

Chapter 4

Interacting natural processes in a fluvial environment

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The material covered in this chapter helps meet the requirements for Achievement Standard 90701 (Geography 3.1) 'Analyse natural processes in the context of a geographic environment', through creating an understanding of:

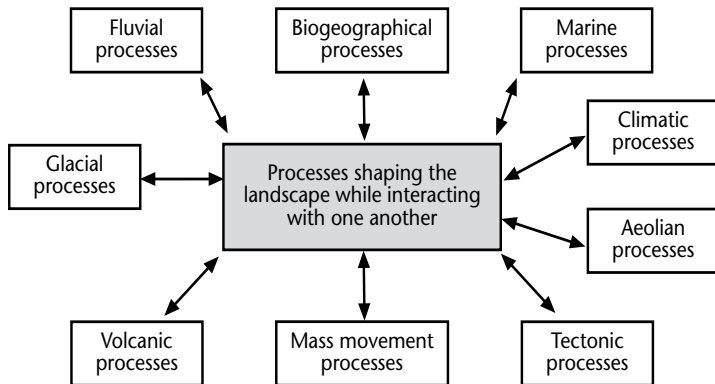
- Fluvial processes.

Fluvial processes

This chapter concentrates on **fluvial processes**. These are the processes caused by *running water*. The word fluvial is from the Latin word for river, which is 'fluvius'. *Running water* is usually in the form of rivers, small rivers, or streams.

A *fluvial environment* is an environment which is dominated by fluvial processes. However, there are often other **processes** operating in a fluvial environment:

- Climatic processes.
- **Mass movement** processes.
- Tectonic processes.
- Biogeographical processes.
- Soil development processes.
- Aeolian (wind) processes.
- Glacial processes.
- Marine (coastal) processes.



A range of these natural processes should be included in your study.

One or two will no doubt be studied in considerably more detail than the others.

In this chapter, fluvial processes are singled out, although there are references to some mass movement processes as well.

Example

**A landscape formed and reformed by volcanic and fluvial processes;
the Waikato river by Tuakau**



The lower reaches of the Waikato river with the long-extinct volcano 'Pukekohe Hill' in the background (right). The river meanders past this and other long-extinct volcanoes as it flows toward the Ake Ake swamp close to its delta. In past times volcanism has been an important building-up process in the landscape. Today fluvial processes are active in the form of both slope processes and channel processes. These present-day fluvial processes are not only wearing away the old landforms, they are also building new ones.

Maori concepts and their relation to fluvial environments

What role does Kaitiakitanga play in your chosen geographic setting?

Kaitiakitanga means guardianship. In most fluvial environments, the local tribe cares about what happens to the local environment. They have an interest in preserving the environment for future generations and also in maintaining the quality of the area as it may provide a food source (kai moana) or they may use the area for bathing or swimming.

What role does Korero purakau play in your chosen geographic setting?

Korero purakau means legend. Associated with many rivers (especially large ones like the Waikato) are a number of legends. They may cover the creation of the river or its environment, or they may cover the previous uses of the river.

What role does Taonga play in your chosen geographic setting?

Taonga means treasure. In many fluvial environments, the river is a source of food and water. If there are deaths in the river, the area becomes tapu. Water from different bodies of water should not be mixed. Rivers such as the Waikato and Whanganui have been, and are, critical transport links between areas.

Separating theory from Case Studies

So long as your selected geographic environment is a drainage basin, or an identifiable part of a drainage basin such as a **stream channel**, **flood plain** or **headwater** area, then it does not matter that your study area is different from the examples used in this text.

The focus of this chapter is to provide a general description of the fluvial processes and of their associated phenomena (fluvial **landforms**) found in the New Zealand landscape.

A brief section at the end of the chapter is devoted to the particular geographic fluvial environment of the Wairau Stream on Auckland's North Shore. All the assessment statements in Achievement Standard 90701 (Geography 3.1) are considered in relation to this environment:

- The size and extent of the drainage basin of the Wairau Stream and the natural features of the environment.
- Natural processes that operate (and may interact) in the drainage basin of the Wairau Stream environment.
- The distribution and formation of the natural features.
- Spatial and temporal variations in the operation of natural processes in the drainage basin of the Wairau Stream environment (how processes vary over space and change over time).
- Human actions that modify natural processes and the outcomes (results) for the natural environment.

Activity 4A: Natural processes

1. Describe the *location* of your chosen geographic environment or setting, using two of the following criteria:
 - a. Latitude and longitude.
 - b. Compass locations within one of New Zealand's islands.
 - c. Distance and direction from a well-known New Zealand landscape phenomenon, either natural or cultural.
2. Describe the *extent* of your chosen geographic environment or setting, using the following criteria:
 - a. Area in km².
 - b. Dimensions in kilometres; both west to east and north to south.
 - c. With reference to boundary landforms.

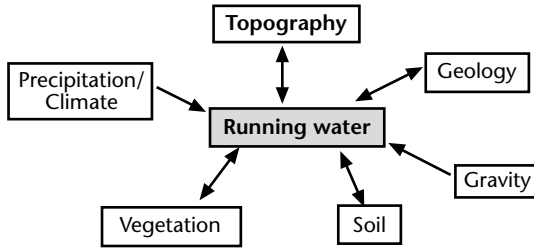
What are the elements and interactions involved in fluvial processes?

In New Zealand, the most widespread and active landscape-shaping **agent** is running water. New Zealand's hilly to mountainous terrain and medium to high rainfall means water running off the land has the ability to modify most environments.

During rainy times, slope and channel processes are most active and observable throughout the country; in dry times, the results of their work are easily observed. In all regions, there are fluvial processes operating at a variety of scales throughout the year.

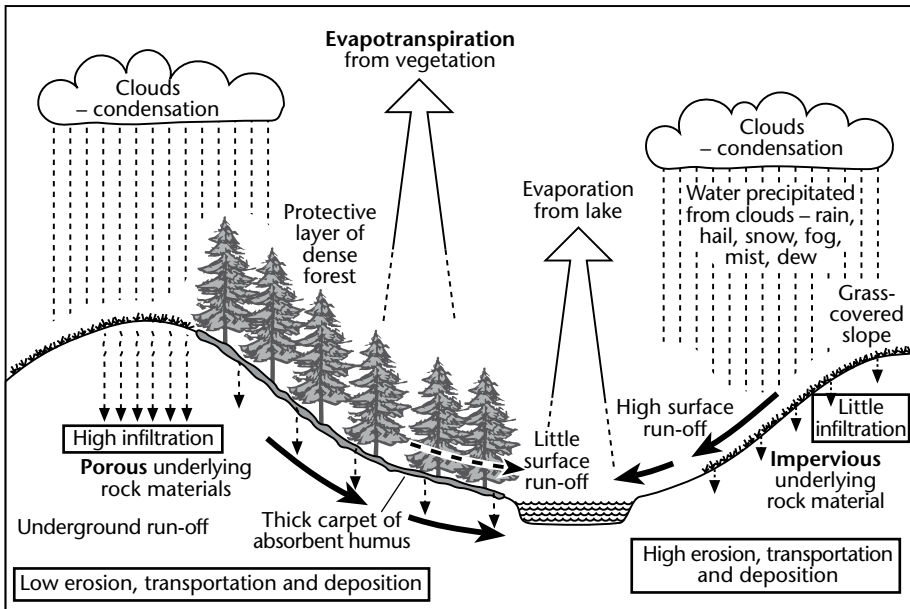
The interacting elements

Running water is the agent by which specific **elements** interact with each other to produce fluvial processes that shape the landscape in a drainage basin:



These elements interact with one another to determine how water will move in any environment. How water flows determines what fluvial processes become active.

The water (hydrological) cycle; surface run-off, infiltration and evapotranspiration



Fluvial channel processes and slope processes are likely to operate differently in landscapes with contrasting geology, slope angle and vegetation even if they have similar climatic conditions.

Drainage basins

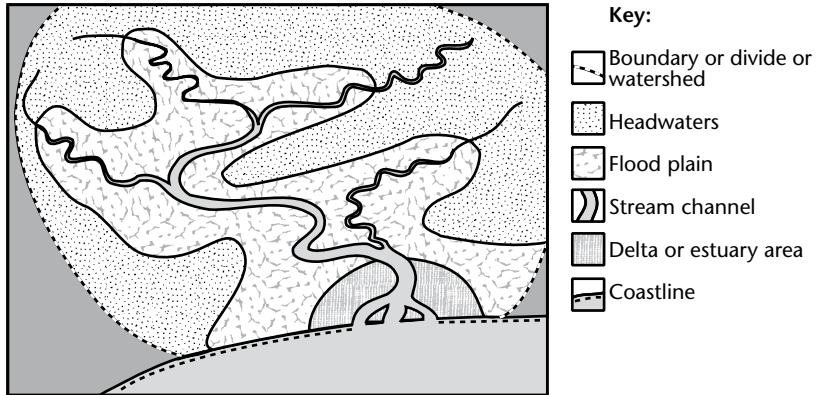
Surface run-off (rather than ground water flow), infiltration and evapotranspiration are the main processes of focus of this chapter.

As surface run-off increases, streams and rivers form and act as a system for channelling water away.

The area drained by a stream system, or stream network, is called the **drainage basin**; sometimes referred to as the river catchment or the catchment area. The drainage basin is the natural fundamental unit for studying the pathways of running water and fluvial processes.

Every drainage basin is separated from adjoining catchments by ridges or watersheds (also known as **interflues**) which follow the line of highest ground.

Main landform divisions within a drainage basin



Location within the drainage basin dictates the type of fluvial processes that are likely to be active at any particular place. In most drainage basins, erosional processes are more dominant in the headwaters areas, while depositional processes are more dominant on floodplain and delta areas.

Divisions within a drainage basin

The stream channel can largely be thought of as a ‘conveyor belt’ which transports water and eroded sediments from the **upper reaches** and **middle reaches** of a drainage basin down to the lower reaches and the sea where they are deposited. During periods of abnormal flow (floods), a lot more erosion and deposition take place, both in the stream channel and on the surrounding slopes and flood plain.

Every drainage basin can be divided up into four separate and unequal divisions, according to area:

- The main stream channel and the channels of the tributaries.
- The headwaters or hilly areas, usually found in the upper reaches.
- The flood plain.
- The **delta** or estuary, where both fluvial and marine processes are equally important.

Activity 4B: Identifying the elements and the drainage basin

1. Name the main agents responsible for:
 - a. Fluvial processes.
 - b. Mass movement processes.
2. Identify *three* elements which interact with running water to produce fluvial processes.
3. What is the name of the processes caused by:
 - a. Running water?
 - b. Gravity?
4. Explain why a slip on a rocky dry hillslope is an example of mass movement, while the collapse of the headscarp of a gully during heavy rain is an example of fluvial processes.
5.
 - a. In a drainage basin fluvial *erosion/deposition* is more dominant in the headwaters.
 - b. In a drainage basin fluvial *erosion/deposition* is more dominant on the flood plain.

Chapter 4: Interacting natural processes in a fluvial environment

Activity 4A: Natural processes (page 51)

1. Students to supply their own unique answers.
2. Students to supply their own unique answers.

Activity 4B: Identifying the elements and the drainage basin (page 53)

1.
 - a. Running water.
 - b. Gravity.
2. topography, geology, soil, vegetation, climate, precipitation, gravity
3.
 - a. Fluvial.
 - b. Mass movement.
4. The slip on the dry slope is caused by gravity alone, while the collapse of the gully headscarp is caused by the erosive power of running water.
5.
 - a. Erosion.
 - b. Deposition.

Activity 4C: Fluvial slope and channel processes (page 64)

1. a.	Fluvial slope processes	Fluvial channel processes	
	Rain splash, sheetwash, rilling, gullyng, slumping, piping	Corrasion, traction, vertical accretion, saltation, lateral accretion, evorsion, attrition, hydrauliclicking, potholing, suspension, solution, attrition	
b.	Fluvial erosion	Fluvial transportation	Fluvial deposition
	Rain splash, sheetwash, rilling, gullyng, corrasion, slumping, evorsion, hydrauliclicking, potholing, piping	Traction, saltation, suspension, solution, attrition (erosion of the load)	Vertical accretion, lateral accretion

2. Answer for transportation

There is a direct relationship between fluvial transportation and fluvial erosion. As the amount of fluvial erosion increases, there is an increase in the amount of load being transported. There may also be a change in the way the load is transported. If little fluvial erosion takes place in the surrounding catchment and along the stream channel, few solid load particles make their way into the stream. As a result, most of the load is transported in solution. When surface run-off increases, and as a result the amount of fluvial erosion increases in the surrounding catchment or along the stream channel, then the amount of load that can be transported in suspension or as bed load also increases.

Answer for deposition

There is a direct relationship between fluvial erosion and fluvial deposition. As the amount of fluvial erosion increases, this increases the amount of load that can be deposited by a stream. If little fluvial erosion takes place in the surrounding catchment, then few solid particles make their way into a stream. As a result, most of the load is transported in solution, which results in virtually no fluvial deposition. When surface run-off increases,