



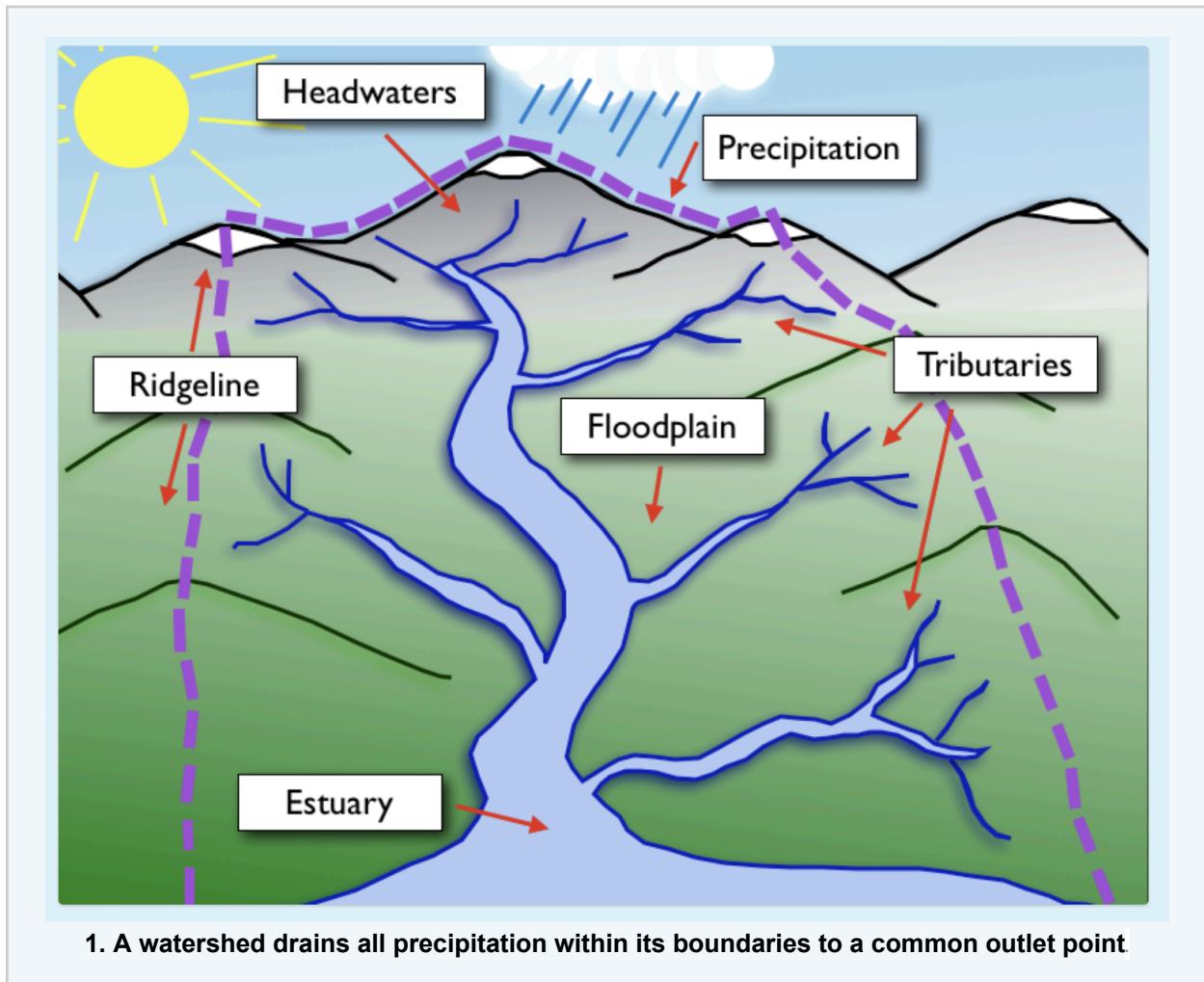
Watersheds & the Water Cycle

Everything in a watershed is connected — from the ridge where rain first falls to the estuary where the river meets the sea. Understanding how water moves through the landscape is the **foundation of aquatic ecology**.

1. What is a watershed?

A watershed — also called a catchment or drainage basin — is an area of land where all precipitation drains to a single common point, usually the mouth of a river. Think of it like a funnel: any rain or snowmelt falling within the boundary will eventually flow downhill to the same destination.

Watersheds are separated from each other by ridgelines — the high edges of hills or mountains that act as dividing lines. A raindrop landing on one side of a ridgeline travels to one watershed; a drop landing on the other side goes to a completely different river system.



Parts of a watershed

Water moves through a watershed following the slope of the land. As it travels downhill, small streams join together to form larger ones, eventually reaching a river, lake, or the ocean.

Term	Definition
Headwaters	The uppermost origin of a stream — typically the highest elevation point in the watershed where water first collects.
Tributaries	Smaller streams or rivers that flow into a larger one. Every river system is built from many tributaries joining together.
Floodplain	The flat area alongside a river that can flood when water levels rise. Naturally fertile; ecologically important.
Estuary	Where freshwater from a river mixes with saltwater from the ocean. One of the most productive ecosystems on Earth.
Ridgeline	The high boundary that divides one watershed from another — the 'edge of the funnel.'
Groundwater	Water that seeps into the ground and is stored in aquifers. It recharges streams during dry periods.

NEW BRUNSWICK

New Brunswick contains approximately 60,000 km of rivers and streams and 2,500 lakes and ponds — about 1,460 km² of surface water. Major watersheds include the Wolastoq (Saint John River), the Miramichi River, and the Petitcodiac River, each with distinct drainage patterns shaped by the province's relatively flat terrain.

2. Drainage patterns

Streams and rivers form recognizable patterns across a landscape. The shape of these patterns depends on the slope and topography of the land, the hardness of underlying rock, and local climate.

Pattern	Description	NB relevance
Dendritic	Tree-like branching — the most common pattern in areas with uniform, gently sloping terrain.	<i>Most common in NB</i>
Meandering	Winding, looping curves formed when water flows slowly across flat land, eroding outer banks.	<i>Common in NB lowlands</i>
Braided	Multiple channels weaving around sandbars and islands, often in high-sediment rivers.	<i>Less common</i>
Anastomosing	Stable, separated channels with vegetated islands between them.	<i>Rare</i>



Dendritic



Meandering



Braided



Anastomosing

Drainage pattern comparison.

Side-by-side diagram or aerial photo showing dendritic vs. meandering patterns. A satellite image of the Petitcodiac River meanders would be ideal.

STUDY TIP

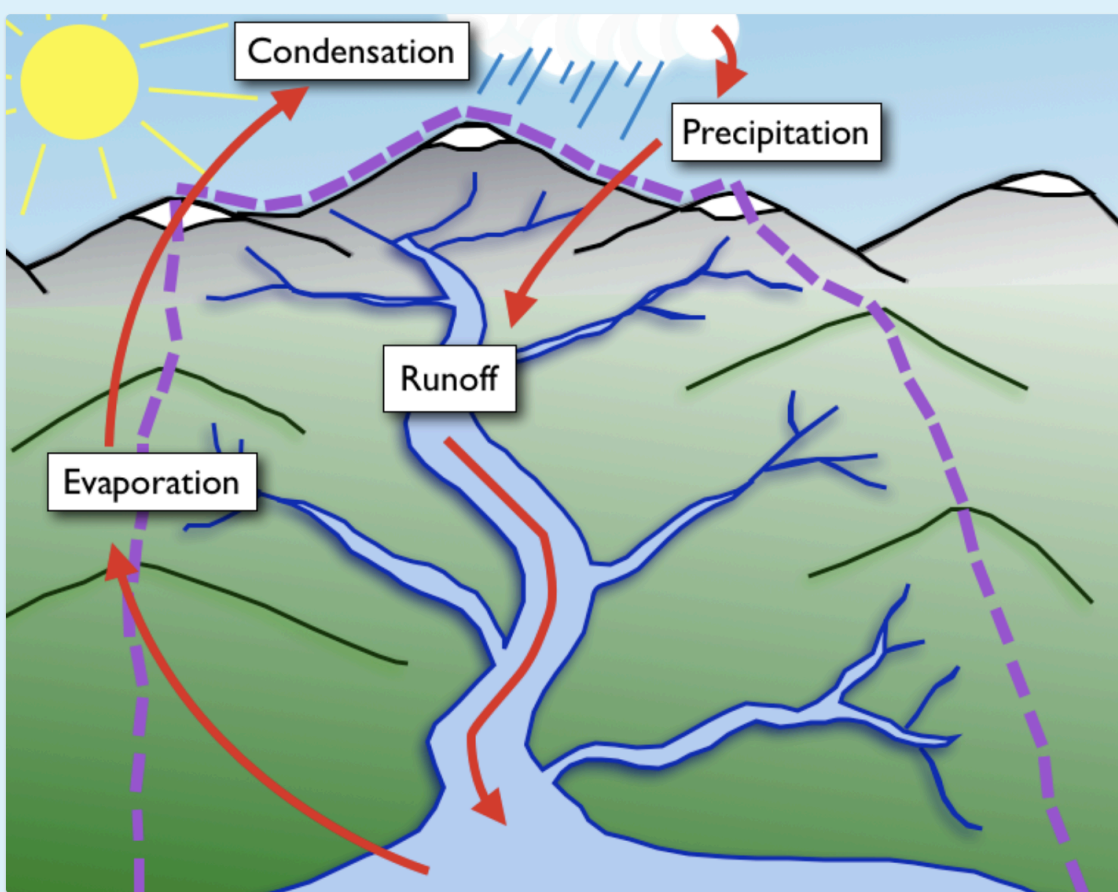
Remember: dendritic comes from the Greek word for tree (dendron). Dendritic drainage looks exactly like a tree with branches — small streams (twigs) joining medium streams (branches) joining the main river (trunk).

3. The water cycle

The water cycle — also called the hydrological cycle — describes how water moves continuously between the atmosphere, land surface, and underground. The sun drives this cycle by providing the energy for evaporation.

#	Stage	What happens
1	Evaporation	Solar energy converts liquid water from lakes, rivers, and oceans into water vapour.

2	Condensation	As water vapour rises and cools, it condenses into tiny droplets forming clouds.
3	Precipitation	Water falls back to Earth as rain, snow, sleet, or hail depending on temperature.
4	Runoff	Water flows over the land surface into streams, rivers, and eventually the ocean.
5	Infiltration	Some water seeps into the ground, recharging aquifers and feeding springs and streams.
6	Transpiration	Plants absorb groundwater through roots and release water vapour through their leaves.



The hydrological cycle continuously moves water between the atmosphere, land, and ocean.

CLIMATE CHANGE CONNECTION

Climate change is intensifying the water cycle in New Brunswick. Warmer temperatures increase evaporation, leading to drier summers and more intense precipitation events — meaning more flooding in spring and longer droughts in late summer, affecting both water quantity and quality in NB rivers and streams.

4. Stream order

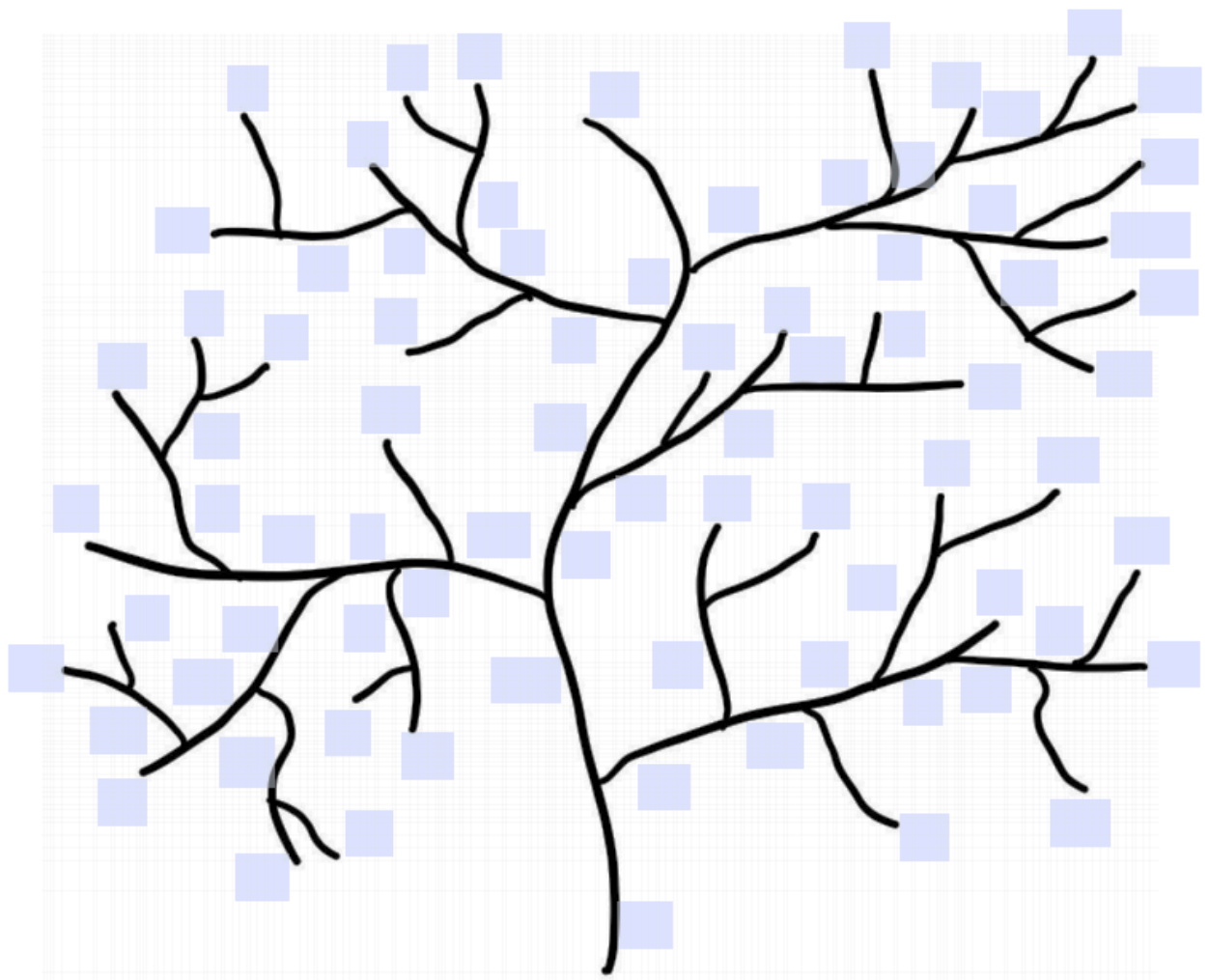
Stream order is a classification system that describes a stream's position within a watershed network. The most widely used system is the Strahler method. Understanding stream order helps predict water temperature, flow speed, species composition, and habitat characteristics.

The rules of Strahler ordering

Order	How it forms	Characteristics
1st order	Smallest streams with no tributaries flowing into them.	Narrow, fast, cool, highly oxygenated. Often spring-fed.
2nd order	Two 1st-order streams join together.	Slightly wider, more stable flow, more riparian shading.
3rd order	Two 2nd-order streams join together.	1st–3rd order streams are considered headwater streams.
4th order +	Two streams of equal order join. Order never decreases downstream.	Warmer, slower, wider. More sediment. Different species.

KEY RULE TO REMEMBER

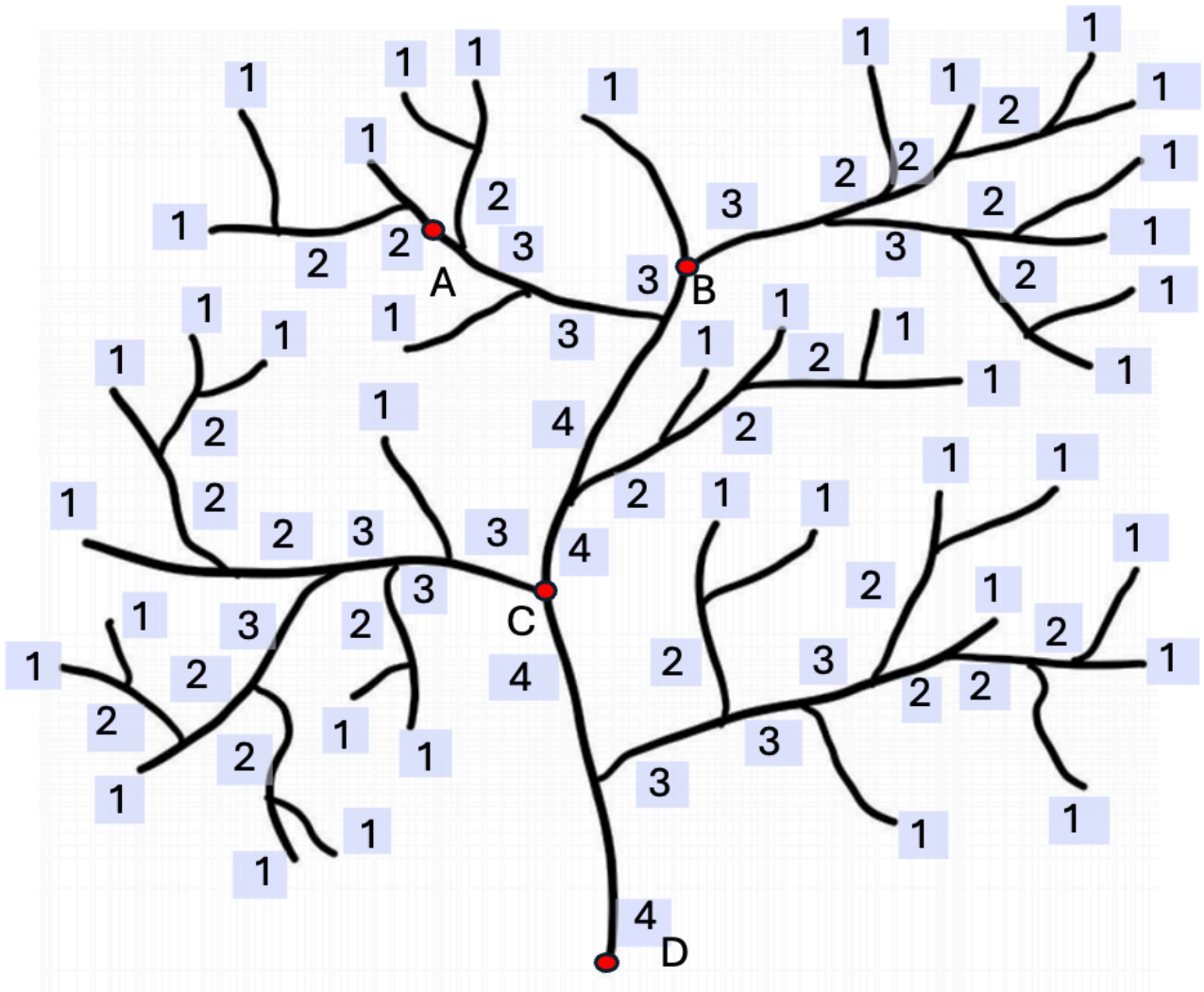
Order only increases when two streams of the same order join. When a lower-order stream flows into a higher-order one, the higher order is maintained. A 1st-order stream joining a 3rd-order stream does NOT create a 4th-order stream — it stays 3rd order.



Stream order schematic.

Give it a try and come back and check your answers.

What is the Stream Order at A, B, C, and D?



What # stream order at:

- A 2
- B 3
- C 4
- D 4

5. Fluvial processes

Fluvial processes are the ways that moving water shapes the land — eroding, transporting, and depositing sediment as it flows downstream. These processes are constantly at work in every river and stream.

Erosion

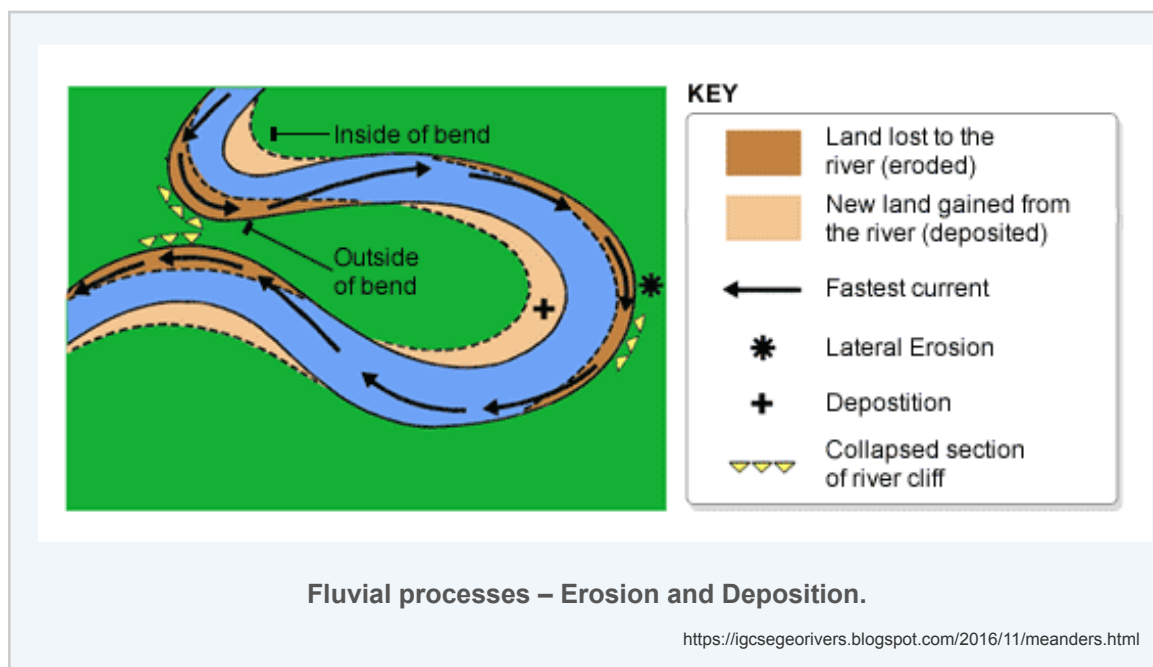
Water wears away riverbanks and streambeds, picking up particles of soil, sand, and rock. Erosion is most powerful on the outside of meander bends, where water moves faster and has more energy. This is why river bends tend to get wider over time.

Transport

Eroded material is carried downstream as sediment load. Larger particles (gravel, sand) roll or bounce along the streambed (bed load), while finer particles like silt and clay are carried suspended in the water (suspended load).

Deposition

When water slows down — at the inside of bends, where rivers widen, or when they reach a lake or ocean — sediment settles out. This builds floodplains, deltas, and sandbars. In NB, the Petitcodiac River is a well-known example of high sediment transport and active fluvial processes.



6. New Brunswick context

New Brunswick's landscape shapes its watershed character in specific ways that are important for Envirothon students to understand.

Terrain and drainage

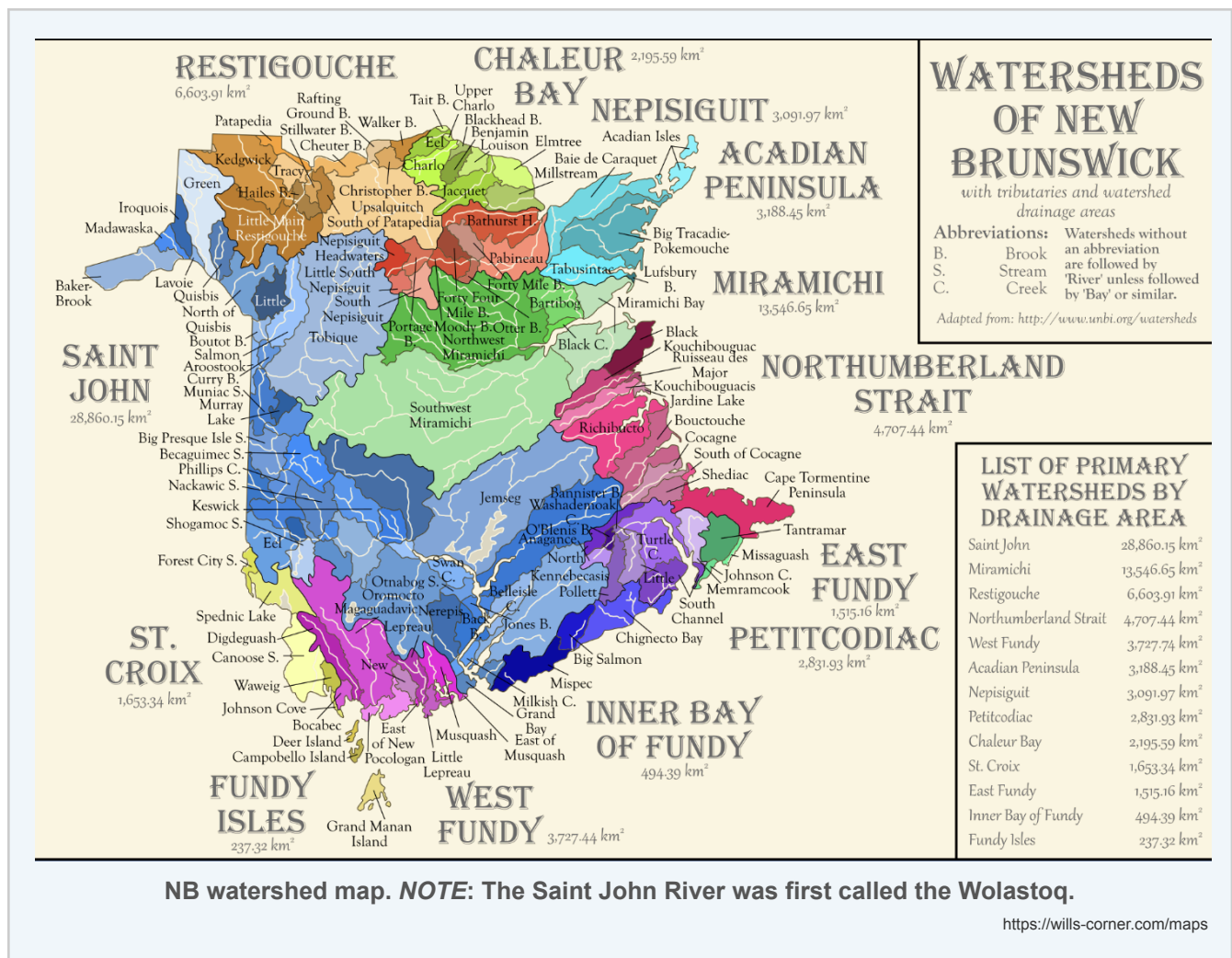
Most of NB has a relatively flat, low-lying terrain with some more prominent slopes in the interior. This means dendritic drainage patterns with meandering watercourses are the most common — rivers wind and loop across the landscape rather than cutting steep gorges.

Key watersheds

Wolastoq (Saint John River)	The longest river in NB and Atlantic Canada. Its large floodplain is home to rare plant communities and is extensively used for agriculture.
Miramichi River	One of the most important Atlantic salmon rivers in the world. Highly sensitive to water temperature and land use changes.
Petitcodiac River	Famous for its tidal bore — one of the largest tides in the world. A restoration success story after dam removal improved fish passage.

BAY OF FUNDY

Many NB rivers drain toward the Bay of Fundy, which has the highest tidal range on Earth — up to 16 metres. This creates unique estuarine and coastal wetland habitats along the southern coast that don't exist anywhere else.



7. Key terms

watershed / catchment An area of land that drains to a single common point; also called a drainage basin.	ridgeline The elevated boundary dividing one watershed from another.
headwaters The upper, source region of a river or stream system.	tributary A stream or river that flows into a larger body of water.
floodplain Flat land adjacent to a river that floods periodically.	estuary Zone where freshwater and saltwater mix at a river's mouth.
evaporation Conversion of liquid water to water vapour by solar energy.	transpiration Water released as vapour through plant leaves.
precipitation Water falling from the atmosphere — rain, snow, sleet, or hail.	infiltration Water soaking into the ground to recharge aquifers.
Strahler method The standard system for classifying stream order based on tributary junctions.	dendritic drainage Tree-like branching drainage pattern; most common in NB.
fluvial processes Erosion, transport, and deposition of sediment by moving water.	aquifer Underground layer of rock or sediment that stores groundwater.

8. Quick check

Test yourself before moving on. Can you answer all of these?

Quick Check — Review Questions

1. What is a watershed and how is it different from a river?
2. Name the five parts of a watershed and describe what happens at each.
3. Trace a water molecule through the full water cycle, starting with evaporation from the ocean.
4. A 2nd-order stream meets a 1st-order stream. What is the stream order downstream? Why?
5. A 3rd-order stream meets another 3rd-order stream. What order forms downstream?
6. Why are headwater streams (1st–3rd order) especially important for biodiversity?
7. BONUS: Which NB river is famous for its tidal bore, and why does it have one?

9. Further resources

- ▶ **What is a Watershed? — USGS** Clear 3-minute explainer with good visuals. Good starter before class. youtube.com/watch?v=oNBnMhEBF9s
- 🌐 **NB Dept. of Environment — Water Resources** Surface water quality data portal, watershed maps, and the NB Water Strategy 2018–2028. gnb.ca/environment
- 🌐 **Petitcodiac Watershed Alliance** Local NB watershed monitoring data, restoration projects, and educational resources. petitcodiac.org
- 📄 **Ducks Unlimited Canada — NB Wetlands** Wetland classification field guide and Atlantic Canada wetland care resources. ducks.ca/places/new-brunswick/
- ▶ **The Water Cycle — National Geographic** Animated overview of all water cycle stages including transpiration and infiltration. *Available on YouTube*

→ **Next:** Module 2: Aquatic Environments & Wetlands