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DON'T FORGET TO RECHARGE YOUR GROUNDWATER! A CASE STUDY FROM THE MURRAY RIVER

Permeability:
Permeability is a measure of how well connected the pores in soil and rock are. Generally groundwater flows through gaps between particles of soil and rock. How well it flows depends on how many gaps there are (porosity) and how well connected the gaps are (permeability). If you were just wearing a T-shirt in the rain it would be considered **permeable** because you would get wet. Your raincoat would be considered **impermeable**.

Aquifer:
A layer of soil or rock with relatively higher porosity and permeability than surrounding layers. This enables usable quantities of water to be extracted from it.

Groundwater Bore:
Tubing which goes into the ground and has a section with holes in it called a "screen" which let's groundwater flow into it. This allows people to observe the groundwater level and pump groundwater for irrigation or to test the chemistry.

Salinity:
A measure of Total dissolved solids (TDS) or Electrical Conductivity (EC) in water. The higher the salt level, the higher the TDS or EC.

Residence time:
Length of time the water has been in the aquifer.

Where does Groundwater come from?

Have you ever dug a hole at the beach or in your backyard and it started filling with water? Where does that water come from? Groundwater, like the water in rivers and streams usually starts with rain. Rain water can soak into the ground like a big sponge if the soil is permeable perhaps has a high sand content, or has cracks the water can get into, but otherwise the water will flow to a creek, river or to drains.

Creek and river flow is an important part of the groundwater cycle because often the banks and river beds have sandy, permeable soil. This means that there can be flow between the surface water and the groundwater.

Figure 1 below shows how river water and stream water can interact with the groundwater depending on the different water levels.

During periods of flood the surface water level is much higher compared to what it normally is. This can cause "gaining streams" (Figure 1A) to become "losing streams" (Figure 1B and 1C). This is another way for groundwater to "recharge".

Recharge of Flood Plains on the Murray River

When a bath overflows what happens? Well obviously water goes everywhere, but if a bathmat is down, this soaks up excess water and stores it. This is similar with floodplain aquifers along the Murray River. Fresh water from flood events and from "losing stream" conditions can be seen in groundwater bores close to the river.

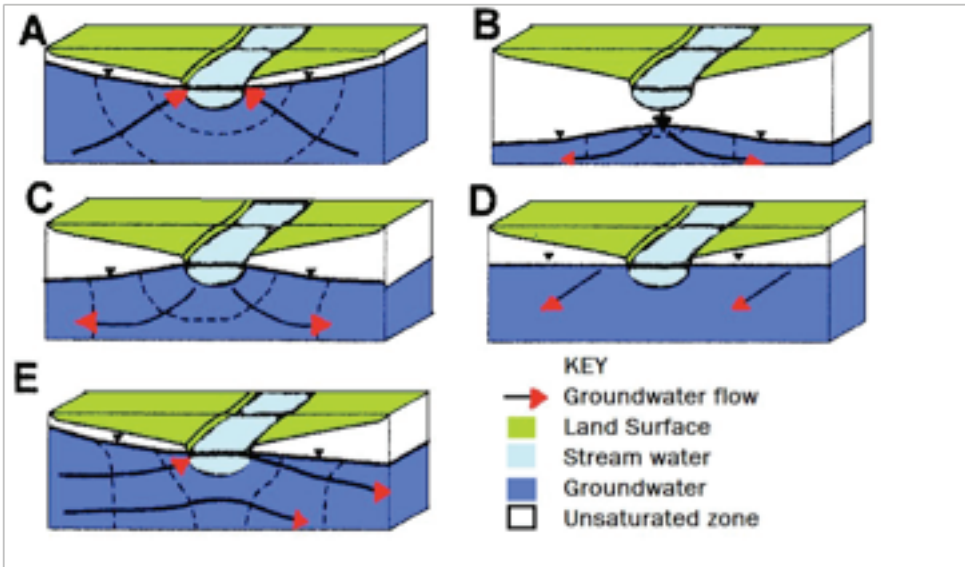

FIGURE 1: A) SHOWS A GAINING STREAM. B) AND C) SHOW LOSING STREAMS WITH C) SHOWING DIRECT INTERACTION WITH THE GROUNDWATER D) SHOWS A STREAM WHERE THE GROUNDWATER FLOW IS PARALLEL TO THE STREAM. E) SHOWS A STREAM WHICH IS FLOWING PERPENDICULAR TO GROUNDWATER FLOW (ADAPTED FROM WOESSNER, 2000)

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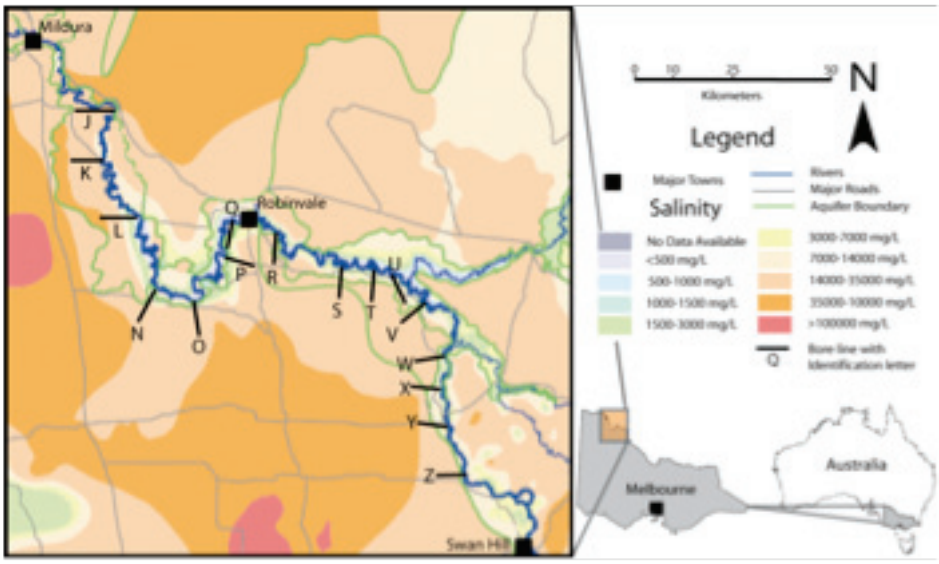

FIGURE 2: THE SALINITY OF THE SHALLOW AQUIFER LOCATED ADJACENT TO THE MURRAY RIVER (AFTER TELFER ET AL., 2006).

BLUE IS FOR FRESH WATER, GREENS FOR BRACKISH (SLIGHTLY SALTY) WATER AND RED IS FOR VERY SALTY WATER

This has a low salinity similar to that of rainwater. The older the groundwater is, the more time it has to dissolve minerals and salts from the soil and rock. Figure 2 shows a section of low salinity groundwater present adjacent to the Murray River.

Going further

Why is fresh groundwater important in this area? What are the biggest industries around this area? What might groundwater be used for?

Hint: look at the salinity values and compare them to those on the Groundwater Beneficial Use website below.
http://vro.dpi.vic.gov.au/dpi/vro/vrosite.nsf pages/water-gw-quality-quantity

How old is Groundwater?

Carbon dating (^{14}C) uses the percentage of modern carbon (pmc) which has been dissolved in the groundwater to determine when the water was recharged. The smaller the pmc value, the older the groundwater. In Figure 3 below, Line J has low pmc values in the deep bores which correspond to recharge around 5-10,000 years ago. This water has a high salinity and long residence time. Line S on the other hand shows high pmc values and low salinity, which means that it has been recharged in the last couple of hundred years.

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Weir:
A low dam build across a river or stream to regulate the flow or raise the level of water up stream.

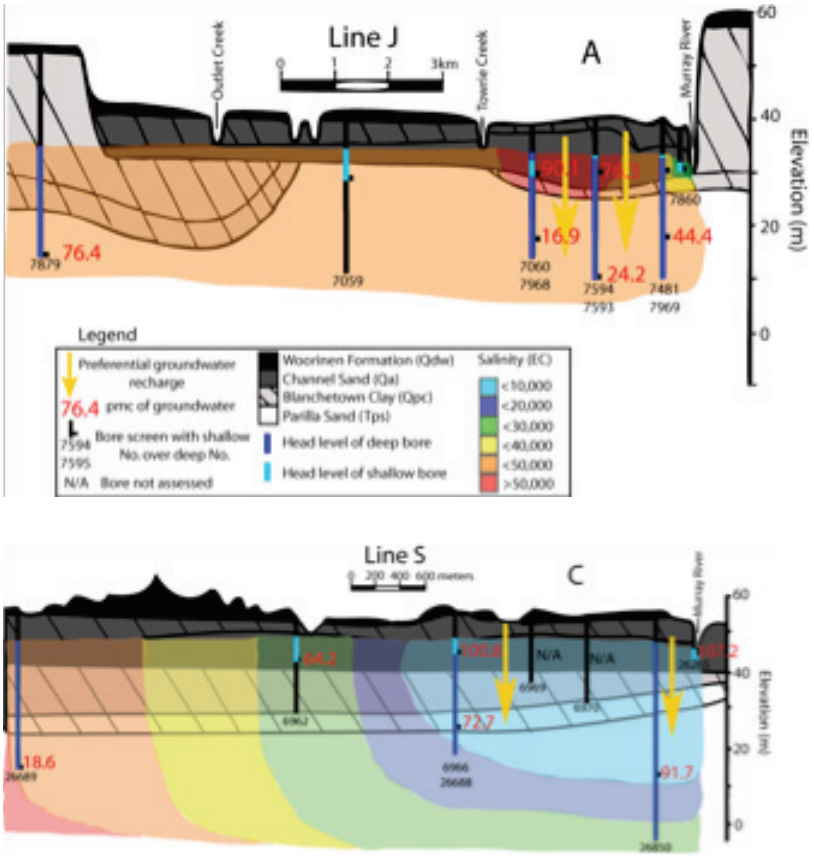

FIGURE 3: THE SALINITY AND PMC AT TWO SECTIONS OF THE SHALLOW AQUIFER (AFTER THORNE ET AL, 1990).

At Line J the Murray is expected to be currently an example of a "gaining stream" where older groundwater with a high salinity is flowing into the river. At Line S the Murray is currently a "losing stream" recharging the Shallow Aquifer.

Since the regulation of the Murray River with weirs, the flow is now highly controlled, which means that flooding events are further apart. Surface water from the Murray River is also in high demand, and this means that the river levels are lower than they have been in the past.

Going Further

From Figure 1 how do you think a "losing stream" might change with a decrease in river water level?
Could groundwater start flowing towards the river?
If the low salinity water is pumped from the Shallow Aquifer for irrigation faster than it can be recharged, is this sustainable or a form of mining?

Many Australian native plants and animals rely on flooding or groundwater for survival. Do some research about how the environment relies on groundwater and discuss how important it is to manage its use?

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