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River Channels Fieldwork

Introduction

There are a number of reasons why river channels fieldwork is important to A Level Geography students. These include:

- the possible effects of climate changes
- to help support the theoretical study of rivers
- as a basis for coursework
- to help you answer examination questions.

This **Geofile** unit illustrates, with reference to specific examples, how fieldwork can be used to support these aspects of river studies.

The possible effects of climate change

As the profile of climate change continues to rise, and more people in countries such as the UK become aware of the possible dangers of living on a floodplain, data collected about river channels can be compared to the surrounding land use. In this way it is possible to make an examination of the likely impacts of increased flood levels and frequency on an area.

In Mediterranean countries, where it is possible to study rivers which only flow at certain times of the year, some interesting investigations can be made. A dry river channel can quite easily be followed along a section of its course and a variety of measurements taken to calculate the potential capacity of the river:

- cross-section
- gradient
- hydraulic radius
- discharge.

Figure 1: Location of Sitges and Riera de Ribes

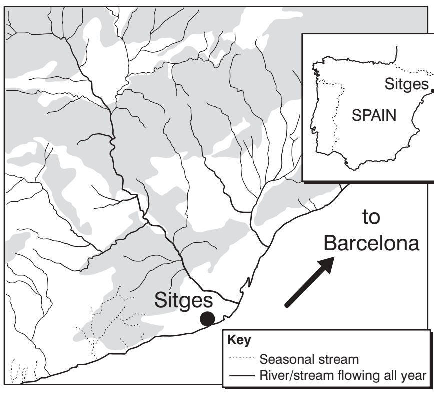
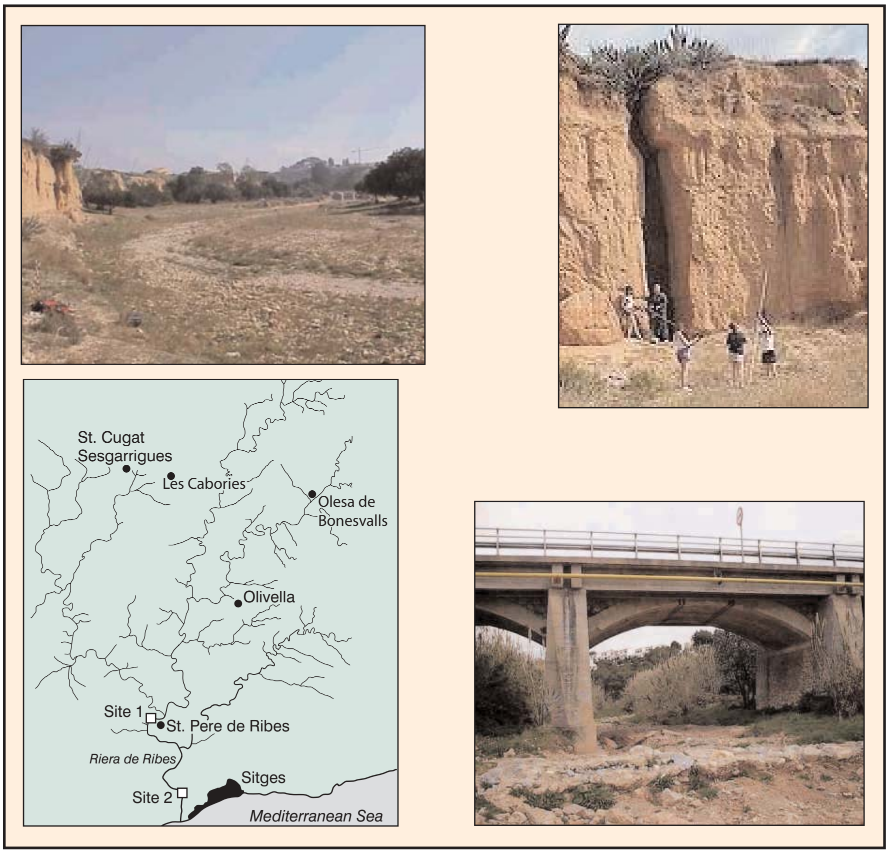
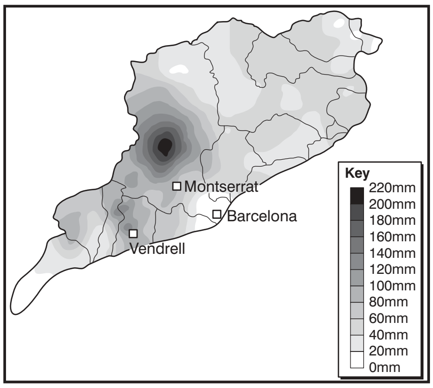


Figure 2: Riera de Ribes:top left and right show site 1 upstream; bottom right shows site 2 downstream



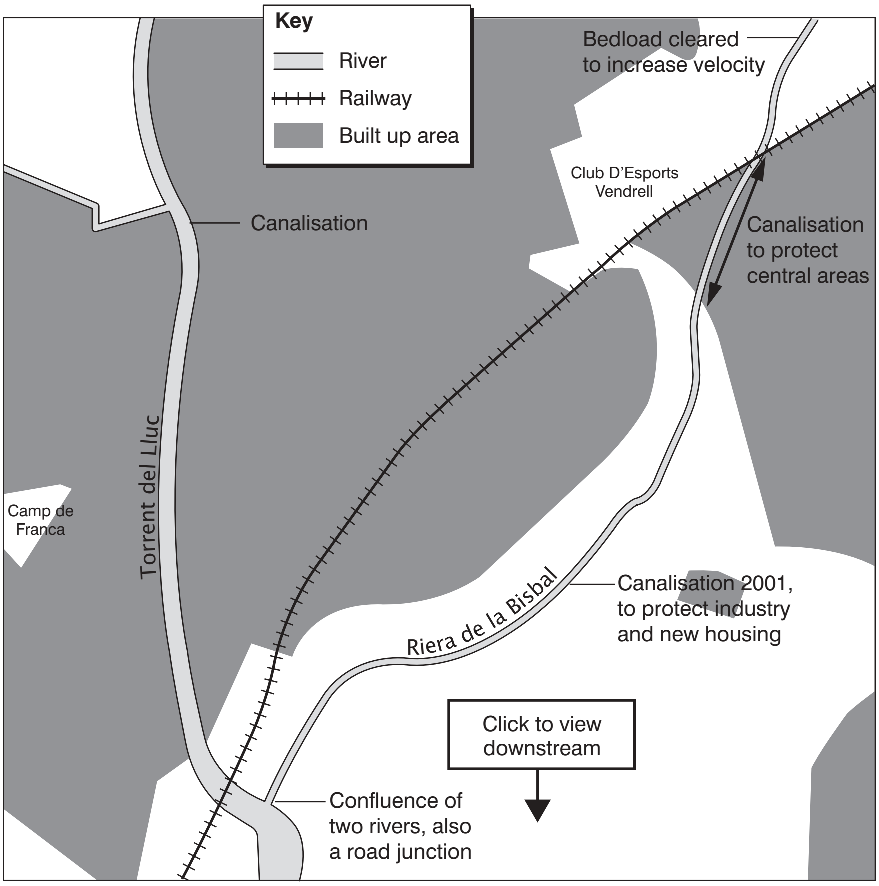
Sometimes land use developments close to rivers alter their capacity in ways that are potentially dangerous. One example of this is a study of the Riera de Ribes river near Sitges, Barcelona (see Figures 1 and 2). Results from fieldwork can be used to assess the risks to recent housing and camp site developments on the river floodplain downstream as well as the effectiveness of river management schemes. On the river cliffs, previous flood levels can be seen and from this, bankful discharge can be calculated. New houses have been developed at this location and some modifications have been made to the channel to reduce the flood risk. Further downstream a camp site has been built next to the river, as well as more houses. If measurements are also taken and the same calculations made here as well, it can quickly be seen that the actual capacity of the river is lower at this downstream location than at the upstream site, thereby potentially creating a much greater flood hazard risk at this point. Gardens border the river channel at this downstream site, with walls significantly reducing its cross-sectional area. The discharge at the upstream site is found to be five times that of this second site downstream at bank-full conditions (Figure 2 shows photos of these two sites).

Figure 3: High rainfall June 2000



On 10 June 2000 flash flooding did occur in the Barcelona area. The maximum rainfall was recorded on Montserrat Mountain, with 224 mm

Figure 4: El Vendrell Flood Management



falling in less than 6 hours. Secondary data on the causes of these floods can be researched, for example Figure 3 is a good illustration of the very high rainfalls and when compared to the river location maps, provides one of the causes of flash flooding. Other possible causes which can be ascertained from secondary data include increased population growth in the area (caused by the deurbanisation of Barcelona) and a move away from agriculture to tertiary activities.

In a nearby area, El Vendrell (Figure 4), 134 mm fell in less than 3 hours, at such an intensity that a state of emergency was announced. El Vendrell lies at the confluence of two normally dry rieras (intermittent streams), the Riera de la Bisbal and the Torrent del Lluc. The confluence of these two rivers flows across a main road into the town. One tributary had been canalised through the town, but the other remained as a natural channel, running at the same level as the main road in several locations. Flooding from this tributary seriously affected dozens of homes and businesses in the town centre. Figure 4 shows the two tributaries and some of the alterations to the channel made since these flash floods, and Figure 5 illustrates the damage caused by the floods.

Investigations which might use this sort of approach would be based around whether the river in question is likely to flood, and, if so, how this would affect surrounding land use. What management strategies should be put into place might then be determined. The necessity for developing these areas in the first place may also be questioned.

To help support the theoretical study of rivers

Sometimes theories such as the Hjulstrom Curve and Schuum's Model of drainage basin characteristics can be difficult to understand. The best way to do this is if students are able to physically collect the data they need, present it using appropriate methods and then compare their findings to the models. It is often the case that it is not possible to collect all the necessary data first-hand, but sometimes secondary data, with supporting maps and photographs, can be just as useful. Fieldwork investigations of this sort are also valuable – consider the example below of the River Rye in North Yorkshire. Figure 6 provides some secondary data on the channel and its processes. These can be used to draw a line graph and compound bar graphs in order to summarise the characteristics of this river, which can then easily be compared to Schumm's Model (Figure 7).

As a basis for coursework

There is still a requirement for specifications which have a coursework element in AS or A2 for work to be individual, even if it is based on group data collection. With river studies like the ones outlined in this article, group data can be adapted and used in a variety of different ways. For example, below are four suggestions which can be used in a variety of locations:

1. How can the flood hazard risk in the __________ area be assessed?
2. How have changing land uses in ______________ affected the flood hazard risk?
3. How does the flood risk vary between ____________ and _________ on the ____river?
4. How could land use planning modify the flood risk in ______________?

To help you answer examination questions

As an alternative to coursework, on some specifications there is an examination paper based on fieldwork investigation. For example, 'With reference to a named river, show how data collected from fieldwork can be used to describe the changes in channel characteristics.' The River Rye data could be adapted for this question. The first part of the answer would need to explain how the fieldwork measurements were collected (this could be done through a series of annotated diagrams) and then the results of the data could be summarised in a series of paragraphs. For example:

> 'The data shows that the width, depth and wetted perimeter of the River Rye increased tenfold. This is due to the large increase in discharge, which could be a result of tributaries joining the main channel. Hydraulic radius increases steadily which shows that the channel is more efficient in size. River gradient is very steep at first but then decreases to a very low angle and sinuosity increases as gradient declines. This suggests there is a large amount of lateral erosion on the floodplain. However, velocity shows a slight increase downstream which reflects the importance of channel efficiency as a factor which affects velocity.

Near the source, bedload is dominated by larger materials with smaller materials becoming more and more significant downstream. This is because in the upland areas, the bedload consists of recently weathered material which has not yet been subjected to a high degree of abrasion and attrition. In the lower sections of the river, however, there is a lot of fine material which has been heavily eroded as it has been transported downstream. Suspended load shows a similar pattern of increase but for the smaller sized particles only. This reflects the competence of the river (although there is evidence that this decreases further downstream as the proportion of the finest materials increases slightly.'

Notice in this answer that additional knowledge of rivers is being used to explain the patterns provided by the statistical data. This answer would be improved further by the addition of figures taken from the tables in Figure 6.

Some examination boards have a more general approach to fieldwork questions, for example:

- 'Using examples from a human, physical or human/physical investigation which you have undertaken, state the aim of your investigation and **two** hypotheses.' (3 marks)
- 'For **one** hypothesis, describe how you **analysed** the data that you collected and show how the results helped your understanding of the topic studied.' (7 marks)

The fieldwork undertaken both around El Vendrell and on the River Rye would be suitable to answer such questions.

Conclusion

This unit has set out a range of ways in which fieldwork on river channels can be applied during your A level course. River channels is a common coursework topic, but most students stick to a comparison of channel characteristics. Now you can see how straightforward measurements like these can be taken further and a higher level of work achieved.

Figure 5 El Vendrell flood damage

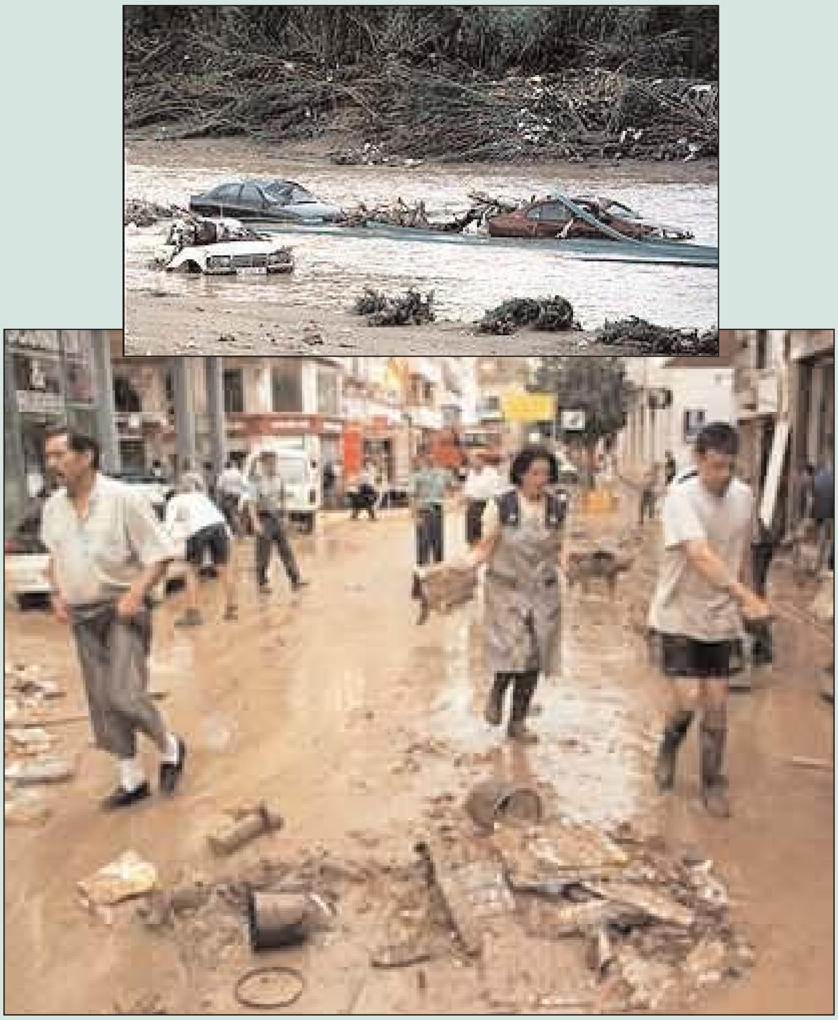


Figure 6: Channel Data for the River Rye, North Yorkshire

Channel characteristics	**A**	**B**	**C**	**D**	**E**
Width (m)	1.9	4.0	7.3	8.1	15.3
Depth (m)	0.12	0.52	0.6	1.2	1.9
Wetted perimeter (m)	2.1	5.0	8.7	10.0	19.3
Cross sectional area (m^2)	0.2	2.08	4.4	10.4	34.1
Hydraulic radius	0.07	0.42	0.51	1.04	1.77
Velocity (m/sec)	1.2	1.3	1.6	1.8	1.8
Discharge (cumecs)	0.24	2.7	7.04	18.7	61.4
River bed gradient	11	3	2	1	1
Sinuosity (1.0 = straight)	1.01	1.2	1.9	2.5	1.9
Bed load %	**A**	**B**	**C**	**D**	**E**
Pebbles 10mm+	50	45	10	2	0
Gravel 1 – 10mm	43	30	43	15	12
Sand 0.1 – 1.0	5	10	22	25	13
Silt 0.01 – 0.1	2	5	15	45	50
Clay 0.001 – 0.01	0	5	10	13	25
Suspended load %	**A**	**B**	**C**	**D**	**E**
Pebbles 10mm+	0	0	0	0	0
Gravel 1 – 10mm	0	0	0	0	0
Sand 0.1 – 1.0	80	50	25	0	0
Silt 0.01 – 0.1	20	45	50	30	25
Clay 0.001 – 0.01	0	5	25	70	75

Figure 7: Schumm's model

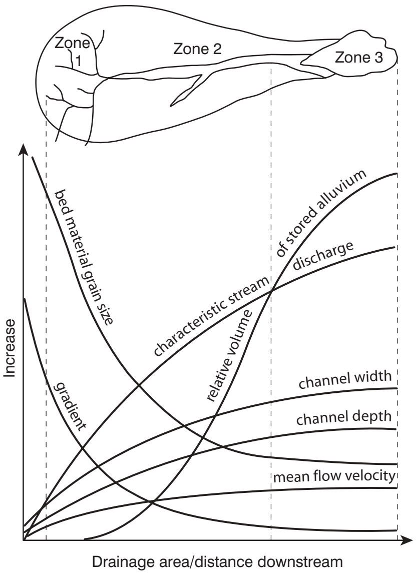
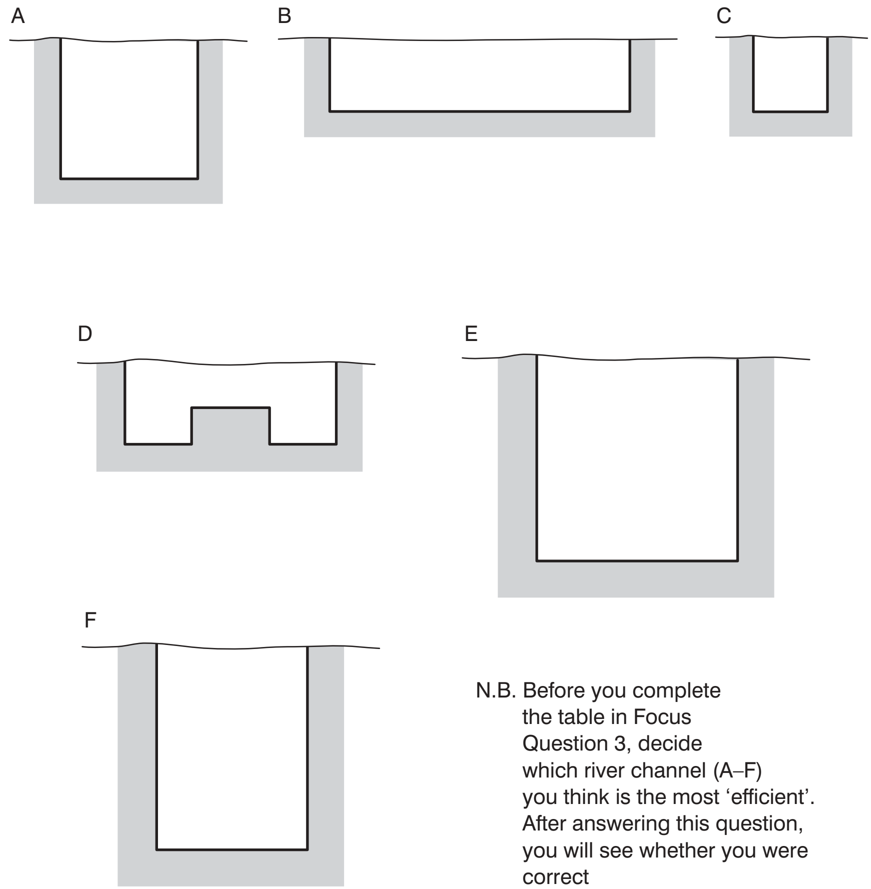


Figure 8: Working out the hydraulic radius of different river channels



N.B. Before you complete the table in Focus Question 3, decide which river channel (A–F) you think is the most 'efficient'. After answering this question, you will see whether you were correct

Scale 5 mm = 50 cm

Focus Questions

1. Use textbooks and the internet to find out how the following are measured:
   - cross-sectional area
   - wetted perimeter
   - velocity.
   - gradient
   - bedload size

2. Use textbooks and the internet to find out how the following are calculated:
   - discharge
   - hydraulic radius
   - cross-sectional area
   - roughness coefficient.

3. Complete the table below using the diagrams in Figure 8.

Channel cross section	Wetted perimeter	Cross-sectional area	Hydraulic radius	Rank order of efficiency
A				
B				
C				
D				
E				
F				

4. Use Figure 6 to produce line graphs and compound bars for the characteristics shown. Write a sentence on each characteristic which describes what happens, compares this to Schumm's theoretical model and attempts to explain any similarities/differences found.

5. Improve the exam answer in the final section by adding data from Figure 6.