Geography

GCSE 2012

Geography B

Exemplar Candidate Work

Rivers

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CONTENTS

Fieldwork Focus Rivers title:

How and why do natural features vary along the stretch of your chosen river/stream?

Centre title:

How and why do natural features vary along the stretch of Ashes Hollow Stream?

INTRODUCTION

In class we discussed how we could breakdown the title into a series of questions and what theories might be relevant:

1. What are they?
Will they be typical of the upper or lower course of a river?

2. In what way does the channel and valley change in a downstream direction?

How and why do natural features vary along Ashes Hollow Stream?

3. What processes might cause the changes to happen?

1. In our study of rivers in class we have looked at the river Tees in north east England and how in its upper course it had steep sided valleys with rapids (cauldron snout) and waterfalls (High Force). In its lower course the river had a wide floodplain in which it meandered (Yarm) and eventually flowed into the North Sea in a wide tidal estuary. We also looked at the river Colorado in USA. Both these rivers are much larger than the Ashes hollow stream and we are only studying a short stretch of it so we might expect to see features typical of the upper course and a few of the lower course.
2. We have looked at the Bradshaw model and could apply it to the Ashes Hollow stream. It shows that eight elements might change in a downstream direction.

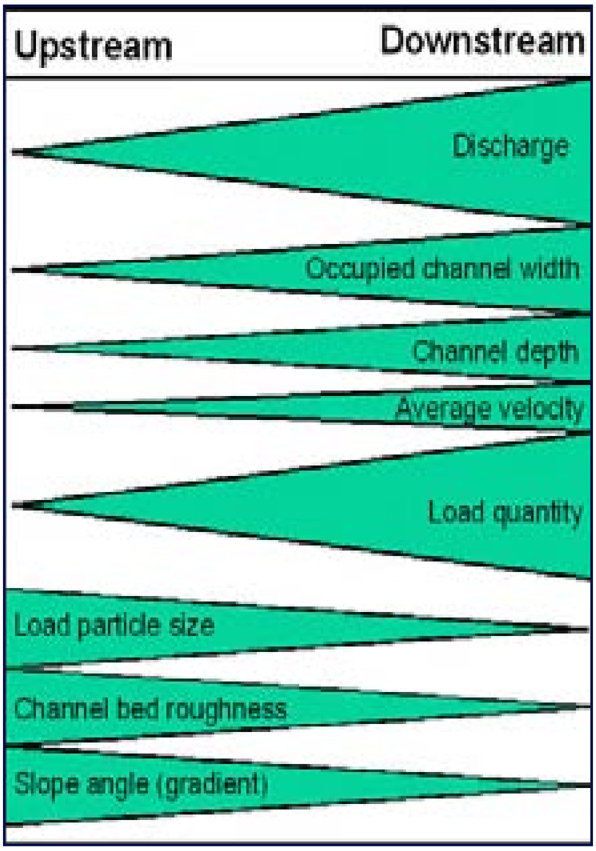
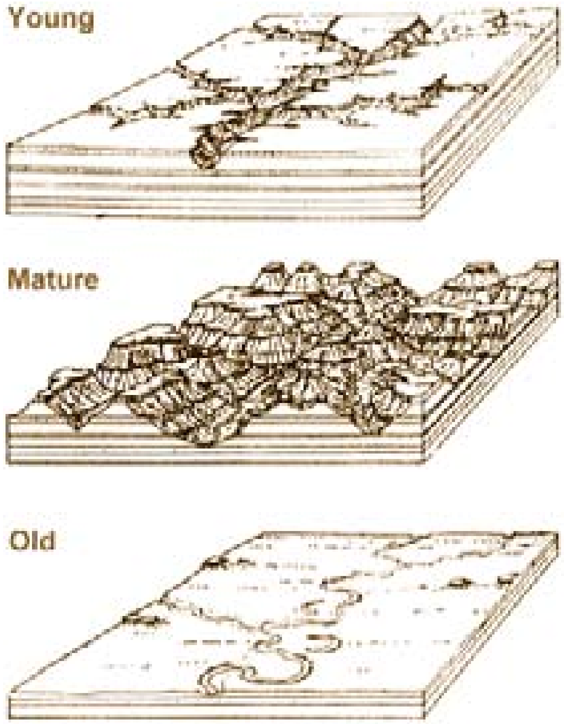


Figure 1

The Bradshaw model suggests the following:

1. Discharge will increase in a downstream direction.
2. Occupied channel width will increase in a downstream direction.
3. Channel depth will increase in a downstream direction.
4. Average velocity will increase in a downstream direction.
5. Load quantity will increase in a downstream direction.
6. Load particle size would decrease in a downstream direction.
7. Channel bed roughness would decrease in a downstream direction.
8. The gradient of the channel would decrease in a downstream direction.



davis2.gif

The diagrams above show another theory which is relevant to our study. W.M.Davis an American geomorphologist suggested that a landscape went through a process which had three stages of development. Some people have applied this concept to rivers so that they can have an upper, middle and lower phase. Some people think that this too simplistic!

3. In class we have studied the processes that affect rivers and have identified three:

- Weathering and erosion. These include freeze-thaw, abrasion/corrasion, attrition, hydraulic action and corrosion/solution.
- We are also aware that the rate of erosion can be affected by the gradient of a river, rock type, bedload and human factors.
- Transportation.
- Deposition.

We have decided to select three elements from the Bradshaw model and one regarding the prominence of meanders (sinuosity of the stream): We have chosen these because we think that we will be able to measure these safely, accurately and in the time we have available in the valley.

Elements	Expected outcomes. What happens downstream	Why
1.Occupied channel width	Increase	There is an increasing volume of water being fed into the mainstream by tributaries and lateral erosion begins to dominate.
2.Channel depth	Increase	It would increase because there is vertical erosion occurring at all times and there is a higher discharge.
3.Floodplain width	Increase	It increases because of lateral erosion and the surrounding area is flatter lower down.
4.Meanders	Increase	Meanders form because the river is trying to create a dynamic equilibrium and in the middle course there is less friction so more potential energy.

<u>Background information</u>

<u>Ashes Hollow</u>

The nearest settlement is Little Stretton. The nearest large village is Church Stretton. The nearest town is Shrewsbury. The nearest City is Birmingham. This is just over one hours drive away.

Ashes Hollow is situated in The Long Mynd. The Long Mynd is 2,300 hectares large (1 hectare=100 metres square), 516 metres at the highest point.

<u>Tributaries</u>

Ashes Hollow
↓
Quinny Brook
↓
River Onny
↓
River Teme
↓
River Severn (mouth in Bristol channel)

} Drainage System

Why we chose Ashes Hollow?

Google images

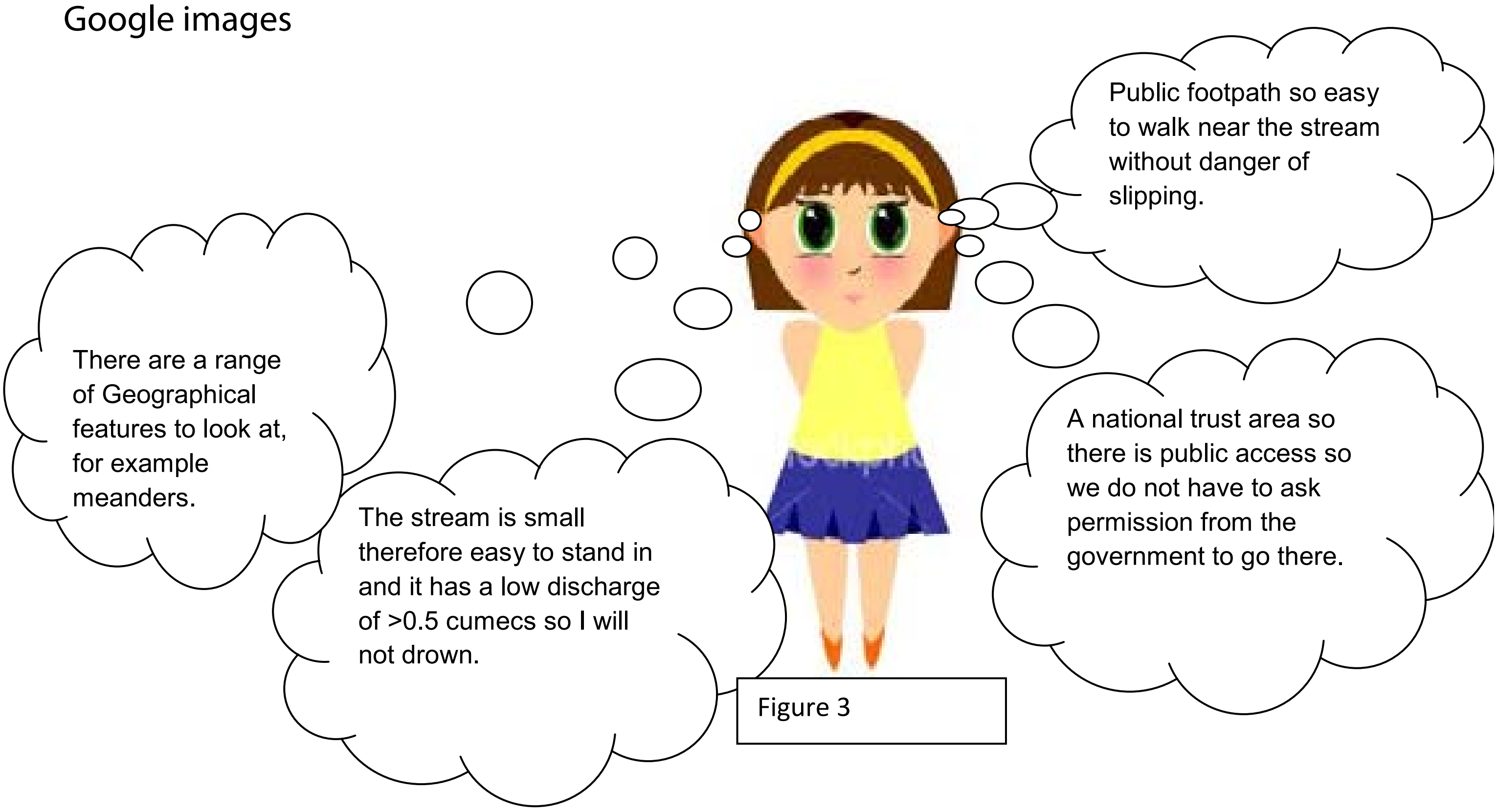


Figure 3

Risk Assessment

Hazards	Management	Risk
Water born diseases	Clean hands after touching the water, wear washing up gloves for the measuring and eat lunch before you start.	The risk is Low
Slippery Rocks	Shoes with grip, sensible behaviour and be aware of moss on rocks.	The risk is Medium
Water drowning	Stay in groups and make sure water is below the top of our boots.	The risk is Low
Weather	Appropriate clothes (sun hat, sun cream, scarf, warm hat, coat)	The risk is Medium
Ticks	Wear long clothes and report to teacher straight away if you get one so it can be removed.	The risk is Low
Traffic	Be aware and stay on one side of the road	The risk is Low

Location

Local Map showing the position of Ashes Hollow in Little Stretton

http://wtp2.appspot.com/wheresthepath.htm

Campsite near Little Stretton.

Contour lines are close together so steep and hilly area.

Private property

1km

Nearest settlement is little Stretton

Figure 5

Local Map showing the position of Ashes Hollow in Little Stretton

http://maps.google.co.uk/

Nearest town

Little Stretton

Access from A49

N

It takes just over an hour to get to Birmingham, the closest city

Nearest city is Birmingham

Nathional Map showing the position of Ashes Hollow in England

http://maps.google.co.uk/

Methodology

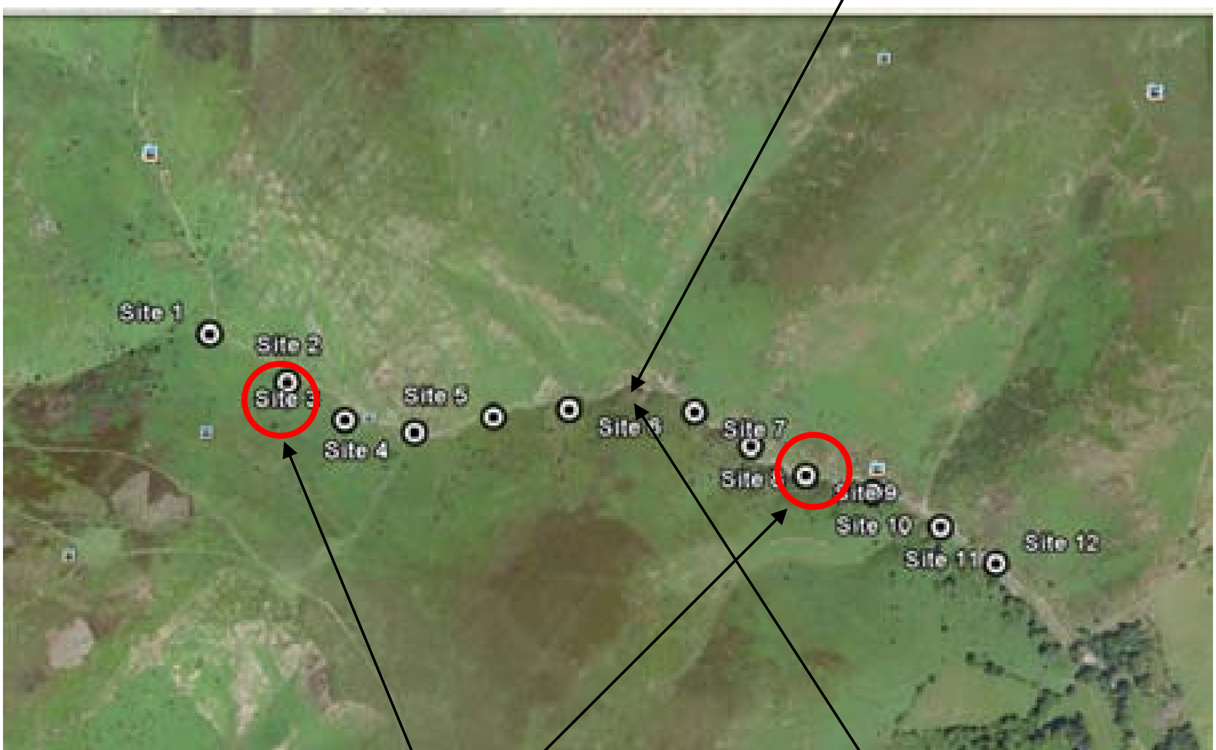
We collected results about four different natural features from twelve different locations along the stretch of Ashes Hollow, from the source to the footbridge above the private property. We collected results for sinuosity, floodplain width, channel depth and channel width. We collected data at stretches of 100 metres apart. This is systematic sampling. We collected data this way instead of random sampling because it ensures that the sites are an even distance apart and we get the best possible range of results.

Table to show the methods we used to collect data

What data was collected?	How was this data collected?
Bankfull Width	We collected this data by using a measuring tape pulled taught over the stream from the top of the river bank on each side.
Bankfull Depth	We used a metre ruler to measure from the ground to the top of the bank at nine points along the width of the stream. We held the measuring tape along the width to help us measure to the right height.
Sinuosity	We measured the length of the stream over a hundred metre straight distance. We walked the measuring tape up the centre of the stream and recorded the distance. Every 30 metres we wound the tape up and started it again. We then worked out the distance up the stream and divided it by the straight distance.
Floodplain width	We used a 30 metre measuring tape to measure from one side of the floodplain to the other. We could tell where the floodplain started because the gradient changed. It became steeper as it was the bottom of the valley.
Photos	We used a camera to take a photo of each method we used to measure a different natural feature and the two sites we took measurements at.

Site Location Map

Difficult access due to waterfall and gorge

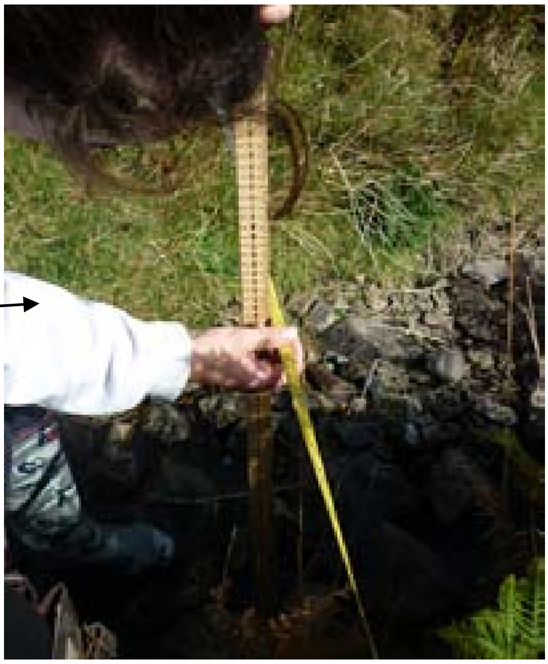


Our group sites

This map shows the length of Ashes Hollow that we collected data from and the twelve different site locations we chose. Each site is 100 metres apart except six and seven as there is a waterfall and gorge.

Sinuosity

Bankfull depth



Hard to see the height accurately because tape is twisted and not pulled taught.

Figure 11

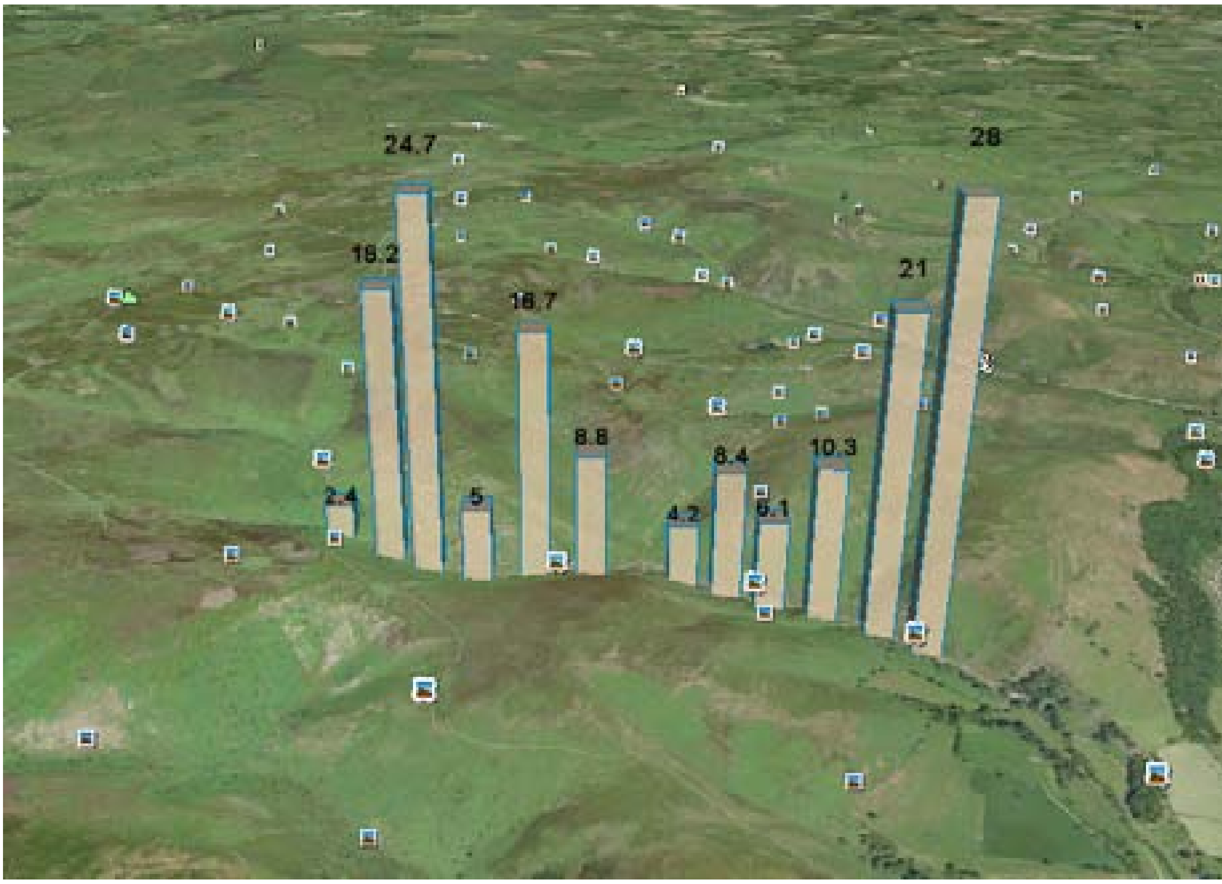
Bankfull Width

Tape should be pulled tight so the result is accurate

Figure 12

Data Presentation and Analysis

Graph to show how the Floodplain width changes downstream



Floodplain Width (m)
2.4
18.2
24.7
5.0
16.7
8.8
4.2
8.4
6.1
10.3
21.0
28.0
Width in metres

Figure 13 Figure 14

- We expected the floodplain width to increase in a downstream direction.

  The bar graphs show great variability ranging from 2.4m at sites 1 to 28m at 12. An increase, but it rises and falls in between with site 3 with 24.7m! Lateral erosion should increase in a downstream direction with abrasion and hydraulic action eroding the bank. However, we did notice in places there was scree on the valley sides so this could have reduced floodplain width. In addition the presence of a gorge and waterfall in the middle of our study area suggests that geology or past glacial history might make this a complex drainage basin.

Table to show the difference in overall sinuosity above and below the gorge

Site number	Distance from source (m)	Straight line distance (m)	River distance (m)	Sinuosity Score	
1	1500	100	119.4		
2	1600	100	118		
3	1700	100	117		
4	1800	100	105.53		
5	1900	100	101.4		
6	2000	100	104		
	Total =	600	665.33	1.11	Above the gorge
		Gorge			
7	2300	100	112.6		
8	2400	100	114		
9	2500	100	162.7		
10	2600	100	153		
11	2700	100	118.94		
12	2800	100	137		
	Total =	600	798.24	1.33	Below the gorge

Sinuosity scale

1.0 – straight channel

1.5 – Typical meandering channel

3.0+ - twisting channel.

Dispersion line to show the difference in sinuosity above and below the gorge

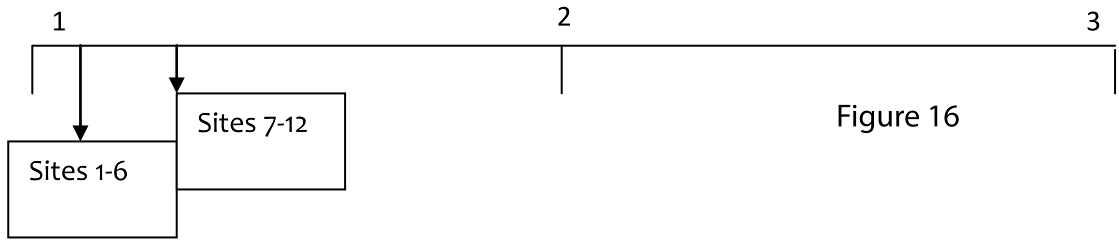


Figure 16

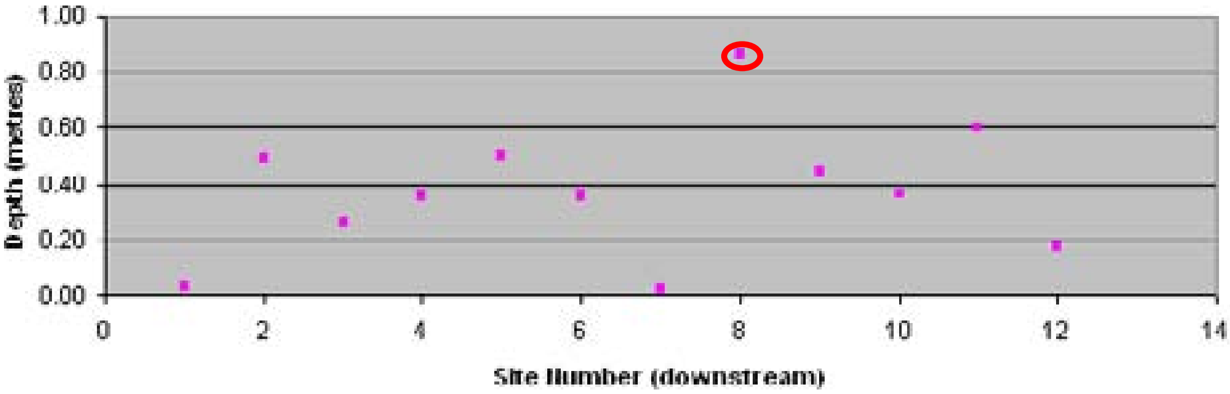
- We expected the sinuosity to increase in a downstream direction.

With the data grouped into upper course 1-6 and lower course 7-12 the stream did show an increase in sinuosity in a downstream direction rising from 1.11 to 1.33. We would expect this because meanders tend to appear as the valley floor becomes flatter and wider with more lateral erosion occurring. However, there is some variability with site 10 at only 118.94. Once again this could be due to factors such as geology and past glacial history.

Table to show Bankfull Depth and Width down the stream

Site number	Distance down stream	Depth (m)									Mean Depth (m)	Width (m)	Cross Sectional area
		1	2	3	4	5	6	7	8	9			
1	1500	0.02	0.03	0.02	0.03	0.02	0.04	0.04	0.03	0.04	0.03	1.27	0.038
2	1600	0.25	0.35	0.38	0.44	0.58	0.62	0.61	0.63	0.60	0.50	3.07	1.521
3	1700	0.37	0.37	0.41	0.18	0.22	0.23	0.20	0.19	0.20	0.26	1.95	0.514
4	1800	0.35	0.42	0.36	0.32	0.29	0.35	0.38	0.37	0.4	0.36	0.90	0.324
5	1900	0.31	0.30	0.61	0.60	0.02	0.57	0.53	0.31	0.20	0.50	3.30	1.646
6	2000	0.41	0.35	0.45	0.41	0.42	0.39	0.31	0.30	0.20	0.36	1.97	0.709
7	2300	0.00	0.03	0.04	0.00	0.00	0.05	0.06	0.07	0.00	0.03	3.16	0.000
8	2400	0.58	1.00	1.03	1.04	1.10	1.11	0.81	0.65	0.50	0.87	4.20	3.649
9	2500	0.42	0.47	0.48	0.44	0.50	0.42	0.48	0.47	0.31	0.44	2.00	0.887
10	2600	0.30	0.36	0.32	0.31	0.32	0.37	0.44	0.43	0.45	0.37	5.00	1.833
11	2700	0.51	0.84	0.85	0.74	0.64	0.61	0.54	0.44	0.24	0.60	7.00	4.208
12	2800	0.30	0.22	0.26	0.21	0.20	0.18	0.12	0.02	0.05	0.17	4.85	0.841
		Depth in centimetres										*Metres*	*Width x depth*

Scatter graph to show how the mean depth of the river changes downstream



- We expected to see the depth increase in a downstream direction.

The scattergraph shows once again variability, but the overall trend on a best fit line is upward from a low of 0.03m at site 1 to as high as 0.6m at site 11. There are outliers such as site 8. With more water joining the stream from tributaries we would have expected the stream to deepen with vertical erosion. Once again external factors might complicate the stream gradient and the streams ability to erode vertically.

Scatter graph to show how the bankfull width changes downstream

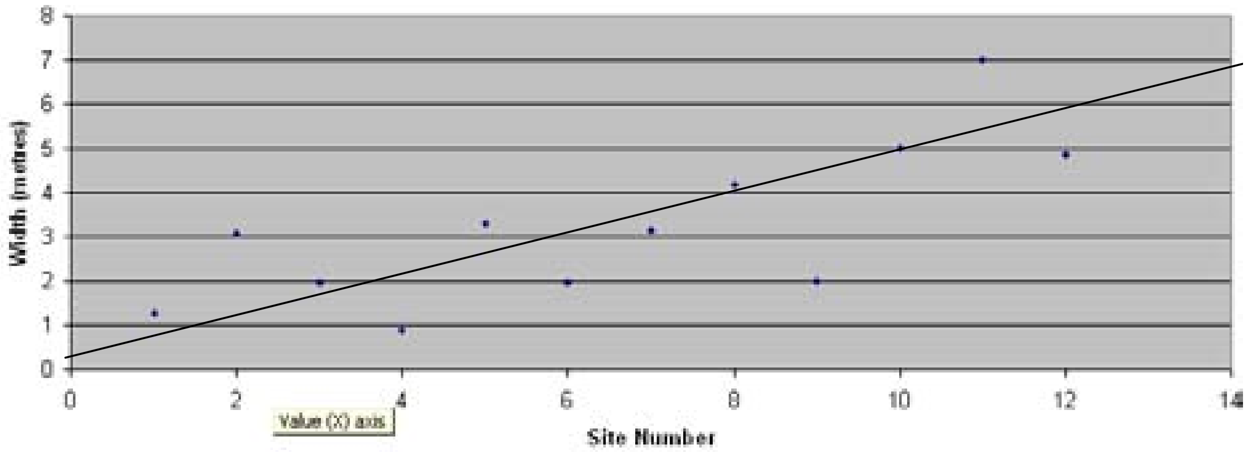


Figure 19

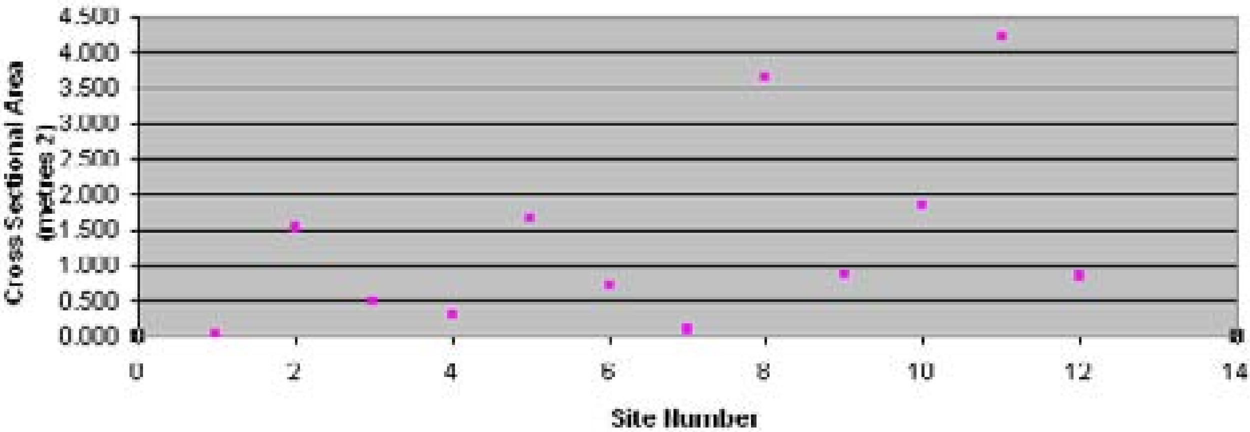
- We expected the width to also increase in a downstream direction. Once again there is variability, but the data is much closer to the best fit line and is less dispersed. It rises from 1.27m at site 1 to 4.85m at site 12, almost 4 times wider. We expected this because lateral erosion and the volume of water should increase downstream. Outliers such as site 9 could have been narrower because of scree.

n	Samples x_1	x_2
1	1	1.27
2	2	3.07
3	3	1.95
4	4	0.90
5	5	3.30
6	6	1.97
7	7	3.16
8	8	4.20
9	9	2.00
10	10	5.00
11	11	7.00
12	12	4.85
13		

Test	Test Statistic Name	Value	Critical Value 0.05	Result
Spearman Rank Correlation	rs	0.783	0.5874	Significant $p < 0.05$

The calculated Rs value, of 0.783 is higher than the critical value of 0.5874 for a sample size of 12 at the 95% confidence level.
Therefore this graph proves the hypothesis that there is a correlation between Bankfull width and distance downstream.

Scatter graph to show how the Cross Sectional Area changes downstream



We would expect the cross sectional area to also increase in a downstream direction. The scattergraph best fit line shows an increase, but once again the data are very dispersed. It rises from 0.04 to 0.84m from site 1 to 12. There are some large outliers such as site 8 and 12.

n	Samples	
	x_1	x_2
1	1	0.04
2	2	1.52
3	3	0.51
4	4	0.32
5	5	1.65
6	6	0.71
7	7	0.09
8	8	3.65
9	9	0.89
10	10	1.83
11	11	4.21
12	12	0.84

Test	Test Statistic		Critical Value	Result
	Name	Value	0.05	
Spearman Rank Correlation	rs	0.545	0.5874	Not significant

The calculated Rs value, of 0.545 is lower than the critical value of 0.5874 for a sample size of 12 at the 95% confidence level.
Therefore we must accept the null hypothesis that there is no correlation between the cross sectional area of the river and how far downstream we are..

Site Locations

Figure 23

Figure 24

Figure 25

Figure 26

Figure 27

Figure 28

Figure 29 Undercutting

Braiding

Smaller bed load

Figure 30

Conclusion

HOW AND WHY DO NATURAL FEATURES VARY ALONG ASHES HOLLOW STREAM?

1. Bankfull depth increases in a downstream direction.

Figure 18 and its analysis show that the overall trend supports this statement. However, the data is dispersed either side of the best fit line. There must be local factors which are causing them to vary. Perhaps the bed is harder in places or the gradient has become shallower for some reason.

2. Bankfull width increases in a downstream direction.

Figure 19 and its analysis show a trend to support the statement. However, there is less dispersal either side of the best fit line and my spearman rank figure 20 shows that the correlation is significant at 0.783.

3. Floodplain width increases in a downstream direction.

Figure 13 show that Ashes hollow stream does not follow this pattern. There is great variability which is surprising. It seems to have several sections, one which included a waterfall and gorge section in the middle! There must be something which has caused this, its geology and past glacial history?

4. The stream would be more sinuous in a downstream direction.

Figure 15 and the dispersion line support this statement. However, once again the average figures are low at 1.33.There is variability between each sites. This is linked to the other elements and the reason for the differences could be similar.

Evaluation

Overall I think the enquiry has been a success as we were able to collect 4 sets of data from 12 sites. However, there was a 300 metre measuring gap between site 6 and 7 due to a waterfall and gorge making access difficult and dangerous. We could also not collect data from the source (Boiling well) as our time was limited so we could not go all the way up there.

Our results were variable and this could have been partly because of human error such as not holding the tape taught. It was frustrating not knowing why there was such variance. If we were to visit again I would also measure stream gradient, bedload and geology as these might help explain things.

Comments on this controlled assessment Fieldwork Focus based upon the 2012-14 new assessment criteria:

AO2 Application of knowledge and understanding in familiar and unfamiliar contexts

- They have described the enquiry question in a wide range and variety of contexts making reference to the Bradshaw model and W.M. Davis. They have also made reference to the River Tees and Colorado and river processes and features. L3
- They have broken the title down into questions and justified them. They have also suggested in detail expected outcomes with justifications. L3
- They have given some background to the study area and included maps to show its location at different scales. They have given reasons for using Ashes Hollow as their study area. They could have given more place detail in particular why it is an AONB and owned by the National Trust, and its geology and recent glacial history. They could have also included more annotated photographs showing the wider landscape of the valley with interlocking spurs and other features. This only just meets level 3. L3
- They have described and explained their evidence in a detailed way. Their descriptions made reference to their data and they gave explanations throughout. L3

Overall 22/24

AO3 Selection and use of a variety of skills, techniques and technologies to investigate, analyse and evaluate questions and issues:
Selection, investigation and presentation.

- They have suggested a wide variety of techniques including the measurement of stream width, depth and floodplain width. They have taken a number of photographs to illustrate their methods. They have justified their sampling methods and techniques. They should have researched the geological and glacial history of the area. This only just reaches level 3. L3
- They have collected and accurately recorded evidence from a wide range of sources, mainly fieldwork. The data collected has been put into very clear tables. They have used the internet and textbooks to obtain further evidence. L3
- They have presented their data in a wide range of appropriate maps, graphs and diagrams. They have drawn bar charts onto an aerial image, scattergraphs, dispersion diagram, maps to show the study area location and labelled photographs. Graphs to show the cross sectional area of the channels could have been drawn for some of the sites and a wider range of photographs could have been taken and annotated rather than labelled. This only just meets level 3. L3
- Their written work is legible and spelling, grammar and punctuation are accurate. They communicated well. L3
- They have written with precision and succinctness and within the 2000 word limit. L3

Overall 15/18

AO3 Selection and use of a variety of skills, techniques and technologies to investigate, analyse and evaluate questions and issues:
Analysis and evaluation.

- They have critically analysed and interpreted some of their evidence. Their analysis of their data included a comparison to their expected outcomes. They did recognise that other factors such as geology and glacial history might be relevant, but did not investigate this. They used spearman rank correlation to analyse the significance of their findings. This convincingly meets level 2. L2
- They made reference to their graphs and data to make substantiated conclusions. L3
- They made an overall critical evaluation of the success of their enquiry. They did not suggest how useful their findings might be to the National Trust education centre at Cardingmill Valley or other schools studying rivers. L2
- They recognised some limitations to their enquiry, but needed to give more detail for their methods and the range of data collected. L2
- They made some suggestions of how to improve their enquiry. This needed to be justified in more detail. L2

Overall 13/18

Overall 50/60

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