Cambridge Secondary 2

Coursework Exemplar 2

Cambridge IGCSE®
Geography **0460**

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Titles or Subjects of Assignment & Curriculum Themes	Knowledge with understanding	Skills and analysis: Observation and Collection	Skills and analysis: Organisation and Presentation	Analysis	Conclusion and Evaluation	Total
An investigation into the downstream changes in a river.	11 (max 12)	10 (max 12)	11 (max 12)	10 (max 12)	10 (max 12)	52 (max 60)
			Amount of Scaling (if relevant)	0	Internally Moderated Mark	52 (max 60)

* Indicates mark to be transferred to Coursework Assessment Summary Form

An Investigation Into The Downstream Changes In A River

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Introduction

I went to Hancock, New Hampshire with my IGCSE with my class and teacher. Hancock is between Keene and Manchester; it is close to the Massachusetts border. Our aim is to investigate the downstream changes in the Nubansit River in New Hampshire. This river is a part of a managed river basin; the Edward Macdowell dam which is managed by the US Army corps of engineers is also present in this drainage basin and regulates the water flow. New Hampshire is in the north east of the USA. New Hampshire has lots of forests and mountains. We chose this location because it is easy to get to safe to get into, east to access by the roads and not too far from our school in Boston.

Hancock,
New Hampshire.

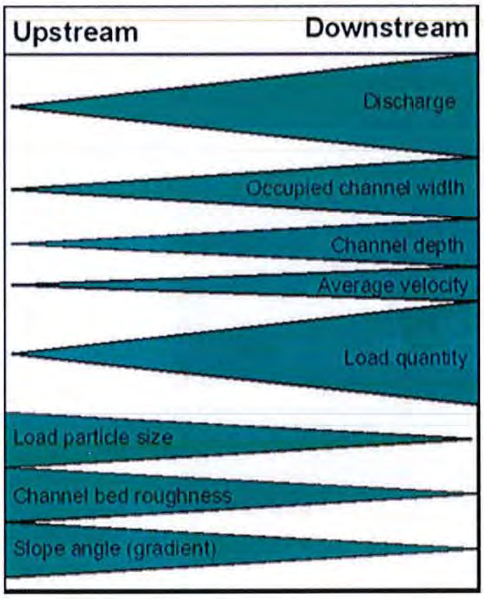
New Hampshire,
USA

K+U - Clearly labelled maps

Nubansit river,
Hancock,
New
Hampshire,USA

We chose May because we know there will be water in the river but the water will not be too cold and will not be frozen and we had just been learning about rivers in class. We chose a river for our coursework because it is easy to access, safe and easy to get our data. Also it is part of the syllabus and since we live in the city we wanted to learn and explore more rural areas. We will investigate width, depth, velocity, sediment size and sediment shape of the river to determine what the downstream changes are.

Prediction



The model to the left is the Bradshaw model. The Bradshaw model describes how a river's characteristics vary between the upper course and lower course of a river. It shows discharge increases downstream, occupied channel width increases downstream, channel depth increases downstream, average velocity slightly increases downstream, and load quantity largely increases downstream. The model shows that load particle size increases upstream, channel bed roughness increases upstream and slope angle (gradient) increases upstream.

River depth

I predict that the river depth will increase downstream because all the tributaries and all the run-off from rain water will meet in the river causing more erosion. Erosion will have a large impact on depth, as gravity ensures that the water is always trying to get to sea level, meaning it will always try to erode the river bed.

River width

I predict that the river will get wider as you get further downstream because there is more water coming down from all the tributaries and river run offs, this will cause more erosion. Erosion is the wearing away of the land as the water flows past the bed and banks. There are four main types of river erosion. These are:

1. **Attrition** - occurs as rocks bang against each other gradually breaking each other down (rocks become smaller and less angular as attrition occurs)
2. **Abrasion** - this is the scraping away of the bed and banks by material transported by the river

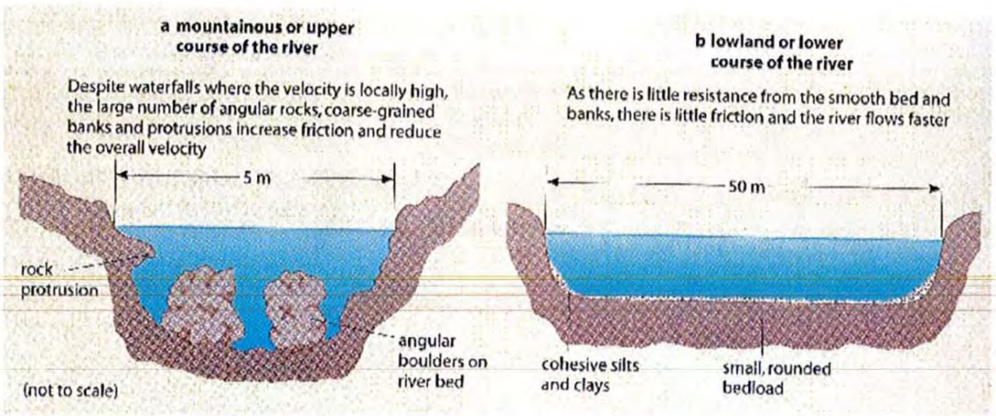
3. **Solution** - chemicals in the river dissolve minerals in the rocks in the bed and bank, carrying them away in solution.
4. **Hydraulic Action** - this is where the water in the river compresses air in cracks in the bed and banks. This results in increased pressure caused by the compression of air, mini 'explosions' are caused as the pressure is then released gradually forcing apart parts of the bed and banks.

Sediment size and shape

I predict that the sediment size will decrease because upstream it would have just broken off from cliffs/boulders and by the end it will have been eroded through attrition and abrasion. I think the shape will go from an angular shape to a more rounded shape due to attrition. It will decrease considerably, the further you go downstream because there will be more attrition. Attrition is when the particles are knocked around by other rocks and they gradually become more rounded and reduced in size.

Velocity K+U - Hypotheses clearly stated

I predict that the velocity will increase the further downstream you go, because the volume of water will increased due to tributaries joining the main stream and surface run-off being added. When there is more water in the channel, more water can flow without being affected by friction from the bed, banks or air so it can flow faster. Also at the top there are larger rocks and by the bottom they are smaller so they are less of an obstacle. It will get more kinetic energy. There is less friction and the river flows faster.



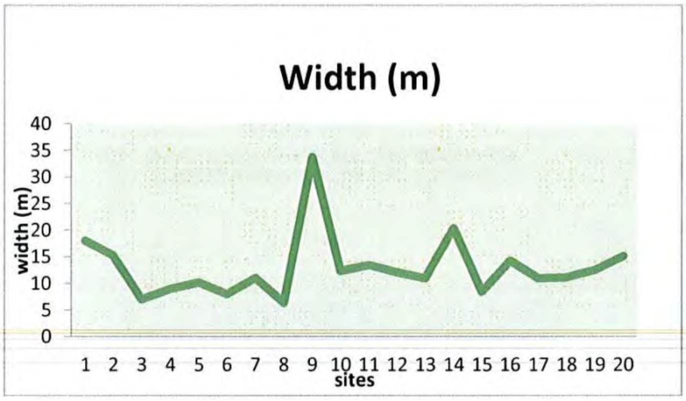
Method, Results And Data Analysis

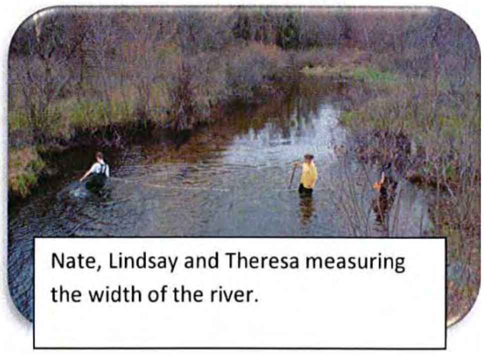
When we went to the river we measured the same things in 20 different parts of the river. We are measuring how a river changes as you go downstream. We will measure width, depth, velocity and sediment size and shape.

The equipment we used was:

- Tape measure
- Stop watch
- Pencil
- Data collection sheet
- Stick
- Meter stick
- Clip board
- Sediment chart

Width





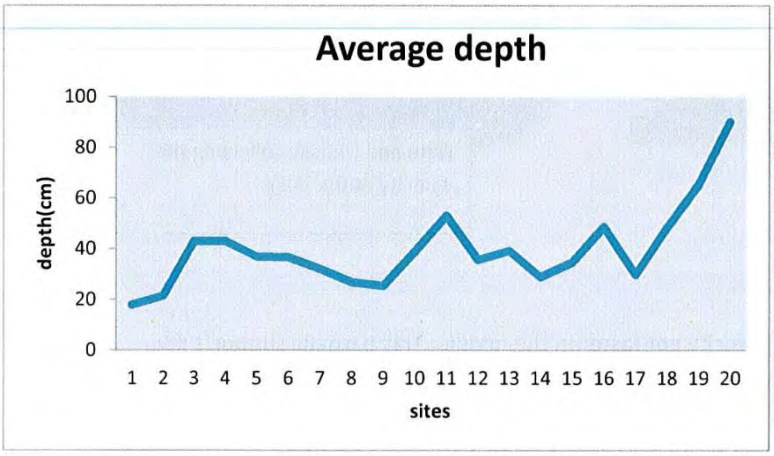
Nate, Lindsay and Theresa measuring the width of the river.

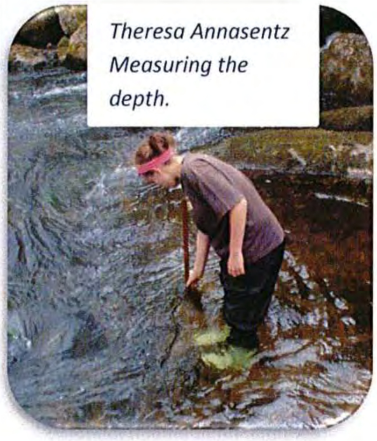
We measured the width by one person standing on one side of the bank while the other walks across to the other side. We measured it with a tape measure.

This graph shows that the width stayed the same for start to finish except for a couple points in the middle; I predicted that the width would be wider at the end but this graph might not show this because there was lots of human intervention at the end, the end of the river ended at a bridge before it flowed into another lake. At site 8 the width was only 7m wide. This can be explained because a bridge crossed the river and it had been artificially narrowed by human intervention. At site 9 the river was spilt by many boulders and obstacles, make it much wider but also inaccurate as water was not flowing across the entire width. Site 16 was after a confluence, so a higher volume of water makes the river wider (20m) here. The Narrowest site was 8, had been narrowed by humans adding large rocks (rip rap) there. This could have been done to prevent future erosion.

Depth

We divided width of the river into 5 parts and measured the depth at equal intervals.



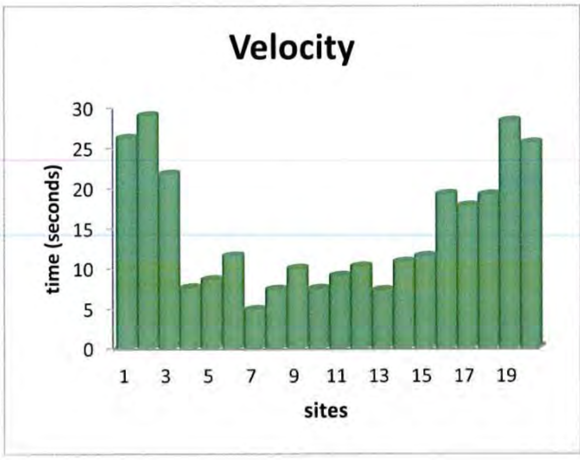


Theresa Annasentz Measuring the depth.

This graph shows that the average depth got deeper the closer we got to the end. The results might not be exact because we did not measure the depth in the same place every site and we might have not measured from the bottom, it might have been measured from a boulder that was on the bottom. NH is known as the 'granite state'. Granite is a hard rock so erosion might be slower than expected. At site 11 was narrow as it had been artificially narrowed by human for a road/bridge. Therefore this site was deep (nearly 60cm) as the water had to fit into a smaller width. My prediction was correct because the depth of the river did increase downstream. Site 20 is narrow width due to human intervention (bridge) so this may explain why it is deepest (horizontal erosion not vertical.)

Velocity

We measured 5 meters downstream in each of the river areas we were investigating. We got someone to go upstream at the end of the measured section. We released a stick, the person downstream recovered it when it gets to the end of the measured section, and a person with a watch which can record in seconds (or tenths of seconds) tells the upstream person to release the float and begins timing it. They stop timing when it reaches the end of the measured section.

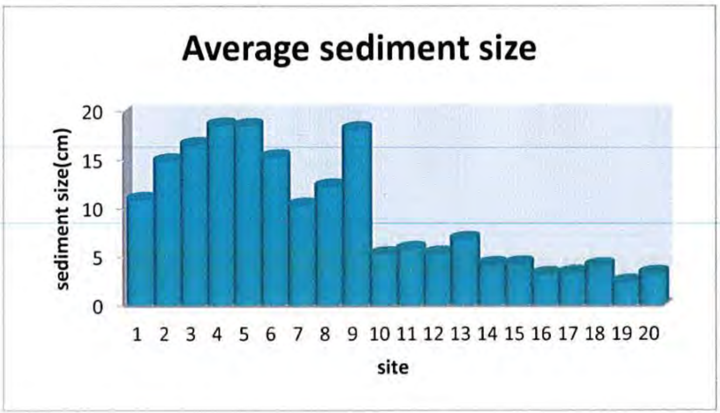


Nate and Lindsay collecting the velocity of the river.

This graph shows that the river velocity got faster in the middle. This partially supports my predictions because the velocity at the beginning and at the end was slower than in the middle, this is because there were a lot more obstacles such as logs, boulders and trees at the beginning and at the end. The first three sites the velocity was 26.2s, 29s and 21.75s. At sites 9, 10 and 11 in the middle of the river the velocity was 10s, 7.25s and 9.1s. At the end sites 18, 19 and 20 the velocity was 19.15s, 28.29s and 25.59s. This shows that the velocity was faster in the middle of the river. This is because the volume of water will increase due to tributaries joining the main stream and surface run-off being added. When there is more water in the channel, more water can flow without being affected by friction from the bed, banks or air so it can flow faster. It is possible that the flow of water at the end of the river was flowing faster at a deeper level in the river, as the depth did increase at that point. If I were to repeat this investigation again, I would use a flow meter to measure the speed more scientifically at a point just below the surface, so there would be no surface air friction.

Average sediment size

We measured sediment size by collecting 5 different rocks from each part of the river, we measured the longest side of the rock with a ruler, we added all the results from each site and found the average size of the rocks at each site.

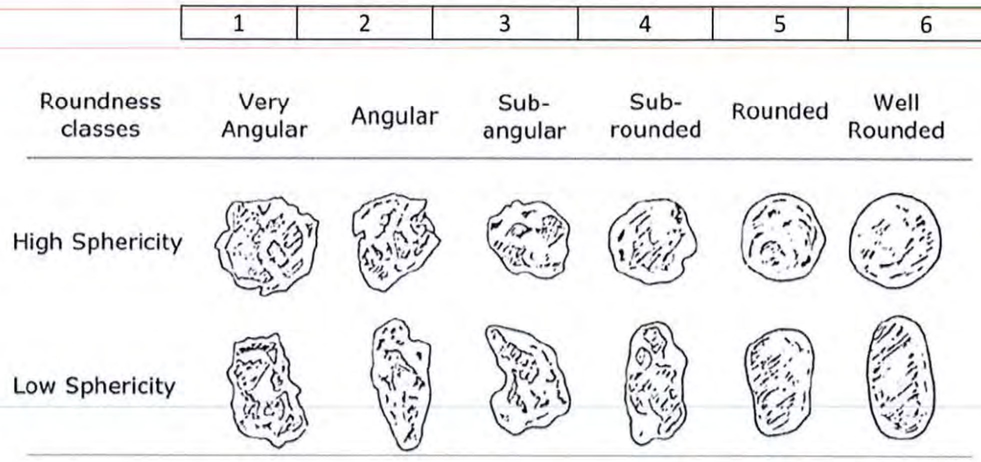


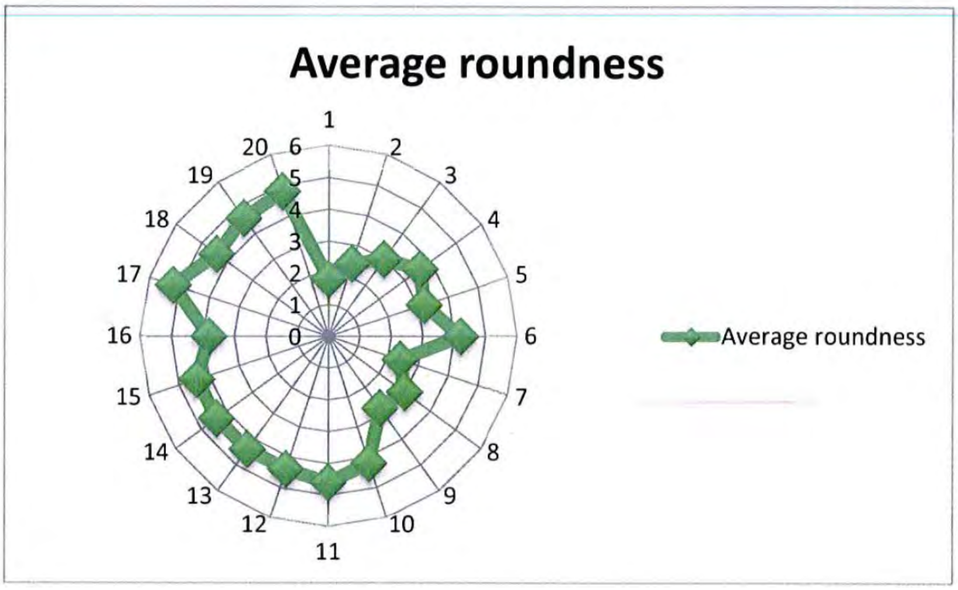
Joelle measuring the sediment size of this rock.

Our results show that the rocks got smaller the further down the river we got. The one result that stands out the most is site 9 this is the widest site. We thought that this one might not fit because at site 8 there were large rocks on the side because the river got really small and the current was fast which pushed the rocks onto the bank of the river. The more downstream you go the more the rocks will have collided with each other and the more they will have been broken down through attrition. These results did match my prediction, the sediments got smaller the further downstream you went, this is due to attrition.

Average roundness

We measured the roundness of the rocks by collecting 5 rocks from each site and using this scale.





The roundness increased the further downstream we went. This is because the velocity increased and there is more attrition and abrasion happening the further you go down the river. You can tell from the graph because at site 1 it is closer to 1 which is fewer rounds then at site 20 which is closer to 6 which Is the roundest. There were some anomalies as the pattern was not linear, but generally the pattern of increasing roundness is clear to see. Site 6 and site 17 are anomalies; this could be because some rocks could have been caught in a pot hole in the river bed.

Spearman's rank

Spearman's rank correlation coefficient is a measure of statistical dependence between two variables. I calculated out spearman's rank to compare the data we collected and to see if there were any correlations using the following formula(from Wikipedia).

$$r_s = 1 - \frac{6\Sigma d^2}{n^3 - n}$$

Variable 1	Variable 2	result
width	Depth	-0.18
Width	Sediment size	-0.31
Width	Velocity	-0.35
Width	Sediment roundness	-0.07
Depth	Velocity	-0.24
Depth	Sediment size	0.5
Depth	Sediment roundness	-0.5
Cross sectional area	Depth	0.41
Cross sectional area	Width	0.69
Cross sectional area	Sediment roundness	0.32
Cross sectional area	Velocity	-0.33
Cross sectional area	Sediment size	-0.38
Sediment size	Sediment roundness	-0.68
Velocity	Sediment size	-0.35
Velocity	Sediment roundness	-0.13

The values closed to 1 are the ones with the strongest correlation. For example cross sectional area and width have a strong correlation of 0.69. This means that the wider the river the larger cross sectional area. We would expect to see this pattern because as the river gets wider it makes sense that the cross sectional area also increases. Additionally sediment size and sediment roundness have a correlation of -0.68. This makes sense because as the sediment moves downstream attrition acts upon the rocks making them smaller and rounder simultaneously. However these are just statistics which means they cannot be totally correct

Conclusion

In conclusion my prediction for width was not correct because there was a lot of human intervention. The river was diverted and there were a couple bridges built in. The depth was what I predicted but not as much as I expected this could be because we could not measure the depth in the same place every site and we might have not measured from the bottom, it might have been measured from a boulder that was on the bottom. At some sites we measured from the side because the depth was too deep for us to go in. The velocity was the same as I predicted, I predicted that the velocity would get faster in the middle and then level out. This is because there were a lot more obstacles such as logs, boulders and trees at the beginning and at the end. The sediment size results matched my prediction. I predicted that the size would get smaller the further down the river you went. This is because of attrition. The sediment shape matched my prediction of the shape; my prediction was that the shape would get rounder the further down the river you went.

Evaluation

I think I have collected enough data because I have at least 5 for each category although my conclusions would become more valid with more data. We had some problems collecting data because the river was too deep and too wide for us to get in and measure accurately. The results will not be completely accurate because the same people did not get the results every time, we took the results over two days and overnight it rained which would have affected our results on the second day. We did not always put the meter sick completely on the bed of the river every time. When we were taking the width we might have not pulled the tape measure extremely tight. If I was to do this study again I would get all the results on one day not over two. We could have had the same people take the results every time to make it a fair test. We could have used a flow meter to measure depth below the surface. The average roundness might not be completely accurate because we used the human eye to determine the roundness. However, we did at least ensure that the same person took this measurement so that there was no disparity in the opinion of how round the rocks were.

Bibliography

http://www.google.com/imgres?um=1&hl=en&sa=X&biw=1366&bih=667&tbm=isch&tbnid=IquR6YRTCsM80M:&imgrefurl=http://khsgeography.blogspot.com/2009/10/bradshaw-model.html&docid=UKX4mrKaZ9J8dM&imgurl=http://2.bp.blogspot.com/_mUyU4-vy4oQ/StOIlW1fn9I/AAAAAAAAAC0/5ncx4uYPZFE/s200/bradshaw_model.gif&w=154&h=200&ei=Ji0xT5GJC4Hm0QGA9ezTBw&zoom=1&iact=hc&vpx=200&vpy=341&dur=282&hovh=144&hovw=111&tx=104&ty=32&sig=103813049215589232205&page=1&tbnh=142&tbnw=109&start=0&ndsp=19&ved=1t:429,r:6,s:0

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