

# The river cross sections essay sample



**ASSIGN  
BUSTER**

## Introduction:

The hypothesis of this coursework is: ‘ within the middle valley stage of its long profile, a river flows at a uniform speed and has the same cross-section’. This suggests that within the intermediate section of a river, it flows at the same speed and does not change in depth.

The purpose of this study is to conclusively prove this hypothesis either right or wrong. We will do this by plotting the cross sections and speeds of two rivers at various stages along their course.

The cross sections will be ascertained by measuring the depth of the rivers at different points along the middle valley stage, and we will use different floats to measure the speed of the rivers by recording the time it takes for them to move between two fixed points.

We will be carrying out these tests with the aid of geographical equipment, including ranging-poles (to determine the angle difference between banks), measuring-tape (to ascertain the width of the river), and a meter rule (to record the depth of the river). In order to help determine the river’s velocity, we will use a stop watch, a flow-meter, plus a float (orange peel).

We will explore the main hypothesis using primary data to help us make a valid judgement. We will be collecting our own data to use in this investigation from the rivers Avon Water and Mill Lawn Brook. We are using two rivers of a similar size and depth in order to get more robust data. Furthermore, in order to try and ensure that the test is fair, we have selected rivers with minimal human interference anywhere along their courses.

The two rivers that we chose, Avon Water and Mill Lawn Brook, are an optimum size for analysis; not too deep (which could be dangerous to draw samples from), and not too small (which might not produce reliable samples and data). Also, their characteristics do not change significantly throughout the season, which is important as it will help ensure that our findings will apply all year round, and not just during the period that we took data from the river.

We could not choose a well known river such as the Thames for many reasons; mainly because it is too big and deep, making it hard to get measurements from, and is heavily influenced by human activities; boats, pollution etc.

Key Terms:

Long Profile:

The long profile of a river is a primitive side-on view of the entire river. A typical river long profile could look like this:

It gives a basic idea of how the gradient of a river changes along its course. In this study we are focusing on the middle valley stage.

Cross Section:

A cross section of a river is when you look head on at a river, and ‘cut’ it in half to see how it is shaped. Of course, this is physically impossible to do, so we use the measurements of the river we took to plan out an accurate cross section.

An example of a cross section can be seen when cutting an apple in half:

Velocity:

Velocity is, essentially, how the river moves. Both speed and direction are required to define it.

Wet and Dry Readings

A wet reading is when you measure the river water itself, and a dry reading is when you measure on the river banks. Knowing the dry readings can help explain the wet ones.

Area of Study:

The rivers that we will be sampling are located in the New Forest; which became one of Britain's newest national parks on 1st May 2005. The forest has existed for around 500 years, but signs of human activity exist from as far back as the Stone Age and into the Bronze Age. It is one of the smaller National Parks, with about 580 km<sup>2</sup> of land, but is one of the more populated with 34, 000 people living in its area.

We chose it as the place to carry out our experiments as it is largely unspoilt by humans, it is not near any major cities so there is minimal chance of outside pollution, and not many people have travel through it regularly.

Mill Lawn Brook Avon

Method:

We collected data at the middle valley stages of Mill Lawn Brook and Avon water in the New Forest, in order to either to prove or disprove our hypothesis: that the rivers would flow at the same speed and have the same cross-section throughout. We used two rivers to try and eliminate any chance of an anomaly in the readings/any outside elements that could affect results.

We measured the width of each river across the bank and also the depth at many different points so as to be able to build up many cross sections. To do this we took 'wet readings' to measure the depth of the river, and 'dry readings' to discover how the slope of the river declines.

Equipment:

We used the following equipment:

Measuring Tape: stretched across the river as a point from which to take readings. From the measuring tape to the bank for a dry reading, and from the measuring tape to the river bottom for a wet reading.

Ranging Pole: used to make sure that the measuring tape was level, so as to help ensure that there were no mistakes in the results.

Meter Rule: used to take dry and wet readings from the measuring tape.

Orange Peel: used to help measure how fast each river flowed (speed in seconds over 10m).

Flow Meter: measured how fast the rivers flowed in Counts per Minute.

We decided to use both a float and a flow meter. Although a Flow Meter is more accurate and less likely to have any other influencing factors (a float could easily become stuck on a bank causing it to take longer to reach the destination), we still used floats because there were certain places where a flow meter would not work where a float would (as shown in much of Mill Lawn Brook).

We repeated each test a number of times to both make sure there were no anomalies in the results, and also that the results were as accurate as possible by obtaining an average.

We also used floats such as orange peel and flow meters to measure how fast the rivers flowed at certain points, to help prove/disprove that the speed of the river stayed the same in the middle valley stage.

The hypothesis has two main points:

1) The river has the same cross-section within the intermediate stage.

We tested this by using a range of geographical equipment to map out a cross-section of the river at different points. We took dry and wet readings to see how the banks are eroding and how this would affect the cross-section.

To measure the cross section we:

A) Set the ranging poles on the two banks horizontally, 1 meter from the bank.

B) Ran the measuring tape from one pole to the other, keeping the

measuring tape as even as possible.

C) Used the measuring tape as a starting point, to record the distance

from the tape to the ground/river bed using a meter rule every cm along the line.

2) The river has the same speed within its intermediate phase.

We tested this by using floats (or a flow meter) to measure the speed of the river on the left, right and middle of a point in the river, over a multitude of points. We did this by:

A) Picking a fixed point in the river.

B) Selecting a point 5 meters down.

C) Dropping a float on the left side of the river.

D) Using a stopwatch to time how long it took for the float to reach the point 5 meters down.

E) Repeating stages C and D (above) in the middle and on the right side of the river.

F) From the point 5 meters down, measure further 5 meters down and repeat stages C, D, and E.

We used an orange peel as a float as it is heavy enough to not be blown around on the surface by the wind; it is very visible against the river and is

hard to be confused with any leaves on the surface. It is also biodegradable so we will not damage the environment.

We also used other alternatives such as:

Dog Biscuit – Advantage

Disadvantage

Quite heavy so won't get blown around by the wind.

Won't get mistaken for leaves.

Takes in water which could affect readings.

Crown so you could have problems seeing it.

Rubber Duck – Advantage

Disadvantage

Brightly coloured so you can see it easily.

Heavy so it won't get blown around by the wind.

Non bio-degradable.

Expensive so if you loose it, it will be hard to replace.

Leaf – Advantage

Disadvantage

Bio-degradable.



Could get mixed up with other leaves

Hard to see as it is brown.

Could get blown around on the surface.

Ping-Pong Ball – Advantage

Disadvantage

Brightly Coloured.

Floats well.

Non bio-degradable.

Light so may be blown around by the wind.

Results:

In the following pages there is a collection of charts depicting results obtained from sampling at Avon Water and Mill Lawn Brook. Included are calibration charts to convert Counts-Per-Minute into Flow Velocity in Cm per Second, cross sections and flow graphs.

River Flow Graphs:

From this chart we can see that right side of Mill Lawn Brook was flowing much faster than both the left and middle of the river.

From this we can see that all sides are running quite fast, with the middle running the fastest.

We can see here that the left side is distinctly slower than the middle and right. This could have been caused by a malfunction in the flow meter.

We can see here that the left side is a lot faster than the middle and right of the river.

As we can see here the middle of the river is much faster than the left and right sides.

As we can see here the middle is moving much faster than the left and right sides.

We can see here that all the sides are almost equal, with the middle being slightly faster.

Here we can see that the middle is much faster than the left and right, with the right being very low – probably caused by a problem with the flow meter.

Here we can see that the middle is faster than both the left and right sides of the river.

As we can see here, the right is much faster than the middle and left sides of the river.

Analysis:

The results of our testing at Mill Lawn Brook and Avon Water help us to assess the validity of the original hypothesis at the heart of this study: “within the middle valley stage of its long profile, a river flows at a constant speed and has the same cross section” is incorrect.

Looking at the matter of 'constant speed' first, it is clear from the graph in the results section ( ) that flow varies significantly at different stations of the river. From the series of charts ( ), the flow speed varies greatly at different stations; further strengthening the evidence disproving our original theory.

Further to this, we observed that at points where there was a noticeable bend in the river, the water on the opposite side was fastest. Therefore, our findings suggest that the first part of our hypothesis should be replaced with the statement that within the middle valley stage of its long profile, a river flows at varying speeds.

Secondly, from the various cross-sections that we created, it is evident that the second part of our hypothesis; that the river has the same cross section throughout, is also incorrect. We can see this by the fact that every cross section differs ( ), although some do share characteristics (particularly consecutive stations).

For example, the cross section for Avon Water station 2 ( ) differs greatly from that at station 3 ( ); Station 3 is 4 meters wider and has a much shallower bed. We can also see a large dip in Avon Water station 4 ( ), which is not reflected on any of the other Avon Water cross sections. This is also apparent in Mill Lawn Brook, which widens along the cross sections ( ).

There are also a number of links that can be made between the flow graphs and the cross sections. This is particularly noticeable at Avon Water station 3 ( ) where on the left side it was impossible to take a reading with the flow meter it is unusually shallow.

However, there are points that do not conform to expectations. For example, at Avon Water station 4( ) there is a large dip on the right hand side of the river, where you would expect it to be flowing fastest. However, from our related flow chart ( ), it is clear that moving the slowest at the right, and fastest in the middle. Based on independent research on river flow (see example below), this is an unexpected result and would either indicate an influencing factor that we haven't noted or else a possible anomaly in our results.

In an independent study on the ' Physics stream depth' they conclude that " River flow is driven by hydrostatic pressure gradient, which is constant across the whole cross-section of the river. Were it not for viscosity effects, this would mean that the river flowed at an equal speed at all points within the cross section since each point is driven with the same force. However, due to viscosity the flow is slower near the fixed boundary (river bed and banks) and faster near the free boundary (surface, since the air offers relatively little resistance to flow), and the quickest flow will be furthest from the fixed boundary, which means away from the sides and where the river is deepest."

As some of our results are inconsistent with what is known about river flow, it is possible that some of our measurements were inaccurate, and this project could have been improved with better equipment/recording, especially at Mill Lawn Brook where the flow meter often did not work. It would also have been beneficial to spend longer at the sites in order to obtain a larger amount of data for analysis, so as to have a more robust sample which could possibly counteract some of the anomalies we observed.

## Conclusion:

According to our original hypothesis, “ within the middle valley stage of its long profile, a river flows at a constant speed and has the same cross section “. By carefully analysing the data that we collected at Mill Lawn Brook and Avon Water, we managed to conclusively disprove both points and thus create a new substantiated hypothesis.

Our results and analysis conclude that the rivers in question actually flow at varying speeds at various points in their intermediate stage, and have varying cross-sections.

However, it must be noted that our findings may be flawed in places as some of our results differed from key independent research studies regarding river flow. For example, it is known that “ due to viscosity the flow is faster near the free boundary, and the quickest flow will be furthest from the fixed boundary, which means away from the sides and where the river is deepest.”, yet some of our readings showed the river to be slowest at the deepest points ( ).

It is also worth noting that there were certain external factors that may have affected our data. For example, at Avon Water there were a lot of overhanging trees, which would affect flow and maybe even the cross section, and due to shallow waters, there were points in both rivers where floats would get stuck and flow meters wouldn't work. The flow meter at Mill Lawn Brook was also affected as it would often get clogged up in the reeds and often did not record results. Repeating this study with new equipment

and comparing those results to our original findings would help produce a more complete picture and analysis.

### Bibliography

Photo of Mill Lawn Brook: [http://www.newforestimages.com/landscape/mill\\_lawn\\_brook1\\_s.jpg](http://www.newforestimages.com/landscape/mill_lawn_brook1_s.jpg)

‘ Winter dawn at Mill Lawn Brook’