SPATIAL CONNECT

Visualising Victoria's Groundwater

Answers

Part 1: Groundwater, seasons and rainfall

How does groundwater change over space?

1. What is the relationship between the location of bores and depth to water table?

Bores are generally found in locations where the water table is closest to the ground surface.

2. What is the relationship between the location of bores and surface elevation?

Bores are generally found in areas of low elevation.

3. What do questions 1 and 2 tell you about suitable locations for accessing and monitoring groundwater?

Monitoring and accessing groundwater is most suitable in locations of low surface elevation and when the water table is close to the ground surface.

What can you learn from bore data?

1. What do the different coloured bores represent?

Blue - Unmonitored

Orange - Previously monitoring

Pink - Monitored

2. Who is accessing groundwater from unmonitored bores?

Farmers, households for domestic use.

3. What type of bores would a scientist be interested in? Why?

Monitored bores because they give information about the quality and quantity of groundwater.

4. a) Describe (in general) where this bore is located in Victoria? (i.e. North? East? etc). What features are near this bore? (Try turning on the VICMAP and VICMAP - IMAGERY).

Northern Victoria. Water features include the Murray River and the wetlands of the Barmah National Park. Other water features include irrigation channels used by farmers.

b) Are these water features natural occurring or made by people? How can you tell?

The Murray River and the Barmah National Park are naturally occurring but the irrigation channels are not. The irrigation channels are in straight lines and so have been constructed by humans.,

5. Record data for the following:
   - Total bore depth (17.00m)
   - Completion date (1987-07-13)
   - Bore use (Observation i.e. monitored)
   - How often is the bore monitored? (monthly)
6. What does this chart tell you? What is the LHx axis / y axis telling you?

LH Y–axis = 'depth from ground level (m) X-axis = Time. Graph is the depth of the water table over time..

7. As of the last monitoring date, how far underground in the water table?

Page 6- 2018/02/08 – 7.91m. Note – if the student fails to go to page 6, their answer will be …. Page 1 - 1990/01/10 – 4.14)

8. Drinking water has a pH of 7, what is the pH of the groundwater for this bore?

7.1

9. Look at the attached pictures. What colour is the bore?

Blue

Summary

1. Who is likely to use this information? Why might they be interested?

Scientists, farmers and industry professionals are interested in this information to better understand the quality and quantity of groundwater in a particular region.

[redacted]

East of Geelong.

2. When did monitoring start in this location?

31 March 1987

3. Is this bore still being monitored?

Yes

4. For the most recent reading, what is the depth of the water table below the ground surface?

Page 5 →2016/05/10 → 2.01m metres.

5. Did the groundwater ever reach the surface? If so, when?

Yes, 12 October 1992.

6. During which months are there peaks and troughs?

Peak - August, Sept, Oct, Nov

Trough - February, March, April, May

7. How do these peaks and troughs on the graph suggest there is a connection with the seasons?

In summer (February) there is less rainfall to recharge groundwater supply. Therefore, the level of the water table decreases. In Winter (August) there is more rainfall to recharge groundwater supply. Therefore, the level of the groundwater increases.

What are some long-term trends that can be observed in groundwater data?

- Turn on the *depth to water table* and make an estimate using the *legend*. Repeat for the *surface elevation* layer. Write down estimates in the table below.
- Click on the *monitoring* tab to complete the rest of table. When thinking about the trends over time, insert one of the following words in each box:
  - Decline
  - Variable
  - Steady
  - Rapid increase.

Bore ID	Location in Victoria	Depth to water table (m)	Surface elevation (m)	Depth (m) closest to surface (year)	Depth (m) deepest to surface (year)	Difference (m)	Trend up to end of 1999	Trend 2000-2009	Trend 2010-2011	Trend 2012 -present
110706	Near Lake Merdeduke & Winchelsea	<5	50 - 100	-6.17 (1994)	-9.232 (2015)	3.062	Decline	Decline	Rapid increase	Variable
110190	Near Lake Merdeduke	20 - 50	50 - 100	-30.0 (1994)	-33.52 (2016)	3.52	Variable	Decline	Rapid increase	Decline or Variable
110534	Near Lake Merdeduke Mt Hesse & Woady Yaloak Crk	<5	50 - 100	-7.59 (1994)	-10.9 (2016)	3.31	Variable	Decline	Rapid increase	Decline or Variable

1. In which years was the water table at its highest (closest to surface) and lowest (deepest to surface)?

1994

2. Is there a consistent pattern between bores?

Yes

3. Comment on the overall difference in water depth from bore to bore?

The bores are exhibiting a similar decrease in water table level.

4. Overall, do the bores appear to behaving in the same way in terms of their trends and changes?

Yes.

5. Does there appear to be any relationship between the level of rainfall in Victoria and the pattern observed in water table level monitoring of bores? What is this relationship?

From the late 1990s, Victoria was in a major drought lasting until 2009. The low levels of rainfall during this time saw significant decreases in the water table.

6. Looking at the rainfall data for the years 1993 to 2010, how many times was the total annual rainfall below the median annual rainfall?

12

7. What happens to rainfall levels in 2010? How might this relate to your observations of the water table change seen in the monitoring graphs?

Rainfall levels increase in 2010 breaking the 'Millennium drought', coinciding with increases in the water table

- Complete the table below for two different locations in Victoria. When thinking about the trends over time, insert one of the following words in each box:

  i) Decline;

  ii) Variable;

  iii) Steady;

  iv) Rapid increase.

Bore ID	Location in Victoria	Depth to water table (m)	Surfaace elevation (m)	Depth (m) closest to surface (year)	Depth (m) deepest to surface (year)	Difference (m)	Trend up to end of 1999	Trend 2000-2009	Trend 2010-2011	Trend 2012 -present
80238	Molka (Lowana) Clarke Rd, Middle Rd, Warange Basin & Rushworth	5-10	50-200	-10.81 (1990)	-16.335 (2010)	5.525	Steady, Variable or decline	Decline	Rapid increase	Variable or Decline
79930	Eagle Nest Rd, Dandenong Range Nat Park,Silvan Res	5	200	-1.94 (1996)	-6.25 (2009)	4.31	Steady or Variable	Variable or Decline	Rapid increase	Decline or Variable

9. Does the trend of total annual rainfall in relation to the long term median (blue line) appear to match the trend seen in the depth to water table monitoring graphs?

Yes

Summary

1. Based on your analysis, what overall conclusion can you draw about the relationship between rainfall and change in the water table?

There is a clear relationship between groundwater and rainfall. As rainfall changes throughout the seasons, so too does groundwater supply. Similarly, in periods of reduced rainfall (i.e. drought) groundwater supplies in these areas will be impacted reflected in reductions in the water table. Victoria underwent a significant drought from 2000 until 2009 and the impacts of groundwater was experienced across the state.

Part 2: How is groundwater used by people?

Exploring groundwater salinity in Victoria

1. Describe distribution of salinity in groundwater in Victoria.

The salinity of groundwater across Victoria varies across space. In east Victoria, groundwater salinity is lowest relative to west Victoria. In northwest Victoria, groundwater salinity is high reaching levels greater than 35,000 mg/L.

2. In general, in which region is there the highest salinity levels?

Northwest Victoria.

3. In general, in which region is there the lowest salinity levels?

East Victoria along the Victorian Alps.

- Complete the table below.

  a) Use conversion equation (see Introduction) to convert Electrical Conductivity into Total Dissolved Solids, and vice versa.

  b) Refer to the table attached which shows the range of applications suitable for different levels of salinity in groundwater.

Bore	Major Ions	EC (mS/cm)	TDS (mg/L) (calculate?)	Salinity range (from map)	Suitable applications for this groundwater
40629	Magnesium, Potassium, Sodium	66221	42382	> 35,000 mg/L	None (too saline)
110140	Bicarbonate, Magnesium, Potassium, Sodium	13000	8320	7,000 - 13,000 mg/L	Horses, beef cattle
144979	Bicarbonate, Carbonate, Magnesium, Potassium, Sodium	1144	732 mg/L	< 500 mg/L	All crops, humans, textiles, boiler water

4. Based on this table, what application are possible if you were to extract groundwater in this region?

See table.

How is groundwater used in the Mallee?

1. What do you observe about the salinity levels near within this area compared with that of the surrounding region?

There is a small patch of groundwater with low salinity levels compared to the high groundwater salinity levels in the surrounding region.

2. By looking at the satellite image of this area, do you think the salinity levels in this region are natural or influenced by human activity?

Human activity.

3. Describe what do you think has caused groundwater in this small area to become less saline.
   (Hint: In this area, water for agricultural purposes is extracted from the Murray River)

Fresh water (from the Murray River) to irrigate crops has seeped into the groundwater indicating that human activity has changed the groundwater chemistry.

Part 3: Drill your own bore!

All answers to questions are students own and dependent on location chosen.