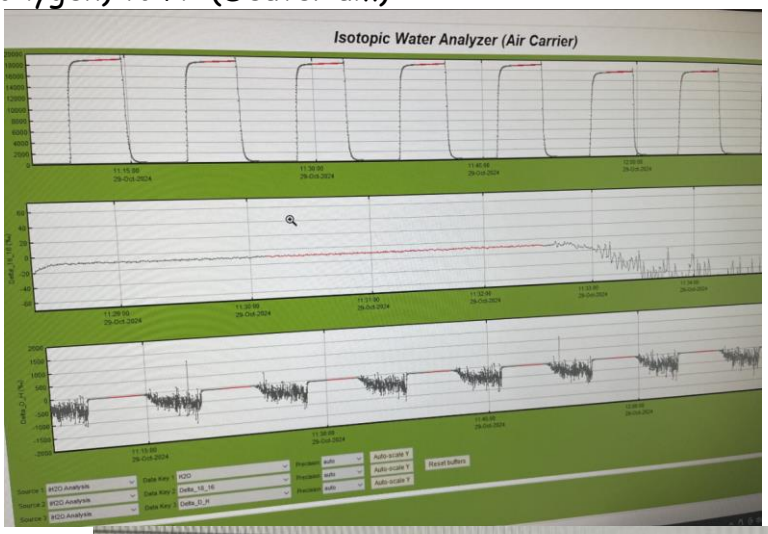
These are a selection of our February and March samples.





8. Each sample takes an hour to set up and run. Over the 12 months we had 156 samples. Due to the time input we were only able to process one set of samples. Eimear, a pHD student, will analyse the rest and send the results when they are ready.
Our results for February and March are excellent according to Dr. Rocha and in line with what would be expected for that time of year.

This is what the data looks like on the computer attached to the detector. The top graph is the water signal, the middle graph is the ring down time for the ratio of O^{18} to O^{16} and the bottom graph is the ring down time for the ratio of O^{18} (heavy oxygen) to H^2 (Deuterium)



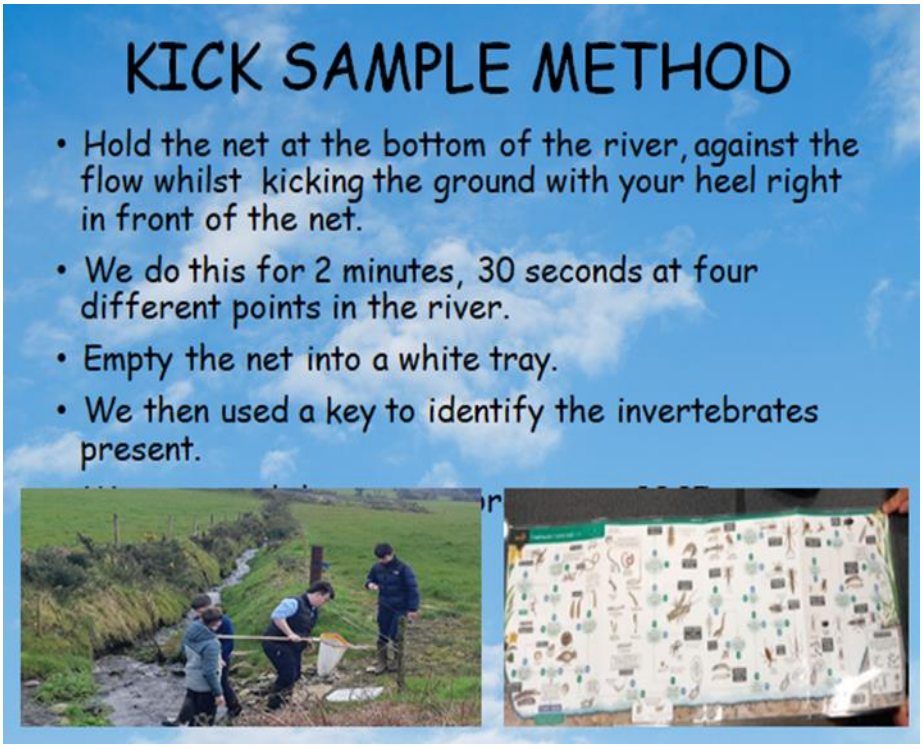
Line	Analysis	Time Code	Port	Inj Nr	d(18_16)M...	d(D_H)Mean	H2O_Mean	Ignore	Good	Identifier 1	Identifier 2	Gas Co
1	P-4208	2024/10/29...	1-01	1	-9.822	-68.824	20510	-1	1	Lab distill 2	Light stand...	H2O
2	P-4208	2024/10/29...	1-01	2	-9.799	-68.095	20029	-1	1	Lab distill 2	Light stand...	H2O
3	P-4208	2024/10/29...	1-01	3	-9.949	-68.643	18866	-1	1	Lab distill 2	Light stand...	H2O
4	P-4208	2024/10/29...	1-01	4	-9.937	-68.935	18828	0	1	Lab distill 2	Light stand...	H2O
5	P-4208	2024/10/29...	1-01	5	-9.929	-68.745	18810	0	1	Lab distill 2	Light stand...	H2O
6	P-4208	2024/10/29...	1-01	6	-9.964	-68.568	18976	0	1	Lab distill 2	Light stand...	H2O
7	P-4208	2024/10/29...	1-01	7	-9.906	-68.580	18974	0	1	Lab distill 2	Light stand...	H2O
8	P-4208	2024/10/29...	1-01	8	-9.948	-68.319	18890	0	1	Lab distill 2	Light stand...	H2O
9	P-4208	2024/10/29...	1-01	9	-9.967	-68.629	19011	0	1	Lab distill 2	Light stand...	H2O
10	P-4208	2024/10/29...	1-01	10	-9.927	-68.225	19011	0	1	Lab distill 2	Light stand...	H2O
1	P-4209	2024/10/29...	1-02	1	-0.235	-26.831	17722	-1	1	Lab boil 2	Heavy stan...	H2O
2	P-4209	2024/10/29...	1-02	2	0.067	-24.127	18087	-1	1	Lab boil 2	Heavy stan...	H2O

Above is an example of the raw data generated. One day of samples requires 250 analyses so an average has to be taken. The instrument must be calibrated first. An International Calibration Standard is used but it is very expensive so Dr. Rocha and his team have developed their own standards to calibrate the graph.

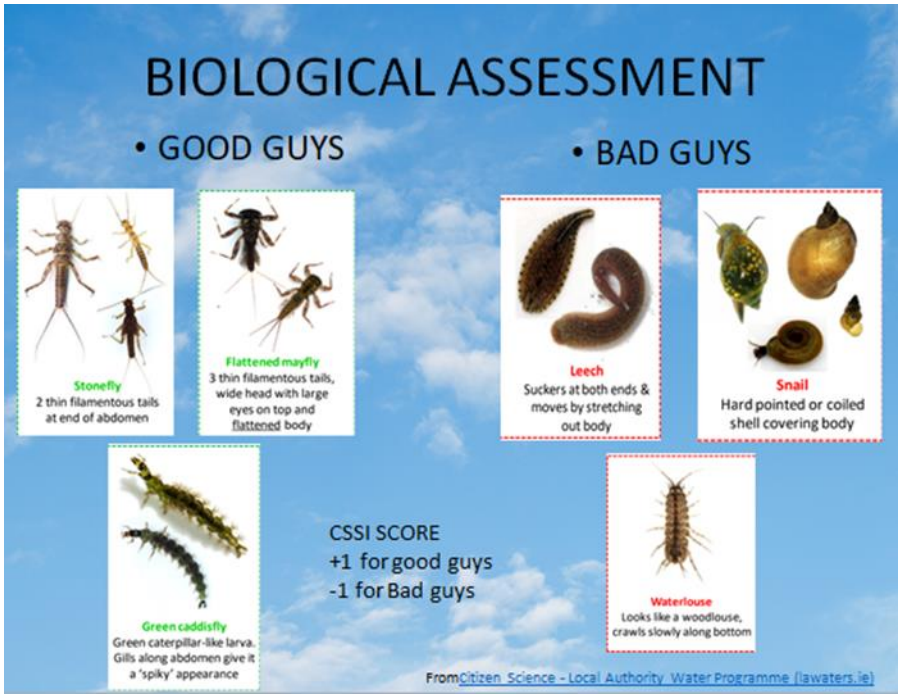
This methodology allowed for precise and reliable measurements to assess the water quality and isotopic composition across our 13 various locations each month along the rivers.

Water Ecosystem support studies

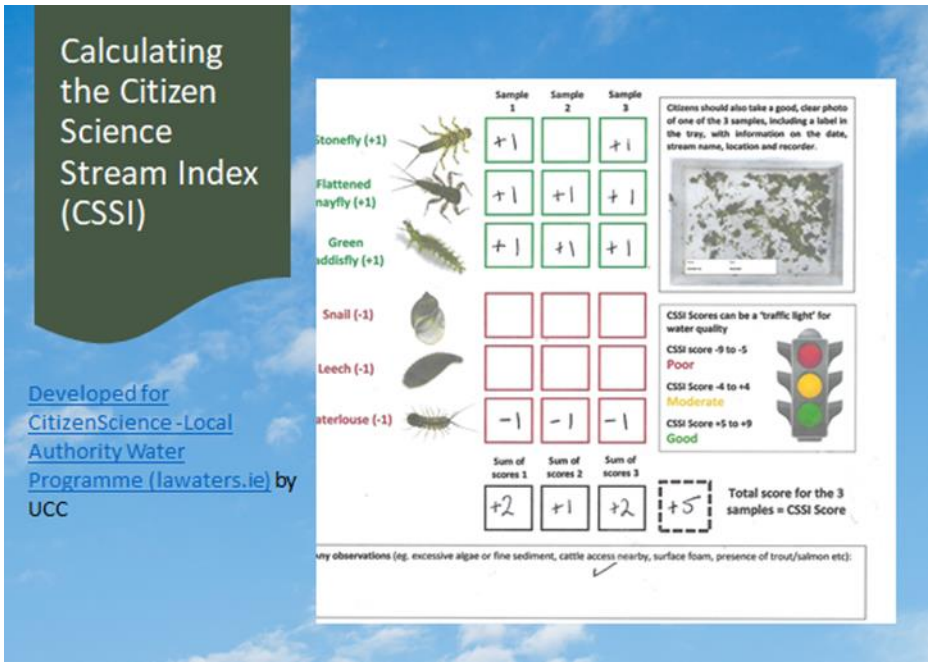
Protocols were strictly adhered to



We repeated the procedure three times. We were looking for these biological Indicator species



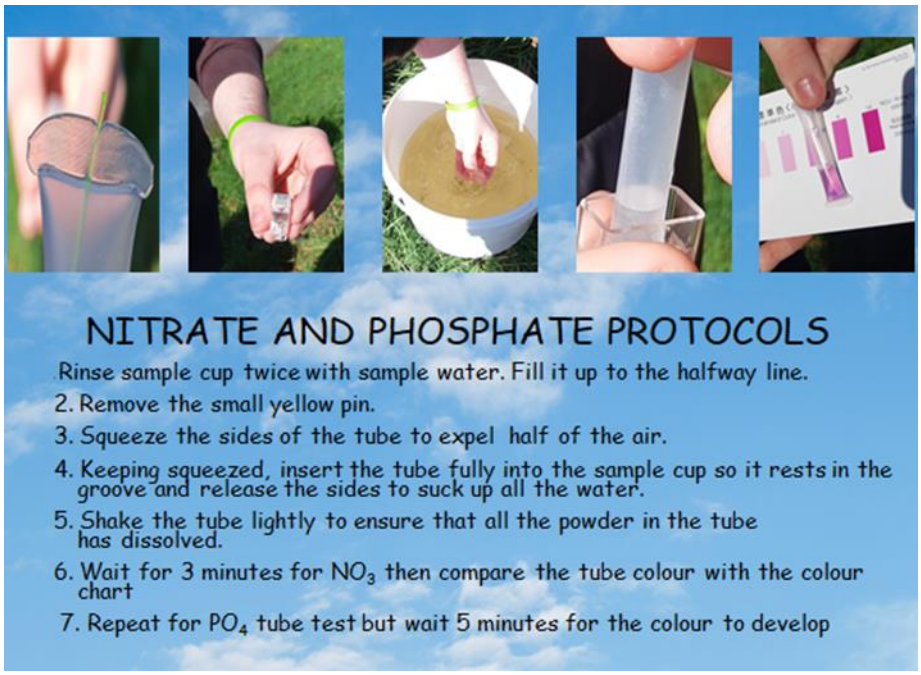
We recorded our findings on this sheet



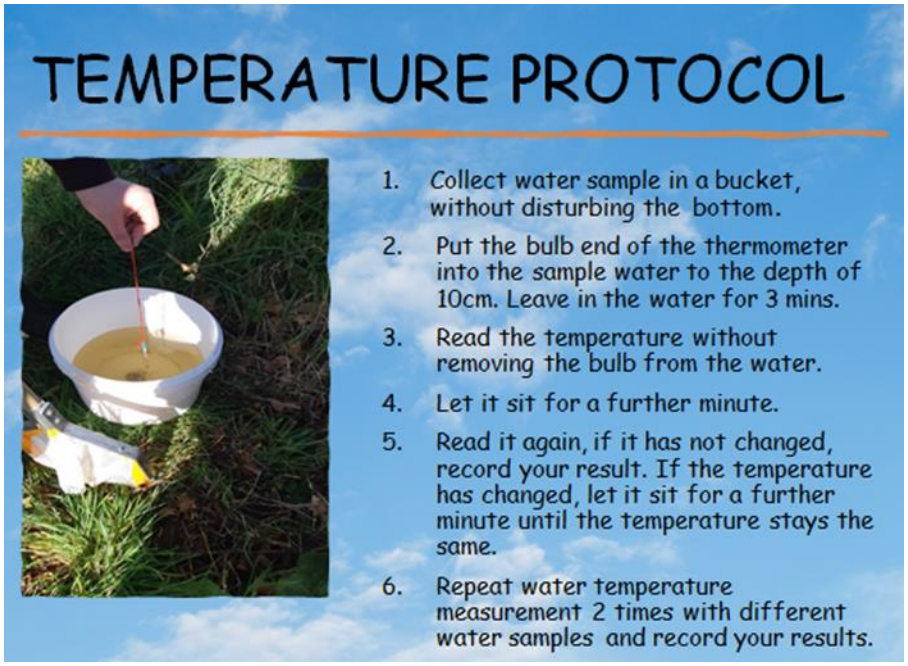
The sheet scores presence of species not number. The range of CSSI scores goes from +9 to –9. In this example sample 1 had all three positive indicator species, so +1 for presence of each. It had water louse present too, so -1. That gave a score of +2. By adding the three

sums together we got a total score. This gives an indication of the long-term health of the river.

We performed chemical tests at each site. We monitored nitrate and pH throughout the year but phosphate only in February due to difficulty in sourcing extra test kits.



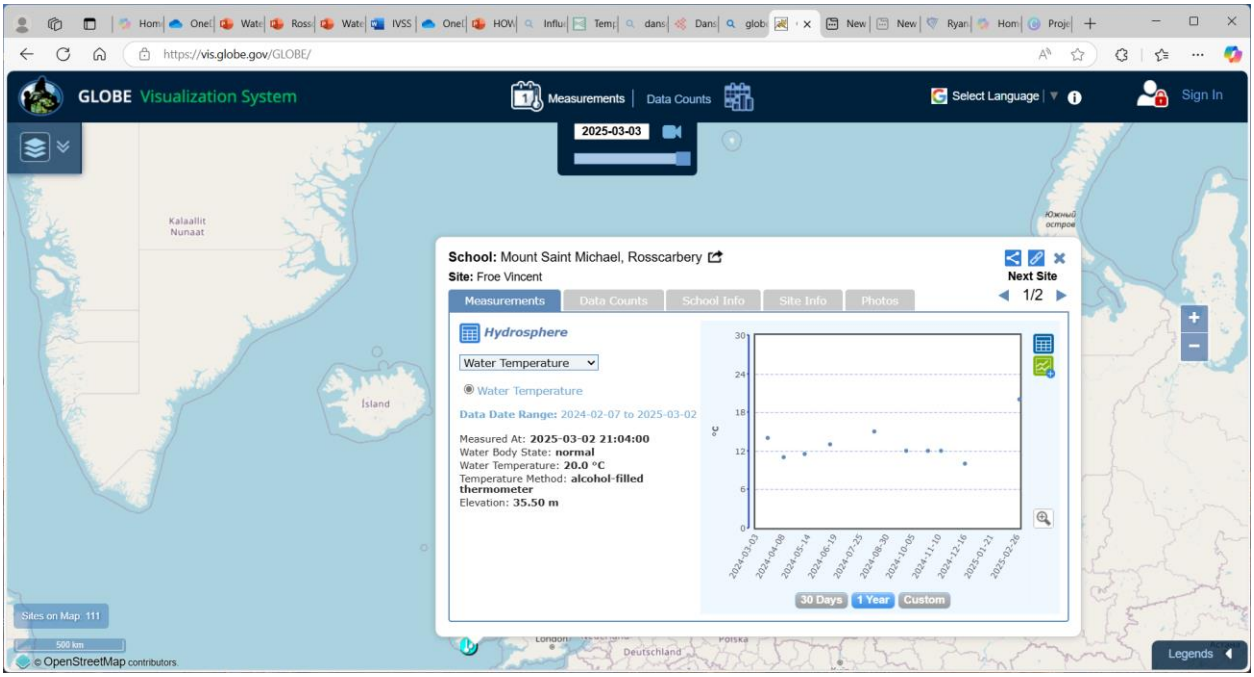
We looked at physical parameters such as depth of river and temperature of water.



Parameter	Tineel stream	Froe stream
Width m	2.3	3.8
Depth m	2.8	3
Land Use	beside main road	rural
Colour	Yellowy brown	Yellowy (may be due to source going through bogland)
Bank vegetation	trees, grass,soil	trees,shrubs,grass,soil
Biodiversity	Birds,invertebrates,plants	Birds, fish, invertebrates,plants
Flow	fast, shallow, some riffles	deep,fast flow
Litter	No	No

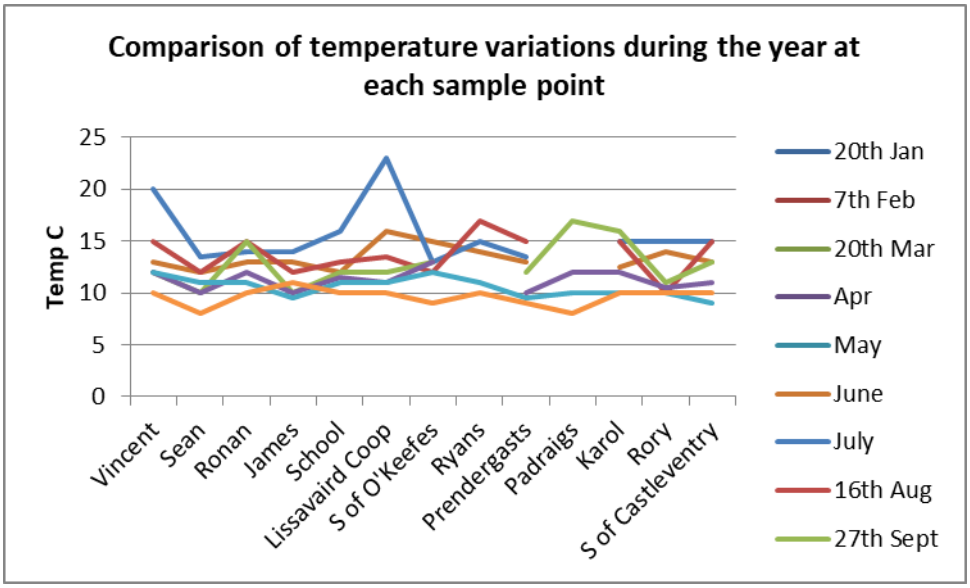
Results and Discussion

Raw data is included in the appendices. Averages were calculated where applicable and graphed for display here. Data gathered using Globe protocols (PH, Temp) was entered onto the Globe Observer app.



All Globe Water Ecosystem Campaign data was submitted to the Globe Ireland Campaign database and results compared with Irish and/or European schools as part of the campaign programme.

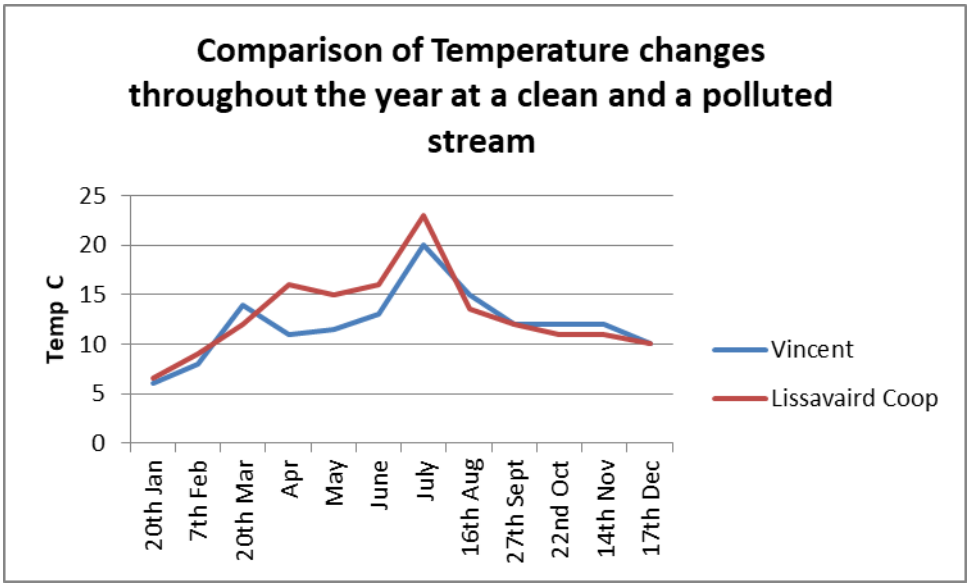
Graph 1



Average Temp over Year	12.4 ° C
Range	8 – 23 ° C

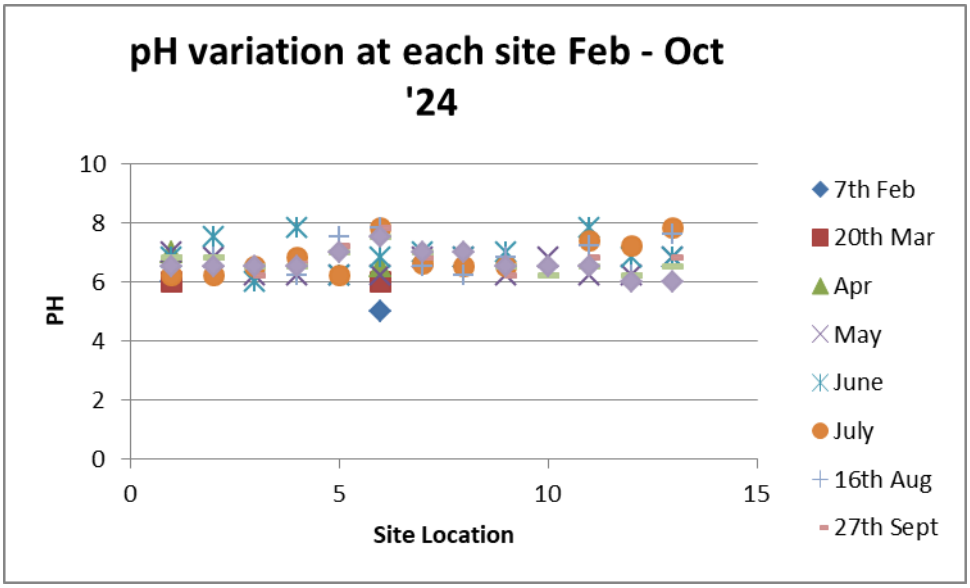
We were surprised at the variation in temperature between the rivers. Vincent and Lissavaird Co-op (Tineel left) were unusually high in July. Vincents site (Froe branch of Tineel river) had extremely low flow which would explain it heating up, but the Coop had a good flow and is sheltered. This may have been a wrong result due to human error or it could be due to hot water discharge at that point in time because the temperature was in line with expectations in August.

Graph 2



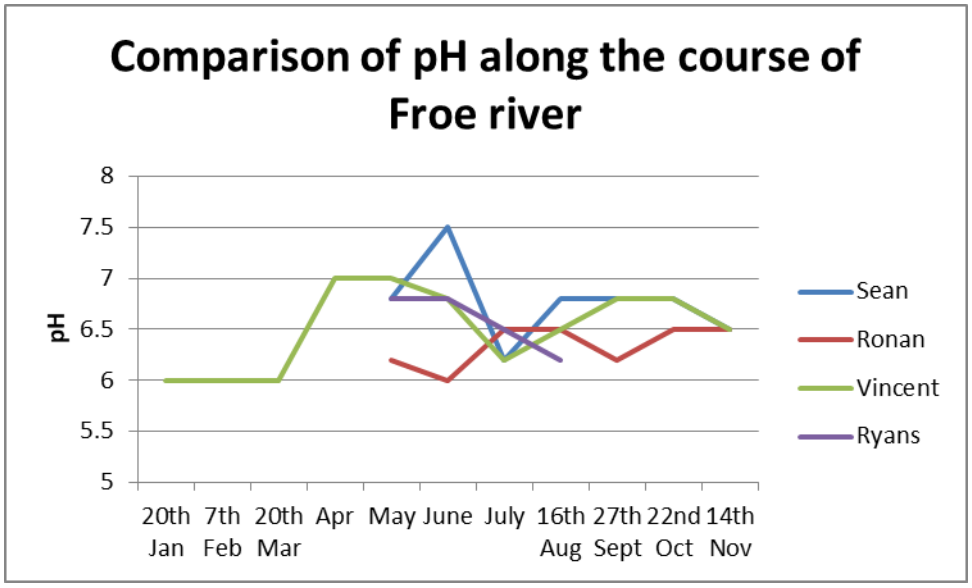
Vincents water had a positive CSSI score and nitrate levels were acceptable (result below), while Lissavaird Co-op site had a negative CSSI score. Temperatures were similar at each site so we dont think temperature variation is a key factor in our study.

Graph 3



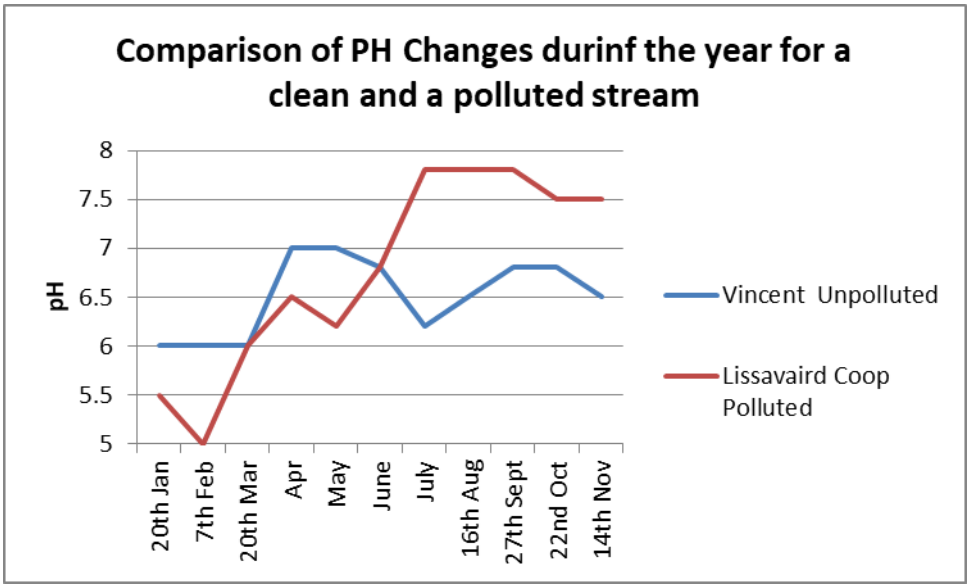
We were again surprised at the huge variation in pH readings. They ranged from pH 6 (acidic)to pH 7.8 (basic) which is almost 100-fold difference. If we trace pH along the course of a single river there is variation too. A pH of 7 is desirable but our results are acceptable (except for Tineel left in Feb) for freshwater organisms to thrive (Dewangan et al, 2023)

Graph 4



We looked at one arm of the Tineel to se how consistent pH is along the course of a river. The river passes through land owned by different farmers but even so, we dont have confidence in these results. If we had a pH meter in school, our results would be more accurate than using universal indicator dip tests.

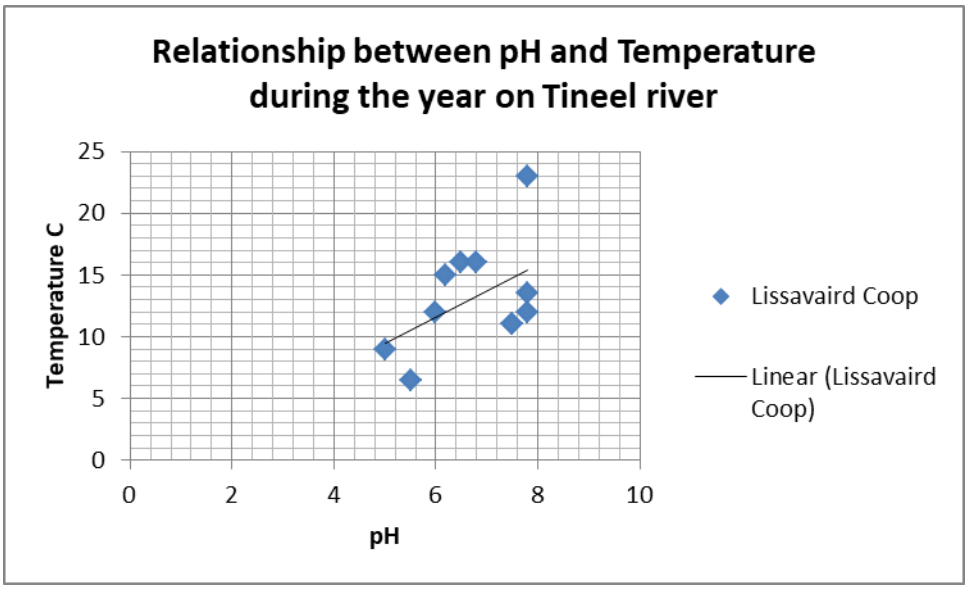
Graph 5



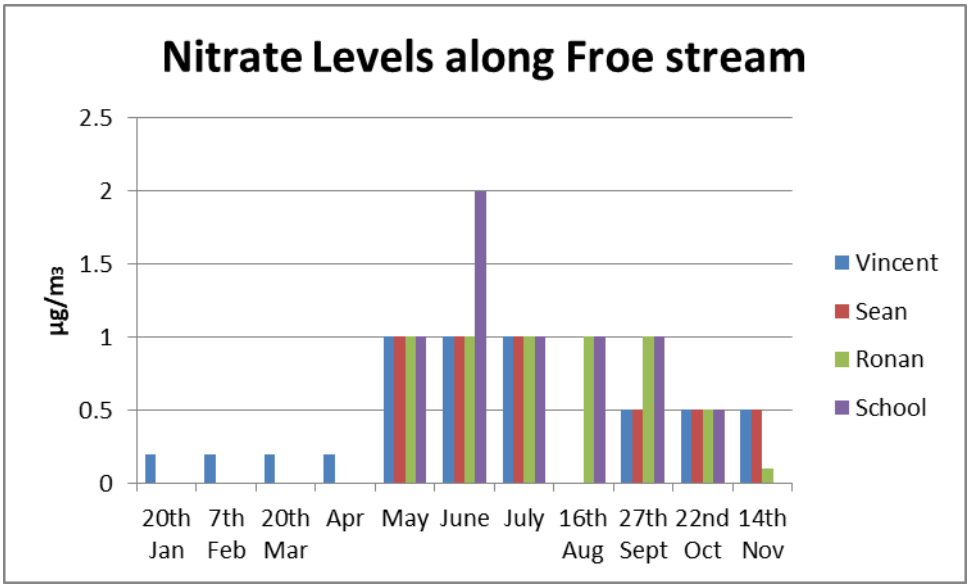
The pH of the polluted Tineel river was more acidic in the winter but rose steeply in Spring. This could be related to the increase in temperature we found.

Graph 6

The scattergram below shows a positive correlation between temperature and pH. Substances are more soluble in warm water so if alkaline substances were dissolved in the warm water, it would raise the pH.

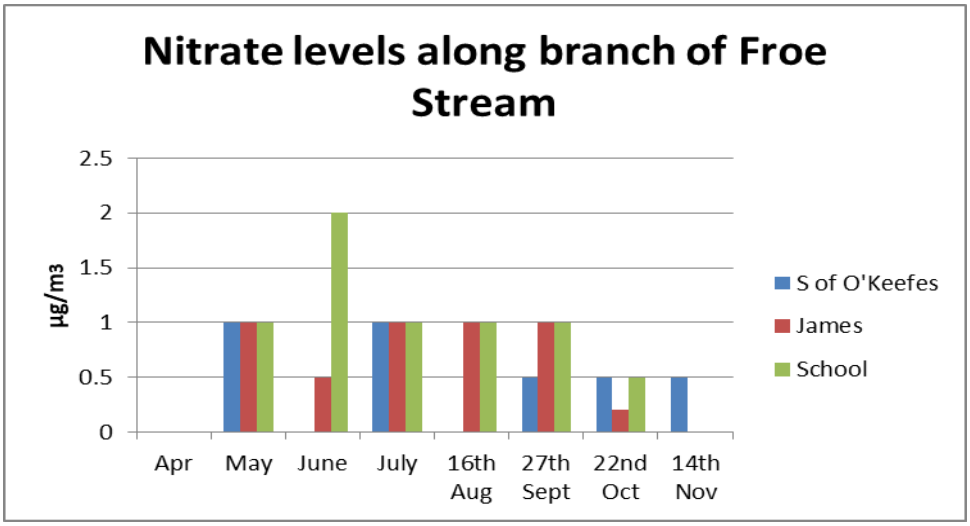


Graph 7



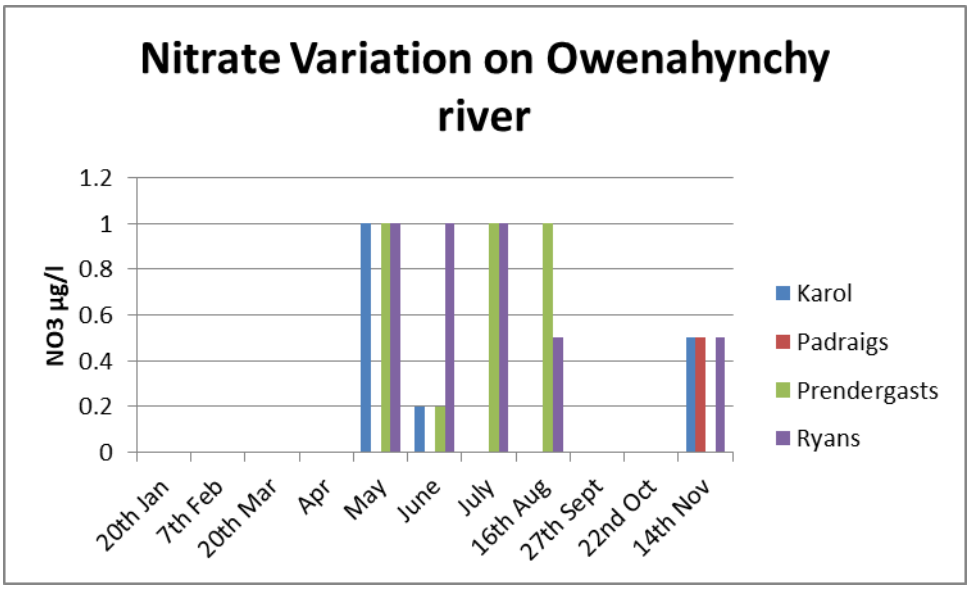
Looking at a single branch of the Tineel river, Nitrate levels increased in the summer months and decreased from the end of October. We expected an increase as these are the fertiliser use times for optimum growth. However, the changes were still within acceptable limits. We do not think they were responsible for the closure of the beach. We spoke to Mr. Aidan Collins of Acorn Laboratories. They were involved in testing the seawater which led to beach closure. From their tests they are sure that the rivers are not carrying elevated levels of ecoli into the bay. Our results support this conclusion. It is more than likely the sewage outflow from the primary treatment plant due to increased population in summer. Another group in our school investigated this theory further.

Graph 8



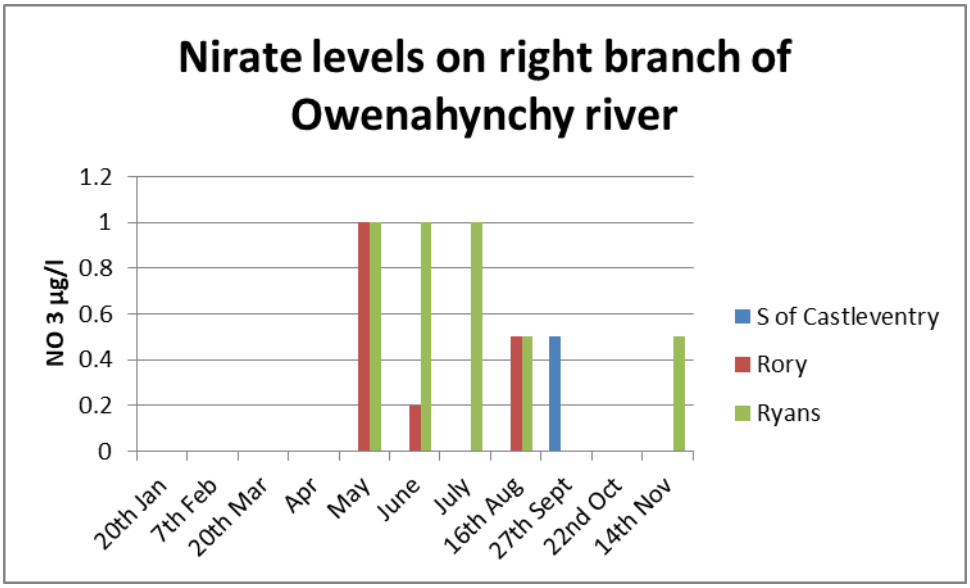
Levels were well below acceptable limit for surface water. **We noted the doubling of the school sample point in June and tested again the following week**, but levels were reduced again. This site is close to the estuary, so the nitrate spike was flushed out but would not represent a pollution problem if this was a single incident.

Graph 9



Levels well below acceptable limit for surface waters.

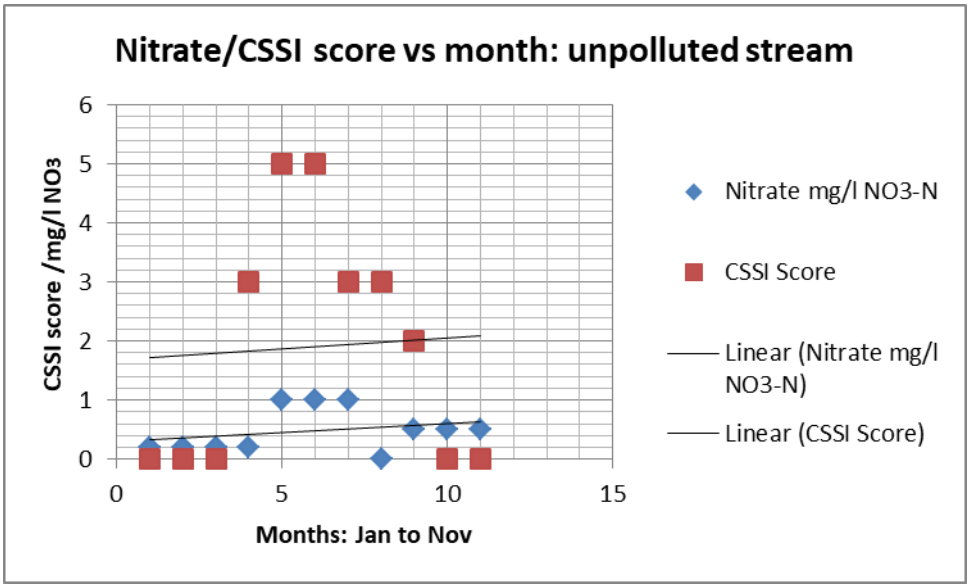
Graph 10



Levels well below acceptable limit for surface waters.

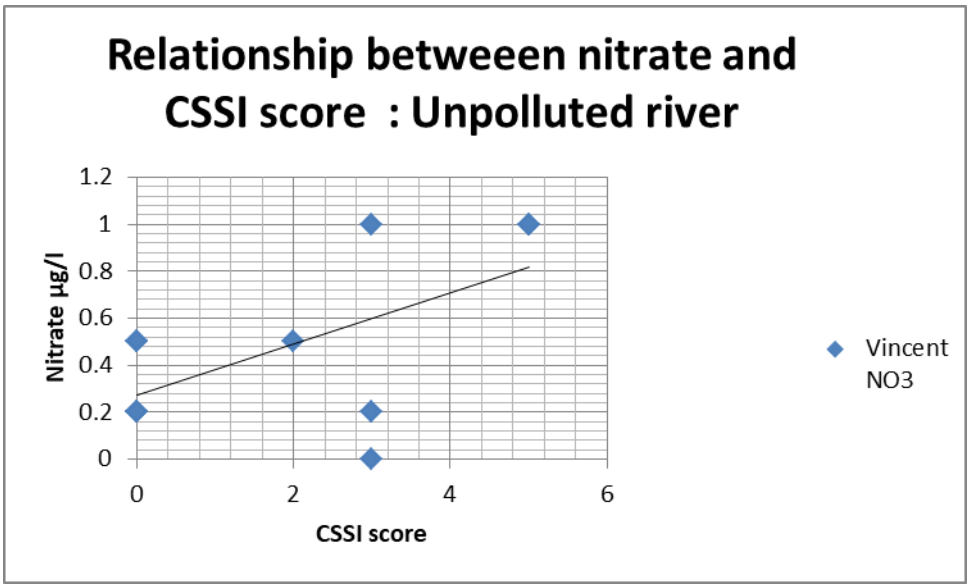
Graph 11

There appears to be a positive relationship between nitrate level/CSSI score as year progresses. Both parameters increase in the summer



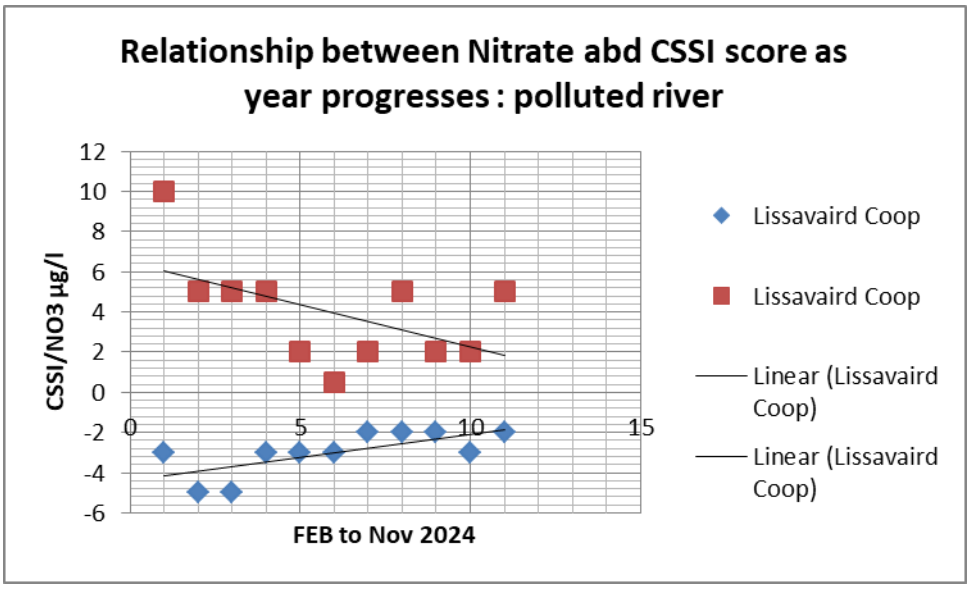
Graph 12

There is a weak to moderate correlation in unpolluted stream. Nitrate is necessary for the growth of organisms. It only becomes a problem when too much nitrate enters the ecosystem.



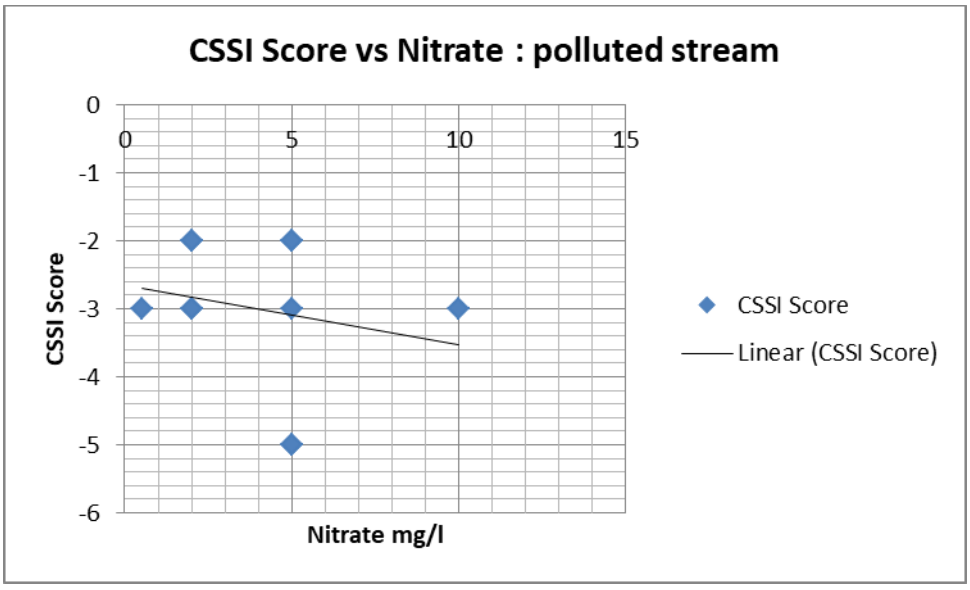
Graph 13

In polluted river, there is a negative trend for Nitrate but positive trend for CSSI. This shows that if nitrate levels decrease then there may be a tendency for CSSI score to increase.

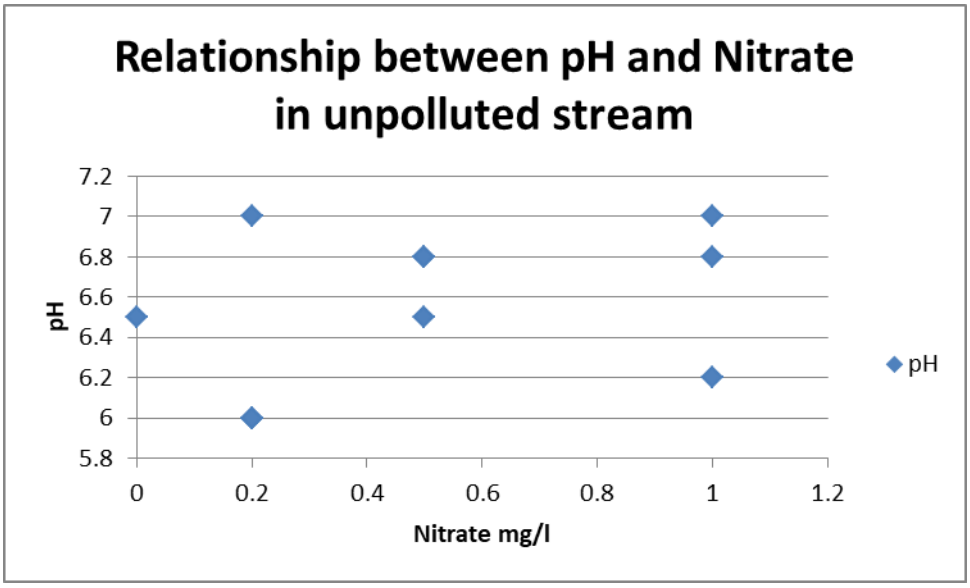


Graph 14

A scattergram gives a very weak negative correlation between CSSI and Nitrate levels, so one change may or may not be causing the other.



Graph 15



There appears to be no correlation between pH and nitrate levels in our rivers. This is not unexpected as the pH is close to 7 for all sites most of the year.

We decided to check our nitrate results for accuracy by sending samples from a number of sites to a registered, certified water testing laboratory. The results are in the table below compared to dip test taken in the same week. We were very disappointed to find that our **dip tests were not at all accurate**, they were underestimating nitrate levels. However we believe they were valid to look for large changes in nitrate levels in water.

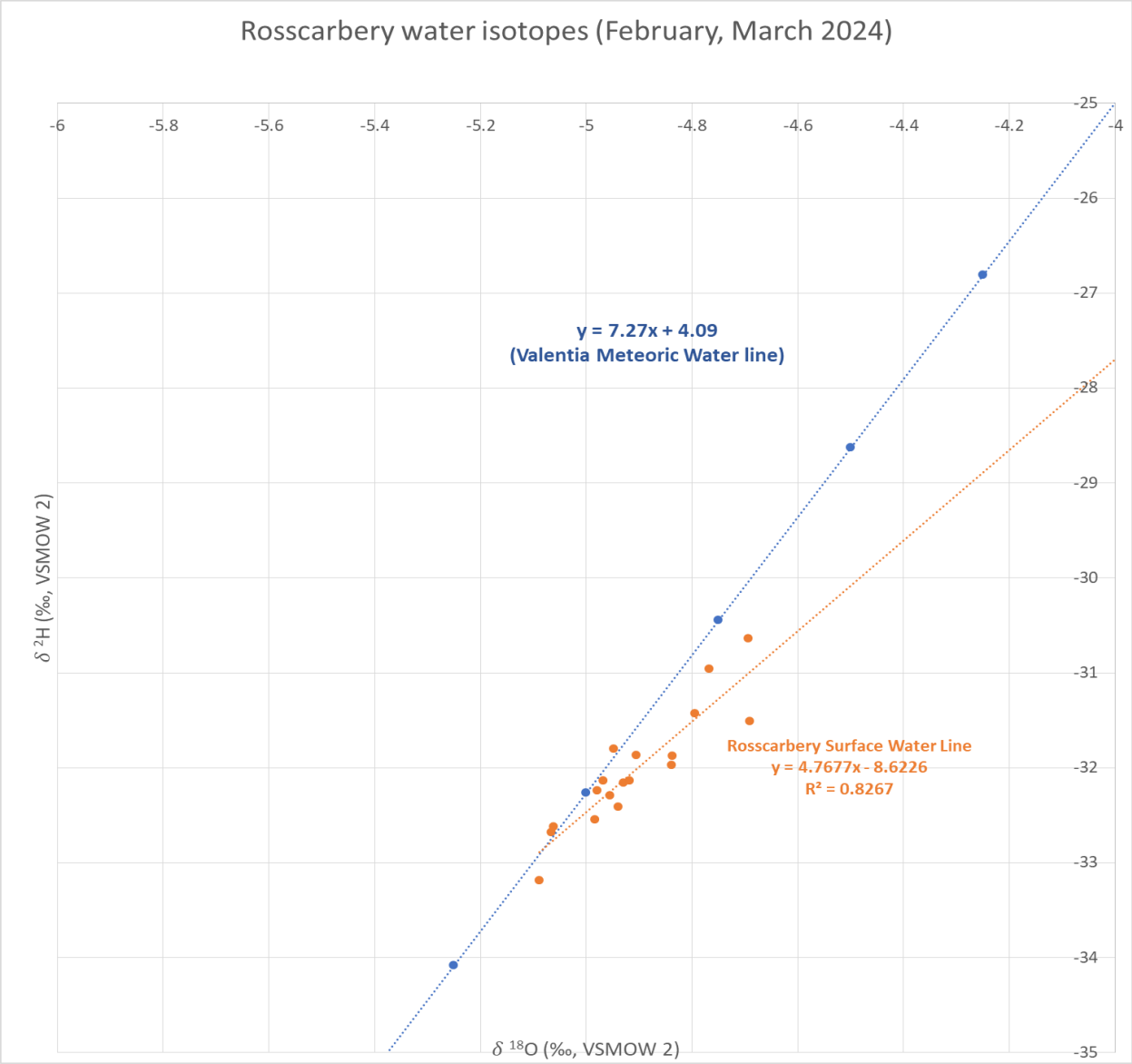
Table 1

Nitrates tested in Registered Lab in October	Column1	Column2
mg/l as NO_3	Lab mg/l	Dip Test µg/l
School	10.8	0.5
Vincent	10.4	0.5
Padraig	16.5	0
Coop	20.6	2

ryans	19.1	1

Graph 16

If you do a scatter plot of the H^2 vs O^{18} for our samples we get a straight-line graph. By plotting this on the same axes as the isotopic signature for the rain which fell on Rosscarbery the previous week (Valentia Meteoric Line) we can see that our samples are related to the rainfall. Once the rain falls and starts to move through the environment, the **ratio of Isotopes will change**. We can see this because the slope of the orange line is less than the blue line. Our samples gave a slope of 4.77, which indicates the samples are from a temperate climate on a cool day. A slope of less than 4 would indicate warmer climate (Dr. Rocha).



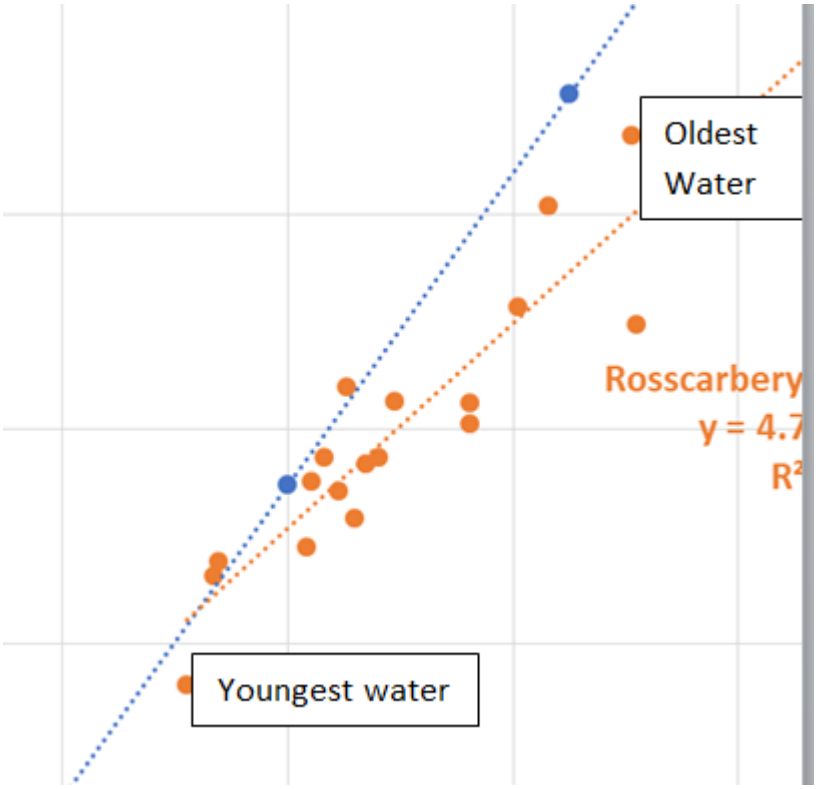
The blue line is the Valencia Meteoric waterline which gives the isotopic signature of the rain as it comes into Ireland. It has been calculated since the 1960's. The orange line is the isotopic signature of our samples.

The lower down the blue line the intercept is, the colder the weather. Since this graph is for February and March samples, we expected the intercept to be lower down the blue line and were happy to see our hypothesis was correct.

The further the points are along the blue line, the older the water is, as shown below.

Graph 18

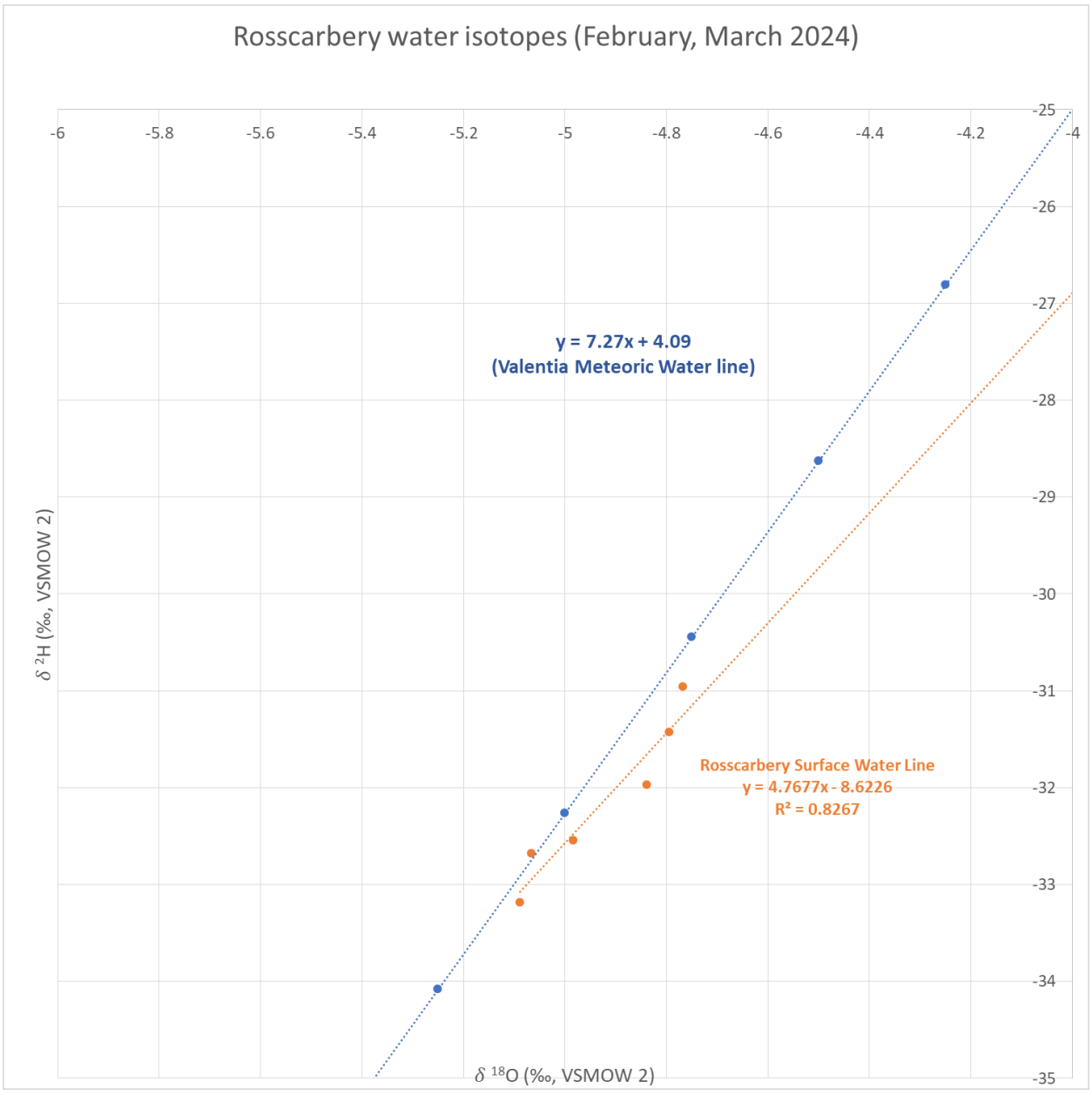
This shows how to tell the difference in ages of water samples as described above



If we look at the graph for February alone (graph 19) it is easier to see which sample was the youngest. Each orange dot corresponds to a sample site. The youngest water, ie the water that has spent least time in circulation since it rained, is the lowest orange dot closest to the blue line. The youngest water was at (-5.1, -33.19) which can be identified by looking at the data table to be Seans point. Next youngest was Ronans which is consistent as they are on the same river and are less than 1km apart .

School

Graph 19

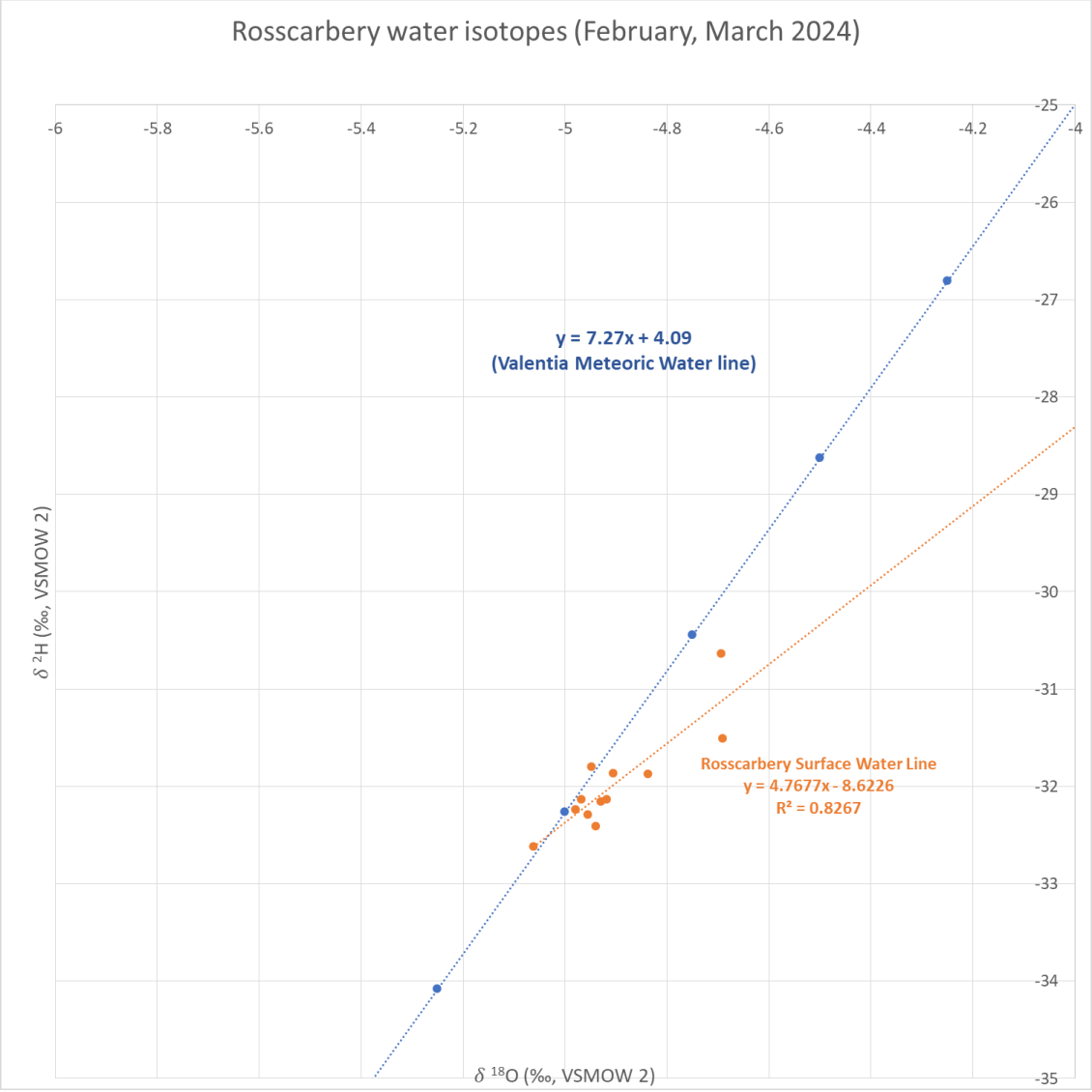


Next was Vincent followed by the co-op. The water that was in the ecosystem for the longest relative to the rain was Castleventry.

There are two possibilities for a sample being the oldest water. One is that it is stagnant, and the other is that it is a spring from groundwater. Castleventry is on a hill at the source of the river, it is fast flowing, not stagnant, therefore it is a spring. A local farmer confirmed this.

When we did the same for March alone Graph 20, we discovered that there is variation from month to month. This is because each rain event has a different ratio of isotopes.

Graph 20



Ranking youngest to oldest in March

Karol<Ronan<James<Sean<Prendergasts<school<O'Keefes<Rory<Padraig<Vincent<Ryans<Co-op.

The Co-op took the longest to get to the river and the second longest in February. This may explain why the Tineel river shows signs of pollution. It takes a long time for pollutants in the water to flush out, so even though the farmer is working to reduce runoff, it is not being seen in the water yet. **Our result shows how important it is to determine the 'Age' of water.**

Looking above at the river starting at Karols, we expected that Padraig and Prendergasts would be of similar age, but this was not the case. Other factors may be affecting the flow of water through the environment eg. Change of soil type, bedrock, topography. Sean and Ronans water, as in February, was younger.

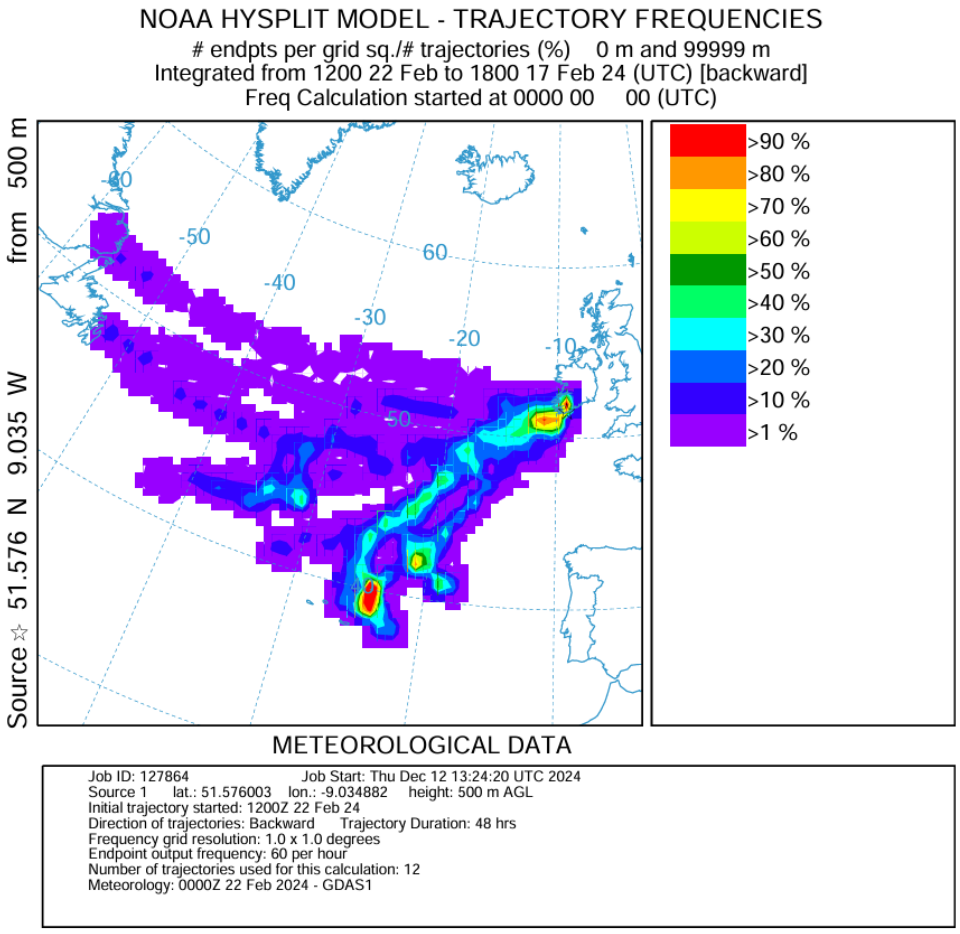
Vincents samples were older in both months, also another group in our school tested for ecoli and Vincents was higher than the other rivers.

This can be explained partly because there was very little water flowing in September but also the older water would take longer to get rid of pollution.

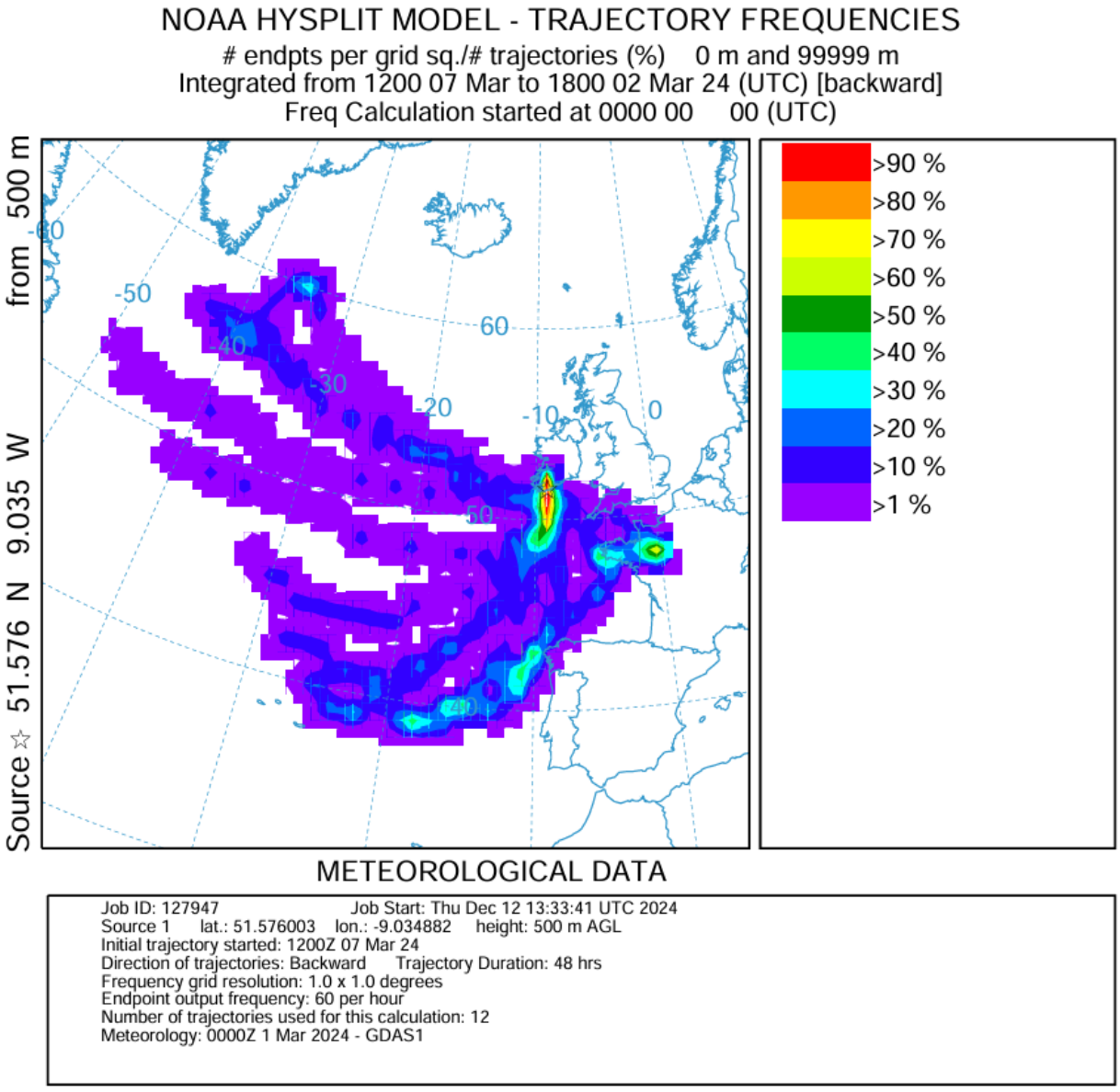
ecoli cfu/100ml	Column1
School	320
Vincent	>2000
Padraig	782
Coop	430
ryans	1013

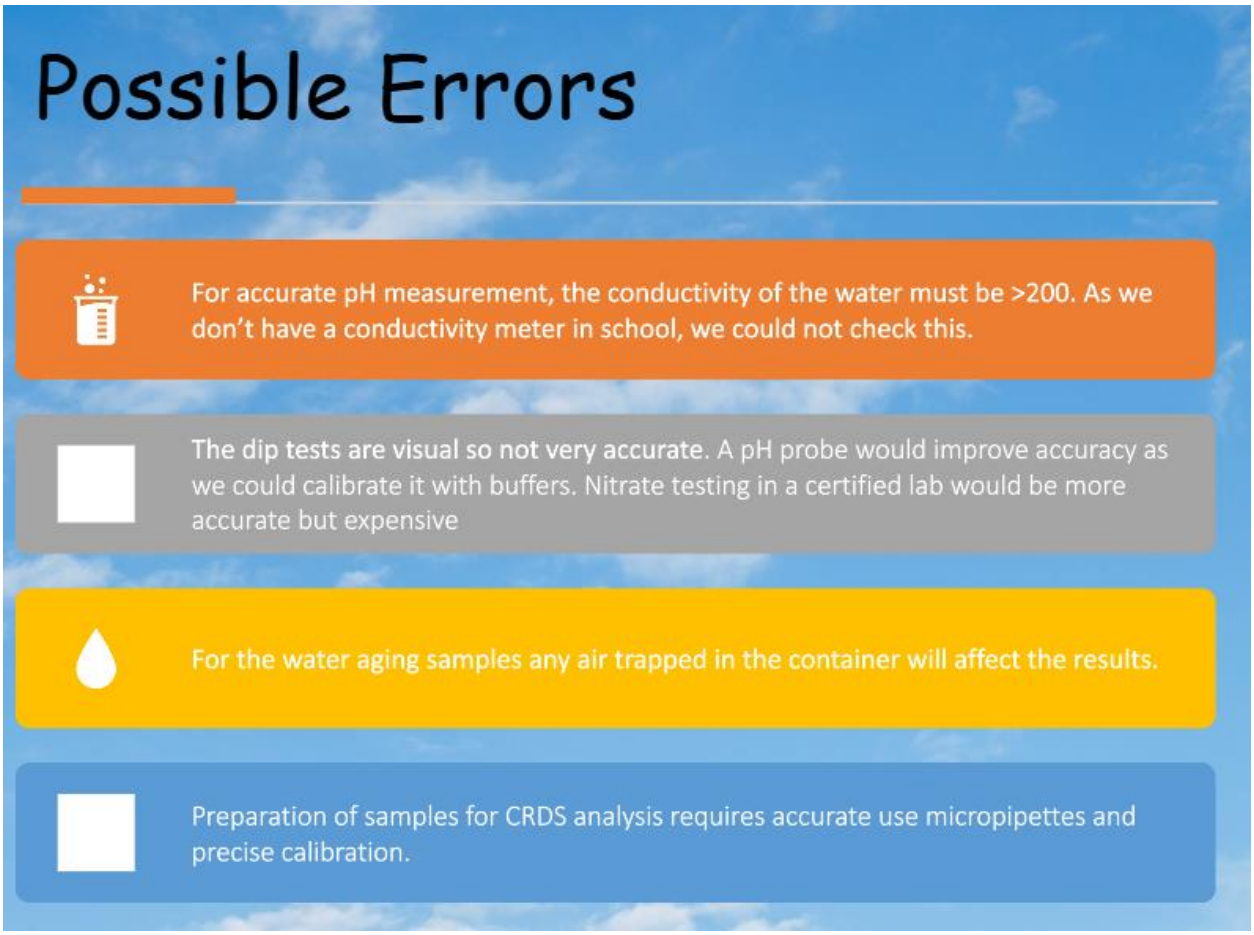
O'Keefes may be spring water as it is at the start of a tributary of the Owenahinchy river and is older than James water mid-way along the river. The site by Ryans near the point where the river flows into the estuary is second oldest in March.

This is the NOAA Hysplit Model for the rain that fell the week before we took our samples in February. All the rain came in from the Azores. Follow the orange blobs- this carries the rain isotopic signature which our sampling site track through the environment.



The trajectory map for March shows rain came from the south but some also came from the Bay of Biscay.





Conclusion

We were successful in 'fingerprinting' water to determine the age of our water samples in relation to a rainfal event.

Our results are reproducible even though there is a lot of variation. We can say this because the younger water was found at the same sites both months, likewise for the older water. We cannot monitor all sites for anothe year as it takes alarge time input. For this reason we have selected two sites – The polluted Tineel site by the Coop and the clean Owenhynchy site by Karols- to monitor for 2025.

The additional Globe Water Ecosystem studies and certified laboratory testing we carried out supported our 'fingerprint' discoveries. Castleventry, the 'oldest' water

in February, was at the source of one of the streams which indicated it comes from groundwater. The finding that Vincent's higher E.coli than other sample points could be explained by our results because as the water takes longer to move through the area bacteria have longer to reproduce and get flushed out more slowly. Likewise, the Tineel (Lissavaird Co-op) river pollution can be explained as it is 'older' water. LAWPRO had expected the quality of the Tineel by the Co-op to improve after their interventions with the farmer upstream. Our bio-indicator results show that the ecosystem has still not improved, however, our 'aging' isotope results have been communicated to them and monitoring will continue.

We were impressed with the low levels of nitrates in our rivers but farms with fields near the 'young' water streams must reduce their use of fertiliser as runoff will get into the waterways quickly especially after heavy rain.

CRDS is an excellent tool to trace an isotopic 'fingerprint' of water as it moves through the environment. We are the first group to collect this valuable data for West Cork. We collected a full year of samples. We present 'aging' data here for February and March only. The rest of the samples are being processed and we will analyse the results with the help of Dr. Rocha. Our collaboration with Rosscarbery Biodiversity group, Lawpro and Dr. Rocha of TCD will continue for another year. Once analysed they will form a baseline for future aging studies in Cork. **Once this baseline is established the technique can be used to study groundwater. This** will give invaluable access to information on groundwater status and speed of transit of water in an area. Such information can inform decisions on where to limit fertilisers, where to introduce mitigation actions and how long it will take for them to be seen in streams.

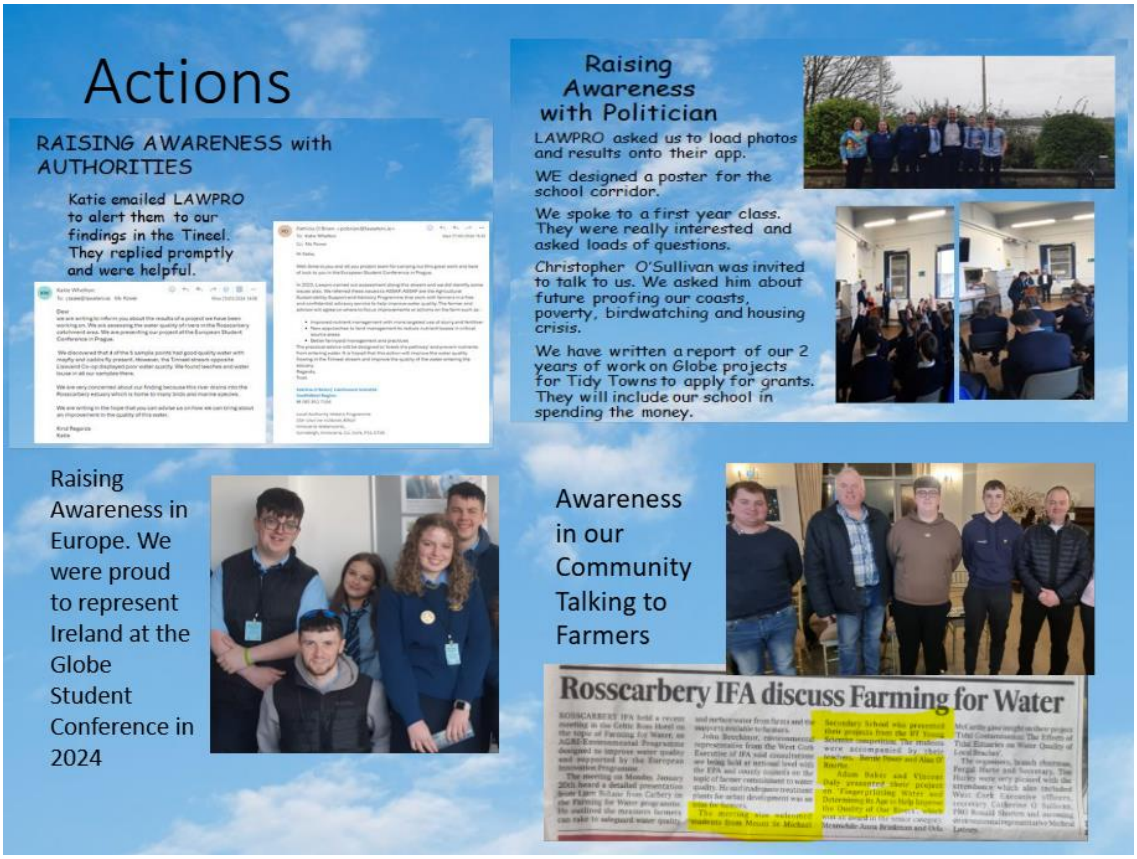
A very surprising but important finding from our research was that the runoff from the farmland is most unlikely to have been the cause of the beach closure this year.

We have raised awareness in many ways. We presented the Water Ecosystem part of our project at the Globe Student Conference in Prague last April. We enjoyed

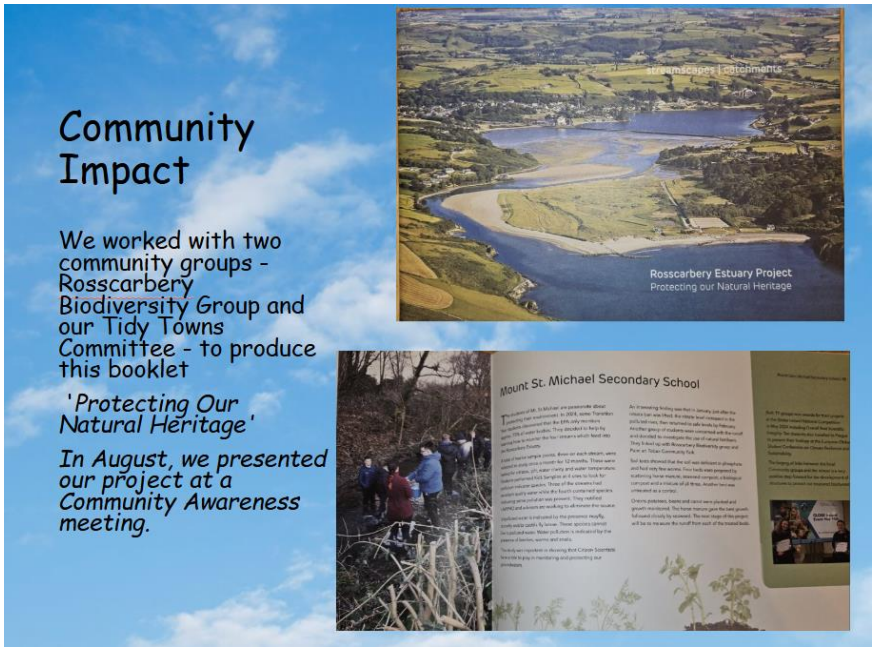
meeting students from all over Europe and sharing our ideas with them. The project won 'Best Water Ecosystem Project' and 'Best Scientific Integrity Award' at the Globe Ireland Competition in May 2024. In January 2025 we attended the BT Young Scientist Competition in Dublin where we won 3rd place in the Senior Biological and Ecological Sciences Category. This gave us great motivation to continue the research as the recognition means our work is important and valued. Our local branch of Irish Farmers Association was keen to hear about our project and invited us to present our results at an information evening on Improving water quality on farms.We also won the Community Awareness award at the 'Best of Europe and Eurasia' recently. We are very proud of our involvement in producing the Streamscapes booklet shown below – Rosscarbery Estuary Project : Protecting our Natural Heritage in conjunction with local community groups and their leaders.

Through the project we have grown in confidence and matured socially and intellectually. We have learned many new skills which will transfer to the workplace. We have developed an appreciation for our rich environment and will always be involved in its protection.

Impact and Awareness Actions



Meeting Dr. Tony Murphy in Czech Republic



Two of our school Globe groups contributed to the development of the **Rosscarbery Biodiversity Plan.** This is us with the LAWPRO educational co-ordinator for West Cork at the launch of the plan.

BT Young Scientist Competition 2025

3rd place in Biological and Ecological Category

Our Stand and poster

Sharing our project with the leader of our government Mr. Micheal Martin

Sharing with the public

Receiving our prize

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Acknowledgements

We would like to express our thanks to the many people who helped us during the year.
To our Principal, Mr. Kerrisk, who allowed us time to do our field studies. To our teacher Ms. Power who drove us every day brought us to Dublin and Prague and provided resources and advice.
To the Globe Ireland Team for their enthusiasm and excellent resources.
A big thankyou to Dr. Carlos Rocha, and his team Eimear and Conor, for your patience and time in guiding us through the use of CRDS and explaining in simple terms how to understand the science.

Appendices

Raw Data

Avg Temp °C	Vincent	Sean	Ronan	James	School	Lissavaird Coop	S of O'Keefes	Ryans	Prendergasts	Padraigs	Karol	Rory	S of Castleventry
20th Jan	6					6.5							
7th Feb	8					9							
20th Mar	14					12							
Apr	11					16							
May	11.5					15							
June	13	12	13	13	12	16	15	14	13		12.5	14	13
July	20	13.5	14	14	16	23	13	15	13.5		15	15	15
16th Aug	15	12	15	12	13	13.5	12	17	15		15	10	15
27th Sept	12	10	15	10	12	12	13		12	17	16	11	13
22nd Oct	12	10	12	10	11.5	11	13		10	12	12	10.5	11
14th Nov	12	11	11	9.5	11	11	12	11	9.5	10	10	10	9
17th Dec	10	8	10	11	10	10	9	10	9	8	10	10	10

ecoli cfu/100ml	Column1
School	320
Vincent	>2000
Padraig	782
Coop	430
ryans	1013

pH	Vincent	Sean	Ronan	James	School	Lissavaird Coop	S of O'Keefes	Ryans	Prendergasts	Padraigs	Karol	Rory	S of Castleventry
20th Jan	6					5.5							
7th Feb	6					5							
20th Mar	6					6							
Apr	7					6.5							
May	7	6.8	6.2	6.2	6.2	6.2	6.8	6.8	6.2	6.8	6.2	6.2	6.8
June	6.8	7.5	6	7.8	6.2	6.8	7	6.8	7		7.8	6.8	6.8
July	6.2	6.2	6.5	6.8	6.2	7.8	6.6	6.5	6.5		7.4	7.2	7.8
16th Aug	6.5	6.8	6.5	6.2	7.5	7.8	6.5	6.2	6.8		7.2	6.2	7.6
27th Sept	6.8	6.8	6.2	6.6	7.2	7.8	6.8		6.2	6.2	6.8	6.2	6.8
22nd Oct	6.8	6.8	6.5	6.5	7	7.5	7		6.5	6.2	6.5	6.2	6.5
14th Nov	6.5	6.5	6.5	6.5	7	7.5	7	7	6.5	6.5	6.5	6	6

Nitrate mg/l NO3-N	Vincent	Sean	Ronan	James	School	Lissavaird Coop	S of O'Keefes	Ryans	Prendergasts	Padraigs	Karol	Rory	S of Castleventry
20th Jan	0.2					10							
7th Feb	0.2					5							
20th Mar	0.2					5							
Apr	0.2					5							
May	1	1	1	1	1	2	1	1	1	0	1	1	0
June	1	1	1	0.5	2	0.5	0	1	0.2		0.2	0.2	0
July	1	1	1	1	1	2	1	1	1		0	0	0
16th Aug	0	0	1	1	1	5	0	0.5	1		0	0.5	0
27th Sept	0.5	0.5	1	1	1	2	0.5		0	0	0	0	0.5
22nd Oct	0.5	0.5	0.5	0.2	0.5	2	0.5		0	0	0	0	0
14th Nov	0.5	0.5	0.1	0	0	5	0.5	0.5	0	0.5	0.5	0	0

CSSI Score	Vincent	School	Tineel (Co-op)	Padraigs	Rory
20th Jan	0	0	-3		
7th Feb	0	0	-5		
20th Mar	0	1	-5		
Apr	3	3	-3	5	
May	5	3	-3	8	5
June	5	4	-3		6
July	3	1	-2		5
16th Aug	3	1	-2		4
27th Sept	2	1	-2	5	4
22nd Oct	0	0	-3	2	0
14th Nov	0	0	-2		0

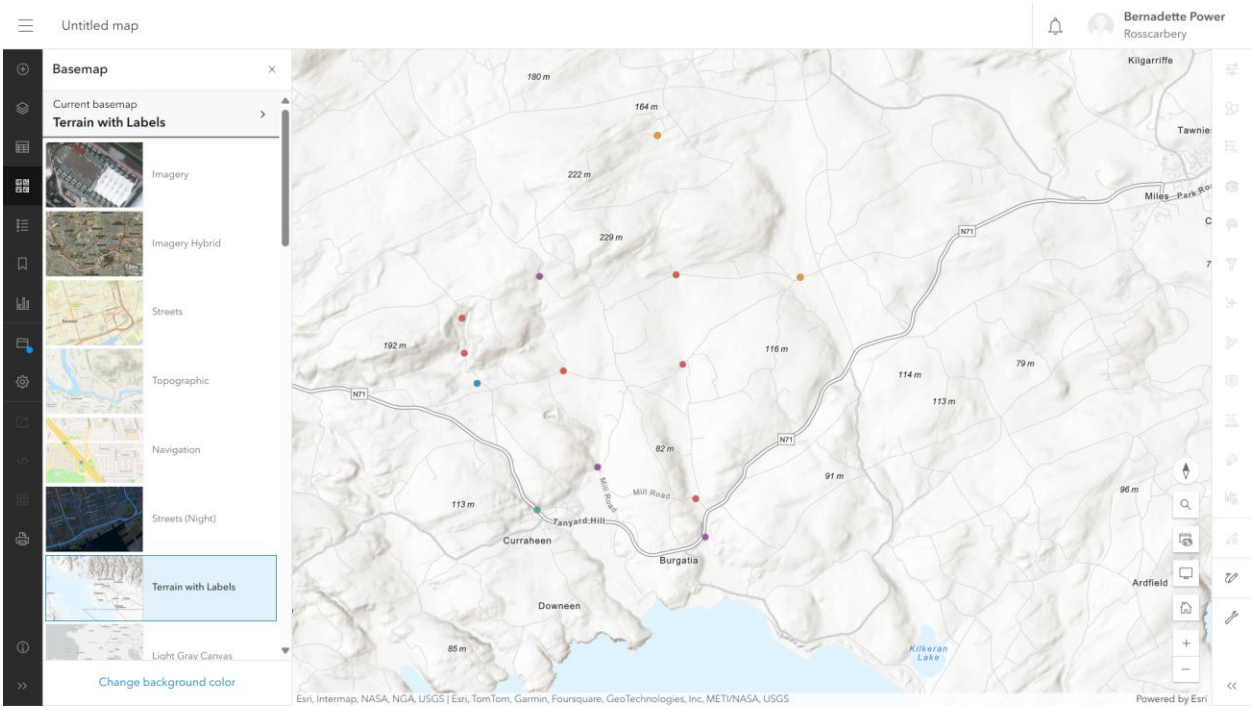
Status	Clean	Clean	Polluted	Clean	Clean

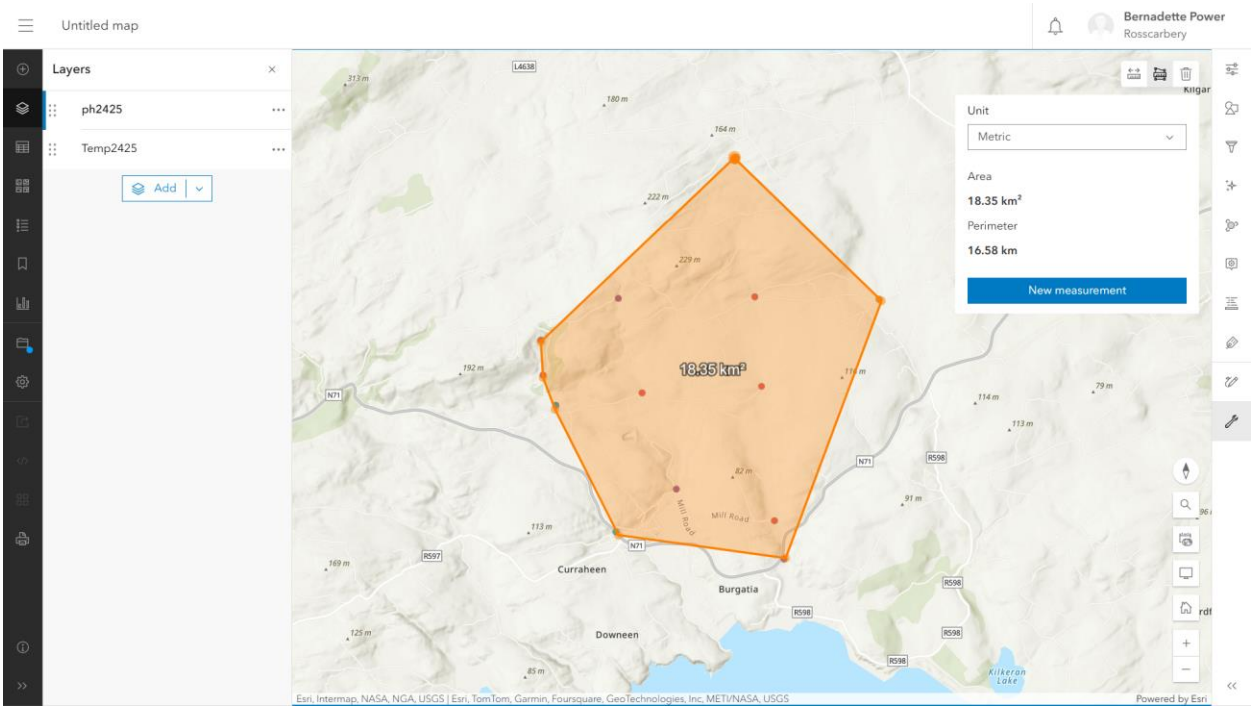
	mg/l as NO_3	Lab mg/l	Dip Test mg/l
	School	10.8	0.5
	Vincent	10.4	0.5
	Padraig	16.5	0
	Coop	20.6	2
	ryans	19.1	

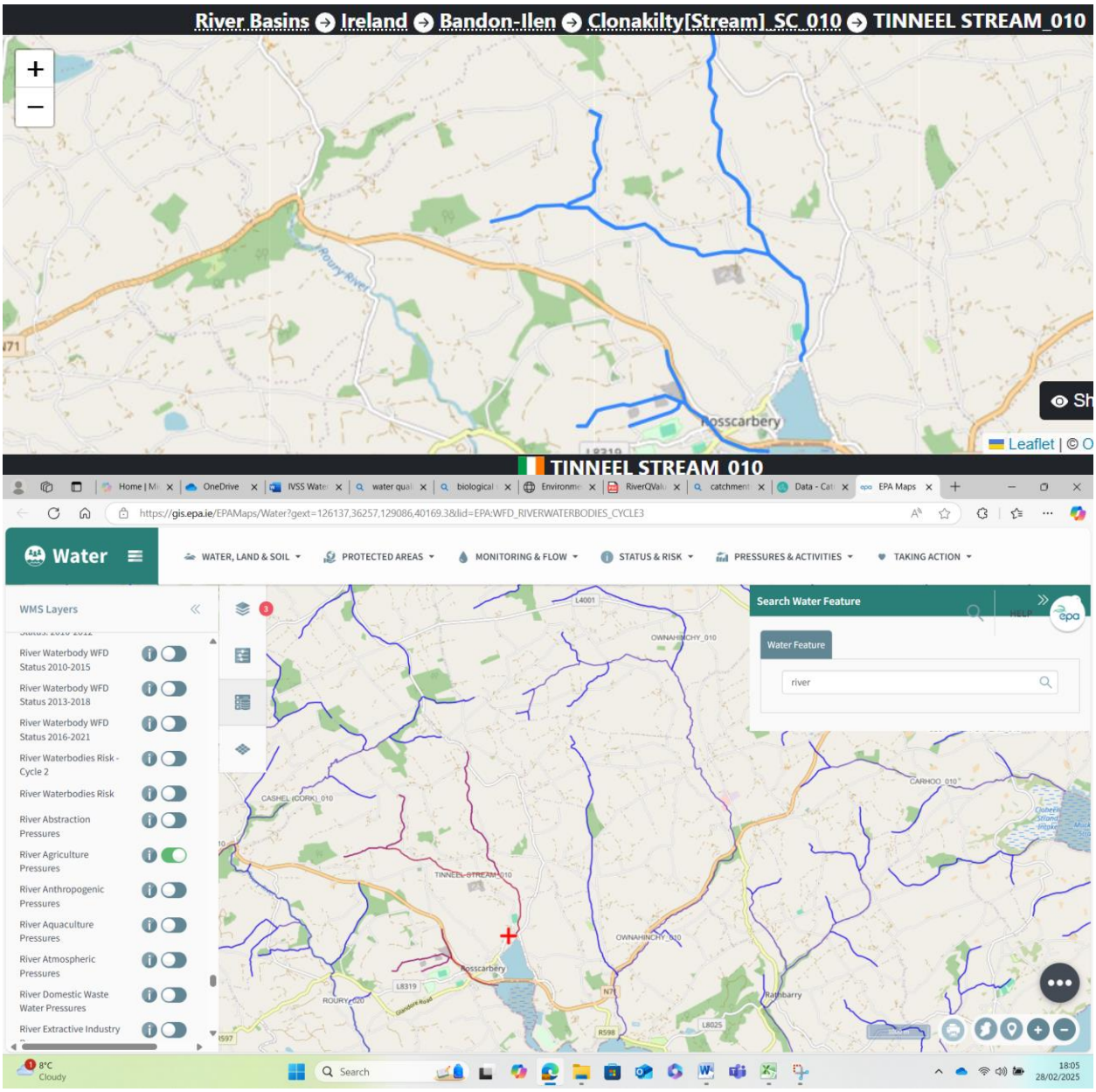
Tineel	Lissavaird Coop pH	Lissavaird Coop Temp
20th Jan	5.5	6.5
7th Feb	5	9
20th Mar	6	12
Apr	6.5	16
May	6.2	15
June	6.8	16
July	7.8	23
16th Aug	7.8	13.5
27th Sept	7.8	12
22nd Oct	7.5	11
14th Nov	7.5	11

Identifier for analysis	Sample point and date	δ18O ‰	δ2H ‰	Column1
Rc1	River next to school 22/2/24	-7.68	-32.55	-5.0
rc2	South of graveyard 22/2/24	-7.47	-30.96	-4.8
rc3	Ronans point 22/2/24	-7.77	-32.68	-5.1
rc4	Vincents point 22/2/24	-7.54	-31.98	-4.8
rc5	Lisavaird coop 22/2/24	-7.49	-31.43	-4.8
rc6	Seans point 22/2/24	-7.79	-33.19	-5.1
rc7	River by prendergasts 7/3/24	-7.67	-32.14	-5.0
rc8	James farm 7/3/24	-7.68	-32.24	-5.0
rc9	River by ryans shop 7/3/24	-7.39	-31.51	-4.7
rc10	River behind Paidrigs 7/3/24	-7.60	-31.87	-4.9
rc11	River by Karols 7/3/24	-7.76	-32.62	-5.1
rc12	River next to school	-7.63	-32.16	-4.9
rc13	Ronans point 7/3/24	-7.65	-32.29	-5.0
rc 14	Seans point 7/3/24	-7.64	-32.41	-4.9
rc 15	South of O keffes fort 7/3/24	-7.62	-32.13	-4.9
rc 16	Vincents popint 7/3/24	-7.54	-31.88	-4.8
rc17	Lisavaird co-cop 7/3/24	-7.39	-30.64	-4.7
rc 18	Rorys point 7/3/24	-7.65	-31.80	-4.9

Map of our site locations and rivers as displayed on arcGIS






River Basins → Ireland → Bandon-Ilen → Clonakilty[Stream]_SC_010 → TINNEEL STREAM_010
Rosscarbery
Leaflet
TINNEEL STREAM_010
https://gis.epa.ie/EPAMaps/Water?gext=126137,36257,129086,40169.3&lid=EPA:WFD_RIVERWATERBODIES_CYCLE3
Water
WATER, LAND & SOIL
PROTECTED AREAS
MONITORING & FLOW
STATUS & RISK
PRESSURES & ACTIVITIES
TAKING ACTION
WMS Layers
River Waterbody WFD Status 2010-2015
River Waterbody WFD Status 2013-2018
River Waterbody WFD Status 2016-2021
River Waterbodies Risk - Cycle 2
River Waterbodies Risk
River Abstraction Pressures
River Agriculture Pressures
River Anthropogenic Pressures
River Aquaculture Pressures
River Atmospheric Pressures
River Domestic Waste Water Pressures
River Extractive Industry
Search Water Feature
Water Feature
river
OWNAHINCHY_010
CASHEL (CORK)_010
CARHOO_010
TINNEEL STREAM_010
Rosscarbery
Rathbarry
L4001
L8319
L8025
R598
N71
8°C
Cloudy
Search
18:05
28/02/2025

Data entry to Globe Observation Site: Freshwater pH

	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	10T12:15:00		mal	8	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-06-		nor	6.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	14T12:10:00		mal	8	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-07-		nor	7.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	20T12:40:00		mal	8	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-08-		nor	7.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	16T12:42:00		mal	6	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-09-		nor	6.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	27T12:20:00		mal	2	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-09-		nor	6.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	27T12:50:00		mal	8	r
	Mount Saint		Castleventry -			-	1						pa
1.07	Michael,	379	Owenahynchy right	51.5	9.03	6. ####		1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	560	source	777	8	7 ####		E+08	22T12:08:00		mal	5	r
	Mount Saint					-	3						pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-02-		nor		pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	07T11:40:00		mal	6	r
	Mount Saint					-	3						pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-03-		nor		pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	20T11:40:00		mal	6	r
	Mount Saint					-	3						pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-04-		nor		pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	11T10:30:00		mal	7	r
	Mount Saint					-	3						pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-05-		nor		pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	10T10:40:00		mal	7	r
	Mount Saint					-	3						pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-06-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	14T10:30:00		mal	8	r

	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-08-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	14T10:30:00		mal	5	r
	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-09-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	27T10:30:00		mal	8	r
	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	27T20:24:00		mal	8	r
	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-11-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	14T11:40:00		mal	5	r
	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-11-		nor	7.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	14T11:30:00		mal	5	r
	Mount Saint				-	3							pa
1.07	Michael,	379		51.5	9.04	5. ####		1.03	2024-12-		nor	6.	pe
E+08	Rosscarbery	534	Froe Vincent	9377	995	6 ####		E+08	17T11:30:00		mal	8	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-02-		nor	6.	pe
E+08	Rosscarbery	552	right		777	8	7 ####		E+08	07T11:30:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-06-		nor	7.	pe
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	Mount Saint				-	1							pa
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E+08	Rosscarbery	552	right		777	8	7 ####		E+08	20T10:20:00		mal	8	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-08-		nor	6.	pe
E+08	Rosscarbery	552	right		777	8	7 ####		E+08	16T11:10:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-09-		nor	6.	pe
E+08	Rosscarbery	552	right		777	8	7 ####		E+08	27T10:20:00		mal	6	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	552	right		777	8	7 ####		E+08	21T23:14:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	James O'S farm	Tineel	51.5	9.03	6. ####		1.03	2024-11-		nor	6.	pe
E+08	Rosscarbery	552	right		777	8	7 ####		E+08	14T11:20:00		mal	5	r
1.07	Mount Saint	379	Karols Owenahynchy		51.5	-	1 ####		1.03	2024-05-		nor	6.	pa

E+08	Michael, Rosscarbery Mount Saint	556 left	777	9.038-1	6.####7	E+08	10T11:45:00	mal	2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-06-14T12:20:00	nor mal	7.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-07-20T12:20:00	nor mal	7.4	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-08-16T11:20:00	nor mal	7.2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-09-27T11:30:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-10-22T12:00:00	nor mal	6.5	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 Karols Owenahynchy 556 left	51.5 777	9.038-1	6.####7	1.03E+08	2024-11-14T13:10:00	nor mal	6.5	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 O'Keefes fort-Tineel 553 source	51.5 777	9.038-1	6.####7	1.03E+08	2024-05-10T11:20:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 O'Keefes fort-Tineel 553 source	51.5 777	9.038-1	6.####7	1.03E+08	2024-06-14T10:21:00	nor mal	7	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 O'Keefes fort-Tineel 553 source	51.5 777	9.038-1	6.####7	1.03E+08	2024-07-20T10:15:00	nor mal	6	pe r pa
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1.07E+08	Michael, Rosscarbery Mount Saint	379 O'Keefes fort-Tineel 553 source	51.5 777	9.038-1	6.####7	1.03E+08	2024-09-27T10:35:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 O'Keefes fort-Tineel 553 source	51.5 777	9.038-1	6.####7	1.03E+08	2024-10-22T11:00:00	nor mal	7	pe r pa
1.07E+08	Mount Saint Michael,	379 O'Keefes fort-Tineel 553 source	51.5 777	-9.03	1 6.####	1.03E+08	2024-11-14T11:30:00	nor mal	7	pa pe

	Rosscarbery				8	7							r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	10T12:40:00		mal	8	r
	Mount Saint				-	1							pa
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E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	14T12:50:00		mal	8	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-07-		nor	6.	pe
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	20T12:50:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-08-		nor	6.	pe
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	16T13:00:00		mal	2	r
	Mount Saint				-	1							
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-09-		unreac		
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	27T13:00:00		hable		
	Mount Saint				-	1							
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-10-		unreac		
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	22T13:06:00		hable		
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-11-		nor		pe
E+08	Rosscarbery	554	Owenahynchy - ryans	777	8	7	####	E+08	14T14:00:00		mal	7	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Padraig Tobin farm -	51.5	9.03	6.	####	1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	558	Owenahynchy left	777	8	7	####	E+08	10T12:00:00		mal	8	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Padraig Tobin farm -	51.5	9.03	6.	####	1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	558	Owenahynchy left	777	8	7	####	E+08	22T12:30:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	10T12:00:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-06-		nor		pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	14T12:40:00		mal	7	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-07-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	20T12:40:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-08-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	16T11:25:00		mal	8	r

	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	22T12:40:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	22T12:22:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Prendergasts-	51.5	9.03	6.	####	1.03	2024-11-		nor	6.	pe
E+08	Rosscarbery	557	Owenahynchy left	777	8	7	####	E+08	14T13:20:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-02-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	07T12:00:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-06-		nor		pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	14T11:00:00		mal	6	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-07-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	20T11:00:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-08-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	16T11:00:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-09-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	27T10:51:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-10-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	22T10:50:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379		51.5	9.03	6.	####	1.03	2024-11-		nor	6.	pe
E+08	Rosscarbery	551	Ronan Tineel right	777	8	7	####	E+08	14T12:00:00		mal	5	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Rory- Owenahynchy	51.5	9.03	6.	####	1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	559	right	777	8	7	####	E+08	10T12:10:00		mal	2	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Rory- Owenahynchy	51.5	9.03	6.	####	1.03	2024-06-		nor	6.	pe
E+08	Rosscarbery	559	right	777	8	7	####	E+08	14T11:30:00		mal	8	r
	Mount Saint				-	1							pa
1.07	Michael,	379	Rory- Owenahynchy	51.5	9.03	6.	####	1.03	2024-07-		nor	7.	pe
E+08	Rosscarbery	559	right	777	8	7	####	E+08	20T12:30:00		mal	2	r
1.07	Mount Saint	379	Rory- Owenahynchy	51.5	-	1	####	1.03	2024-08-		nor	6.	pa

E+08	Michael, Rosscarbery Mount Saint	559	right	777	9.038-1	6.####7	E+08	16T12:50:00	mal	2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 559	Rory- Owenahynchy right	51.5 777	9.038-1	6.####7	1.03E+08	2024-09-27T12:40:00	nor mal	6.2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 559	Rory- Owenahynchy right	51.5 777	9.038-1	6.####7	1.03E+08	2024-10-22T12:15:00	nor mal	6.2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-05-10T10:50:00	nor mal	6.2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-07-20T10:30:00	nor mal	6.2	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-08-16T11:50:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-09-27T10:45:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-10-22T10:40:00	nor mal	6.8	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 550	Sean -Tineel right	51.5 777	9.038-1	6.####7	1.03E+08	2024-11-14T11:50:00	nor mal	6.5	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 535	Tineel by Coop	51.5 777	9.038-1	6.####7	1.03E+08	2024-02-07T12:30:00	nor mal	pe 5	r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 535	Tineel by Coop	51.5 777	9.038-1	6.####7	1.03E+08	2024-03-20T12:30:00	nor mal	pe 6	r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 535	Tineel by Coop	51.5 777	9.038-1	6.####7	1.03E+08	2024-04-11T11:09:00	nor mal	6.5	pe r pa
1.07E+08	Michael, Rosscarbery Mount Saint	379 535	Tineel by Coop	51.5 777	9.038-1	6.####7	1.03E+08	2024-04-11T11:30:00	nor mal	6.5	pe r pa
1.07E+08	Mount Saint Michael,	379 535	Tineel by Coop	51.5 777	-1 9.03	6.####	1.03E+08	2024-05-10T11:30:00	nor mal	6.2	pa pe

	Rosscarbery				8	7						r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-06-		nor	6.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	14T11:40:00		mal	8	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-07-		nor	7.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	02T11:30:00		mal	8	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-08-		nor	7.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	16T11:30:00		mal	8	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-09-		nor	7.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	27T11:30:00		mal	8	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-10-		nor	7.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	02T11:30:00		mal	5	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-12-		nor	7.	pe
E+08	Rosscarbery	535 Tineel by Coop	777	8	7	####	E+08	17T20:34:00		mal	2	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-05-		nor	6.	pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	10T12:50:00		mal	2	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-06-		nor	6.	pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	14T10:20:00		mal	2	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-07-		nor	6.	pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	20T13:00:00		mal	2	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-08-		nor	7.	pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	16T12:50:00		mal	5	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-09-		nor	7.	pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	27T12:50:00		mal	2	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-10-		nor		pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	22T12:50:00		mal	7	r
	Mount Saint				-	1						pa
1.07	Michael,	379	51.5	9.03	6.	####	1.03	2024-11-		nor		pe
E+08	Rosscarbery	555 Tineel right by school	777	8	7	####	E+08	14T11:10:00		mal	7	r

Data Entry to Globe Observation Site: Water Temperature

	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-05-		10
5302	Rosscarbery	560	source	777	8	7####		E+08	10T12:15:00		.5
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-06-		
5302	Rosscarbery	560	source	777	8	7####		E+08	14T12:10:00		13
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-07-		
5302	Rosscarbery	560	source	777	8	7####		E+08	20T12:40:00		15
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-08-		
5302	Rosscarbery	560	source	777	8	7####		E+08	16T12:42:00		15
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-09-		10
5302	Rosscarbery	560	source	777	8	7####		E+08	27T12:20:00		.5
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-09-		
5302	Rosscarbery	560	source	777	8	7####		E+08	27T12:50:00		11
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-10-		
5302	Rosscarbery	560	source	777	8	7####		E+08	22T12:08:00		11
	Mount Saint		Castleventry -			-	1				
10718	Michael,	379	Owenahynchy right	51.5	9.03	6.####		1.03	2024-11-		
5302	Rosscarbery	560	source	777	8	7####		E+08	14T12:40:00		9
	Mount Saint					-	3				
10718	Michael,	379		51.5	9.04	5.####		1.03	2024-02-		
5302	Rosscarbery	534	Froe Vincent	9377	995	6####		E+08	07T11:40:00		8
	Mount Saint					-	3				
10718	Michael,	379		51.5	9.04	5.####		1.03	2024-03-		
5302	Rosscarbery	534	Froe Vincent	9377	995	6####		E+08	20T11:40:00		14
10718	Mount Saint	379		51.5	-	3####		1.03	2024-04-		
5302	Michael,	534	Froe Vincent	9377	9.04	5.####		E+08	11T10:30:00		11

	Rosscarbery					995	6					
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-05-			11
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	10T10:40:00			.5
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-06-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	14T10:30:00			13
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-08-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	14T10:30:00			15
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-09-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	27T10:30:00			12
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-10-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	27T20:24:00			12
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-11-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	14T11:40:00			12
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-11-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	14T11:30:00			11
	Mount Saint					-	3					
10718	Michael,	379		51.5	9.04	5.	####	1.03	2024-12-			
5302	Rosscarbery	534	Froe Vincent	9377	995	6	####	E+08	17T11:30:00			10
	Mount Saint					-	1					
10718	Michael,	379	James O'S farm	Tineel	51.5	9.03	6.	####	1.03	2024-02-		
5302	Rosscarbery	552	right		777	8	7	####	E+08	07T11:30:00		12
	Mount Saint					-	1					
10718	Michael,	379	James O'S farm	Tineel	51.5	9.03	6.	####	1.03	2024-06-		
5302	Rosscarbery	552	right		777	8	7	####	E+08	14T10:28:00		13
	Mount Saint					-	1					
10718	Michael,	379	James O'S farm	Tineel	51.5	9.03	6.	####	1.03	2024-07-		
5302	Rosscarbery	552	right		777	8	7	####	E+08	20T10:20:00		14
	Mount Saint					-	1					
10718	Michael,	379	James O'S farm	Tineel	51.5	9.03	6.	####	1.03	2024-08-		
5302	Rosscarbery	552	right		777	8	7	####	E+08	16T11:10:00		12
	Mount Saint					-	1					
10718	Michael,	379	James O'S farm	Tineel	51.5	9.03	6.	####	1.03	2024-09-		
5302	Rosscarbery	552	right		777	8	7	####	E+08	27T10:20:00		10

	Mount Saint					-	1			
10718	Michael,	379 James O'S farm Tineel	51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	552 right	777	8	7 ####		E+08	21T23:14:00		10
	Mount Saint					-	1			
10718	Michael,	379 James O'S farm Tineel	51.5	9.03	6. ####		1.03	2024-11-		
5302	Rosscarbery	552 right	777	8	7 ####		E+08	14T11:20:00		11
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-05-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	10T11:45:00		11
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-06-		12
5302	Rosscarbery	556 left	777	8	7 ####		E+08	14T12:20:00		.5
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-07-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	20T12:20:00		15
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	16T11:20:00		15
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-09-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	27T11:30:00		12
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	22T12:00:00		12
	Mount Saint					-	1			
10718	Michael,	379 Karols Owenahynchy	51.5	9.03	6. ####		1.03	2024-11-		
5302	Rosscarbery	556 left	777	8	7 ####		E+08	14T13:10:00		10
	Mount Saint					-	1			
10718	Michael,	379 O'Keefes fort-Tineel	51.5	9.03	6. ####		1.03	2024-05-		
5302	Rosscarbery	553 source	777	8	7 ####		E+08	10T11:20:00		13
	Mount Saint					-	1			
10718	Michael,	379 O'Keefes fort-Tineel	51.5	9.03	6. ####		1.03	2024-06-		
5302	Rosscarbery	553 source	777	8	7 ####		E+08	14T10:21:00		15
	Mount Saint					-	1			
10718	Michael,	379 O'Keefes fort-Tineel	51.5	9.03	6. ####		1.03	2024-07-		
5302	Rosscarbery	553 source	777	8	7 ####		E+08	20T10:15:00		13
	Mount Saint					-	1			
10718	Michael,	379 O'Keefes fort-Tineel	51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	553 source	777	8	7 ####		E+08	16T10:20:00		12
10718	Mount Saint	379 O'Keefes fort-Tineel	51.5		-	1	####	1.03	2024-09-	13

5302	Michael, Rosscarbery Mount Saint	553	source	777	9.038-1	6.####7	E+08	27T10:35:00		
10718	Michael,	379	O'Keefes fort-Tineel	51.5	9.038-1	6.####7	1.03	2024-10-		11
5302	Rosscarbery Mount Saint	553	source	777			E+08	22T11:00:00		.5
10718	Michael,	379	O'Keefes fort-Tineel	51.5	9.038-1	6.####7	1.03	2024-11-		
5302	Rosscarbery Mount Saint	553	source	777			E+08	14T11:30:00		12
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-05-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	10T12:40:00		12
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-06-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	14T12:50:00		14
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-07-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	20T12:50:00		15
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-08-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	16T13:00:00		17
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-09-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	27T13:00:00		
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-10-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	22T13:06:00		
10718	Michael,	379		51.5	9.038-1	6.####7	1.03	2024-11-		
5302	Rosscarbery Mount Saint	554	Owenahynchy - ryans	777			E+08	14T14:00:00		11
10718	Michael,	379	Padraig Tobin farm -	51.5	9.038-1	6.####7	1.03	2024-05-		
5302	Rosscarbery Mount Saint	558	Owenahynchy left	777			E+08	10T12:00:00		10
10718	Michael,	379	Padraig Tobin farm -	51.5	9.038-1	6.####7	1.03	2024-10-		
5302	Rosscarbery Mount Saint	558	Owenahynchy left	777			E+08	22T12:30:00		12
10718	Michael,	379	Prendergasts-	51.5	9.038-1	6.####7	1.03	2024-05-		
5302	Rosscarbery	557	Owenahynchy left	777			E+08	10T12:00:00		10
10718	Mount Saint	379	Prendergasts-	51.5	-	1 ####	1.03	2024-06-		
5302	Michael,	557	Owenahynchy left	777	9.03	6.####	E+08	14T12:40:00		13

	Rosscarbery				8	7					
	Mount Saint				-	1					
10718	Michael,	379	Prendergasts-	51.5	9.03	6. ####		1.03	2024-07-		13
5302	Rosscarbery	557	Owenahynchy left	777	8	7 ####		E+08	20T12:40:00		.5
	Mount Saint				-	1					
10718	Michael,	379	Prendergasts-	51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	557	Owenahynchy left	777	8	7 ####		E+08	16T11:25:00		15
	Mount Saint				-	1					
10718	Michael,	379	Prendergasts-	51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	557	Owenahynchy left	777	8	7 ####		E+08	22T12:40:00		12
	Mount Saint				-	1					
10718	Michael,	379	Prendergasts-	51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	557	Owenahynchy left	777	8	7 ####		E+08	22T12:22:00		10
	Mount Saint				-	1					
10718	Michael,	379	Prendergasts-	51.5	9.03	6. ####		1.03	2024-11-		9.
5302	Rosscarbery	557	Owenahynchy left	777	8	7 ####		E+08	14T13:20:00		5
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-02-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	07T12:00:00		12
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-06-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	14T11:00:00		13
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-07-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	20T11:00:00		14
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	16T11:00:00		15
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-09-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	27T10:51:00		15
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	22T10:50:00		12
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-11-		
5302	Rosscarbery	551	Ronan Tineel right	777	8	7 ####		E+08	14T12:00:00		11
	Mount Saint				-	1					
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-05-		
5302	Rosscarbery	559	right	777	8	7 ####		E+08	10T12:10:00		11

	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-06-		
5302	Rosscarbery	559	right	777	8	7 ####		E+08	14T11:30:00		14
	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-07-		
5302	Rosscarbery	559	right	777	8	7 ####		E+08	20T12:30:00		15
	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	559	right	777	8	7 ####		E+08	16T12:50:00		10
	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-09-		10
5302	Rosscarbery	559	right	777	8	7 ####		E+08	27T12:40:00		.5
	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-10-		10
5302	Rosscarbery	559	right	777	8	7 ####		E+08	22T12:15:00		.5
	Mount Saint					-	1				
10718	Michael,	379	Rory- Owenahynchy	51.5	9.03	6. ####		1.03	2024-11-		
5302	Rosscarbery	559	right	777	8	7 ####		E+08	14T13:50:00		10
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-05-		
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	10T10:50:00		12
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-07-		13
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	20T10:30:00		.5
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-08-		
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	16T11:50:00		12
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-09-		
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	27T10:45:00		10
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-10-		
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	22T10:40:00		10
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-11-		
5302	Rosscarbery	550	Sean -Tineel right	777	8	7 ####		E+08	14T11:50:00		11
	Mount Saint					-	1				
10718	Michael,	379		51.5	9.03	6. ####		1.03	2024-02-		
5302	Rosscarbery	535	Tineel by Coop	777	8	7 ####		E+08	07T12:30:00		9
10718	Mount Saint	379	Tineel by Coop	51.5		-	1 ####		1.03	2024-03-	12

5302	Michael, Rosscarbery Mount Saint	535		777	9.038 -	6.####1	E+08	20T12:30:00		
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-04-11T11:09:00		16
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-04-11T11:30:00		16
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-05-10T11:30:00		15
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-06-14T11:40:00		16
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-07-02T11:30:00		23
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-08-16T11:30:00		13 .5
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-09-27T11:30:00		12
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-10-02T11:30:00		11
10718 5302	Michael, Rosscarbery Mount Saint	379	535 Tineel by Coop	51.5 777	9.038 -	6.####1	1.03 E+08	2024-12-17T20:34:00		10
10718 5302	Michael, Rosscarbery Mount Saint	379	555 Tineel right by school	51.5 777	9.038 -	6.####1	1.03 E+08	2024-05-10T12:50:00		10
10718 5302	Michael, Rosscarbery Mount Saint	379	555 Tineel right by school	51.5 777	9.038 -	6.####1	1.03 E+08	2024-06-14T10:20:00		12
10718 5302	Michael, Rosscarbery	379	555 Tineel right by school	51.5 777	9.038	6.####1	1.03 E+08	2024-07-20T13:00:00		16
10718 5302	Mount Saint Michael,	379	555 Tineel right by school	51.5 777	- 9.03	1 6.####	1.03 E+08	2024-08-16T12:50:00		13

	Rosscarbery				8	7					
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6.	####	1.03	2024-09-		11
5302	Rosscarbery	555	Tineel right by school	777	8	7	####	E+08	27T12:50:00		.5
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6.	####	1.03	2024-10-		11
5302	Rosscarbery	555	Tineel right by school	777	8	7	####	E+08	22T12:50:00		.5
	Mount Saint				-	1					
10718	Michael,	379		51.5	9.03	6.	####	1.03	2024-11-		
5302	Rosscarbery	555	Tineel right by school	777	8	7	####	E+08	14T11:10:00		11