Investigation of Human Impact on River Ecosystems

Name: _____

School: _____

Date: _____/_____/_____

National Marine Science Centre

This material has been developed as part of the *Australian School Innovation in Science Technology and Mathematics Project* funded by the Australian Government Department of Education, Science and Training as part of *the Boosting Innovation in Science Technology and Mathematics Teaching (BISTMT) Programme*.

Practical Introduction

Clean fresh water is one of our most valuable resources. It is essential for sustaining aquatic environments and their inhabitants, as well as a vital component for human activity. Various human activities can have profound effects on a river ecosystem.

An area which is bound by ridges, hills or mountains from which water drains to a river, stream, lake, wetland or estuary is called a **Catchment**. Water catchments vary in size and makeup.

Water quality of a river or stream, such as water temperature, flow rate, water depth will naturally change as it flows downstream. A catchment can be divided into three zones. The **upper catchment** (ie stream) is characterized as being narrow, shallow and fast moving. The water is cold and clear with a high level of dissolved oxygen. The **lower catchment** (ie. River, estuary, lake) is normally deep and wide and slow moving. The water is warmer and more turbid with lower dissolved oxygen. A large amount of sediment will be deposited in this area. The **Middle catchment** has water characteristics in between the upper and lower catchments.

Pollution can be described as any substance that causes harmful or undesirable changes in the physical, chemical or biological quality of air, water or soil. Pollution can be defined to come from two sources. **Point source** pollution comes from a clearly identifiable source and is easier to manage. **Diffuse pollution** (or non-point source) introduces contaminants from a widespread area and are more difficult to identify and rectify.

We all live within a catchment and our actions have a direct effect on catchment health. Alterations to the catchment upstream will have profound effects on the catchment downstream and will directly affect water quality and river health.

Study Aims

The aim of this study is to investigate the health of a catchment by testing various water quality parameters. A number of sites are visited along the waterway beginning at the top of the catchment and working down through the catchment, stopping at a number of determined sites. At each site, the students and teachers are engaged in a range of activities including water quality monitoring, site and habitat assessment.

- Perform and collect readings for a number of biological and chemical water quality parameters from three sites along a river catchment.
- Record and Graph the water quality parameters from the three sites.
- Compare and interpret the results from the three sites.
- Discuss and draw conclusions from the results.

Practical Equipment

(Per group)

- Field Handout
- Water Quality test kit
- Site and Habitat assessment sheets
- Pencil 2B

Study Methods

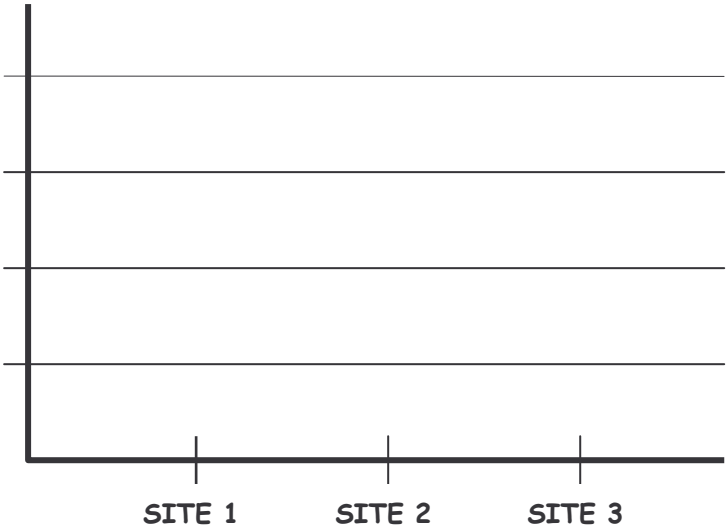
1. Proceed to Site 1
2. Perform Water Quality analysis of parameter assigned to your group.
3. Record and Graph data for Site 1
4. Complete the habitat and site assessment form.
5. Proceed to Site 2
6. Perform Water Quality analysis of parameter assigned to your group.
7. Record and Graph data for Site 2
8. Complete the habitat and site assessment form.
9. Proceed to Site 3
10. Perform Water Quality analysis of parameter assigned to your group.
11. Record and Graph data for Site 3
12. Complete the habitat and site assessment form.
13. Discuss the finding of the three sites and draw any conclusions from these findings.

Dissolved Oxygen (DO)

*measured in ppm

Record Dissolved Oxygen reading for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the Dissolved Oxygen readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

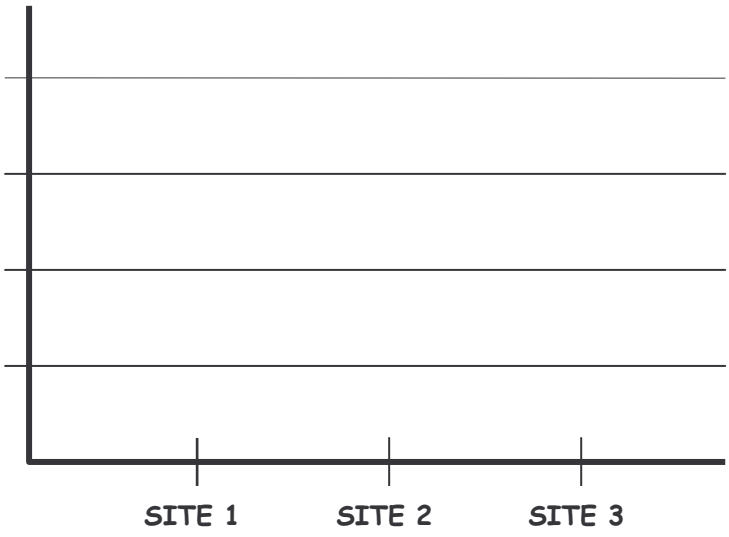
_____

Temperature

*measured in °C

Record the Temperature for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the Temperature readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

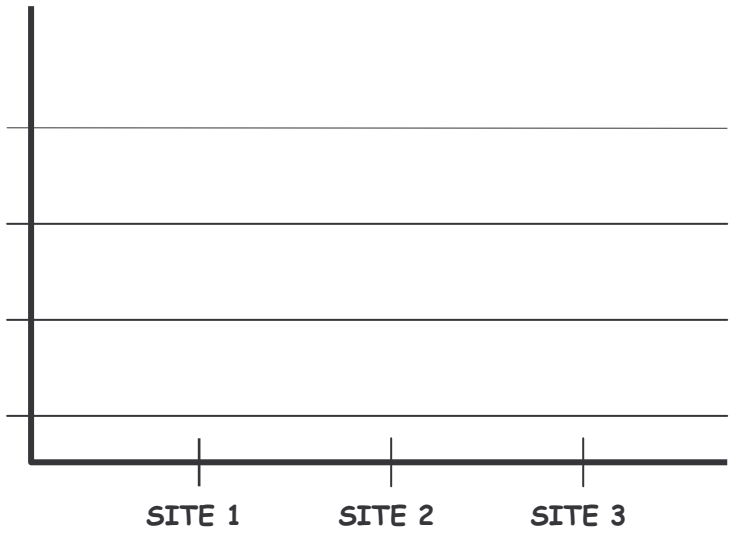
_____

Conductivity (Salinity)

*measured in µs/cm

Record the Conductivity for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the Conductivity readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

_____

_____

EVERYONE CATCHME

1. Forests maintained on steep slopes protect the soil and maintain water quality. National Parks provide wildlife habitats and cater for recreational areas and tourism.

2. The high quality of the water in the storage is maintained because the water has been "filtered" by the forested area. The water is clear and suitable for farm, domestic and industrial use.

3. Pasture should be maintained and conservatively grazed on steep slopes.

4. Contour cultivation and a system of contour banks, waterways and conservation cropping enables the use of land while minimizing soil erosion.

5. Trees maintained along stream banks help prevent stream bank erosion. Strips of trees provide wind breaks to prevent soil erosion, shade and shelter for livestock and wildlife and improve the appearance of the farm.

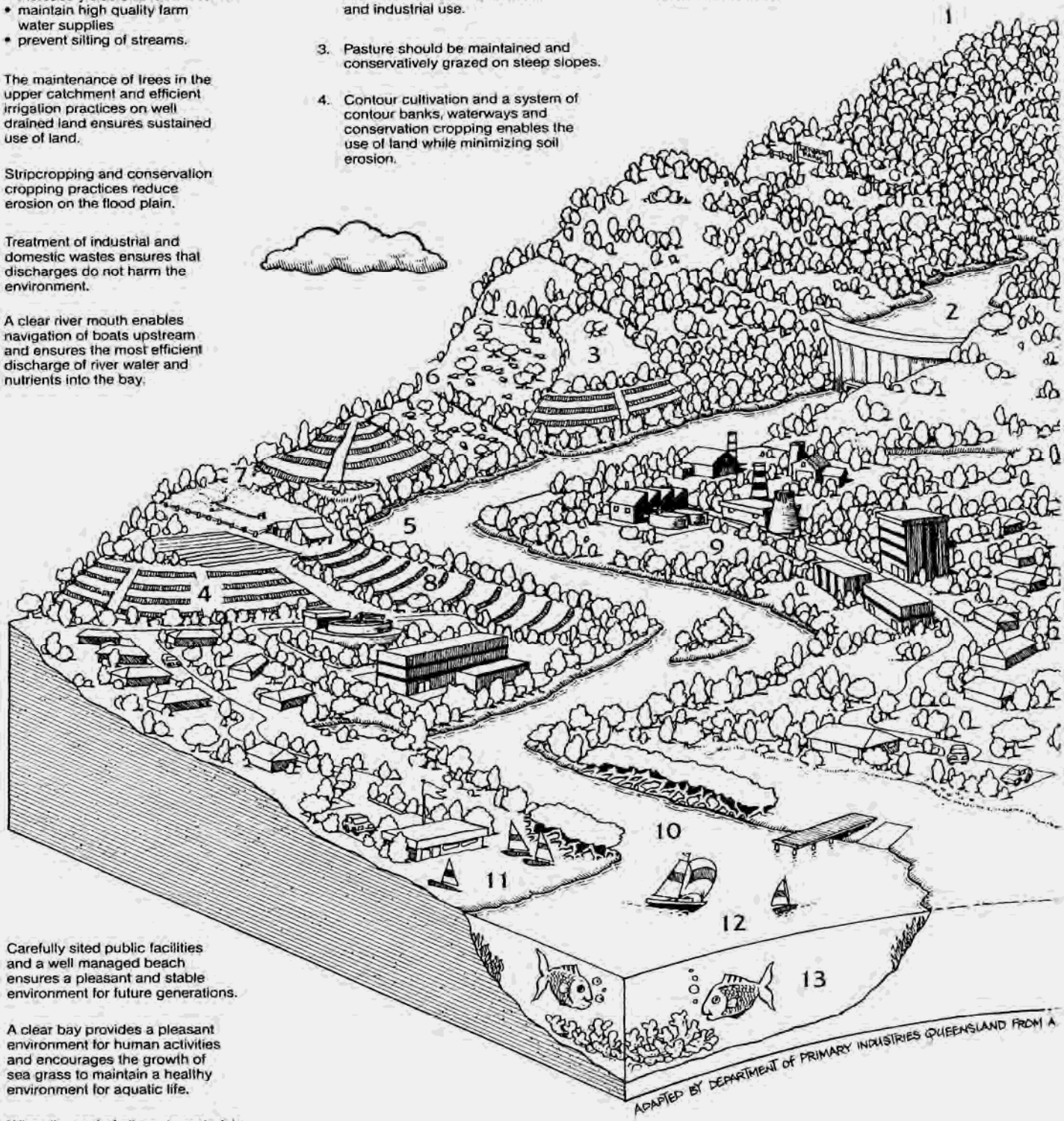
6. Well managed farm land which maintains a good ground cover of trees, grasses or crops helps to
   - minimize erosion
   - increase yields and farm income
   - maintain high quality farm water supplies
   - prevent silting of streams.

7. The maintenance of trees in the upper catchment and efficient irrigation practices on well drained land ensures sustained use of land.

8. Stripcropping and conservation cropping practices reduce erosion on the flood plain.

9. Treatment of industrial and domestic wastes ensures that discharges do not harm the environment.

10. A clear river mouth enables navigation of boats upstream and ensures the most efficient discharge of river water and nutrients into the bay.



11. Carefully sited public facilities and a well managed beach ensures a pleasant and stable environment for future generations.

12. A clear bay provides a pleasant environment for human activities and encourages the growth of sea grass to maintain a healthy environment for aquatic life.

13. Wise disposal of all waste materials allows the reef to prosper naturally and prudent fishing will ensure continued fish stocks.

ADAPTED BY DEPARTMENT OF PRIMARY INDUSTRIES QUEENSLAND FROM A

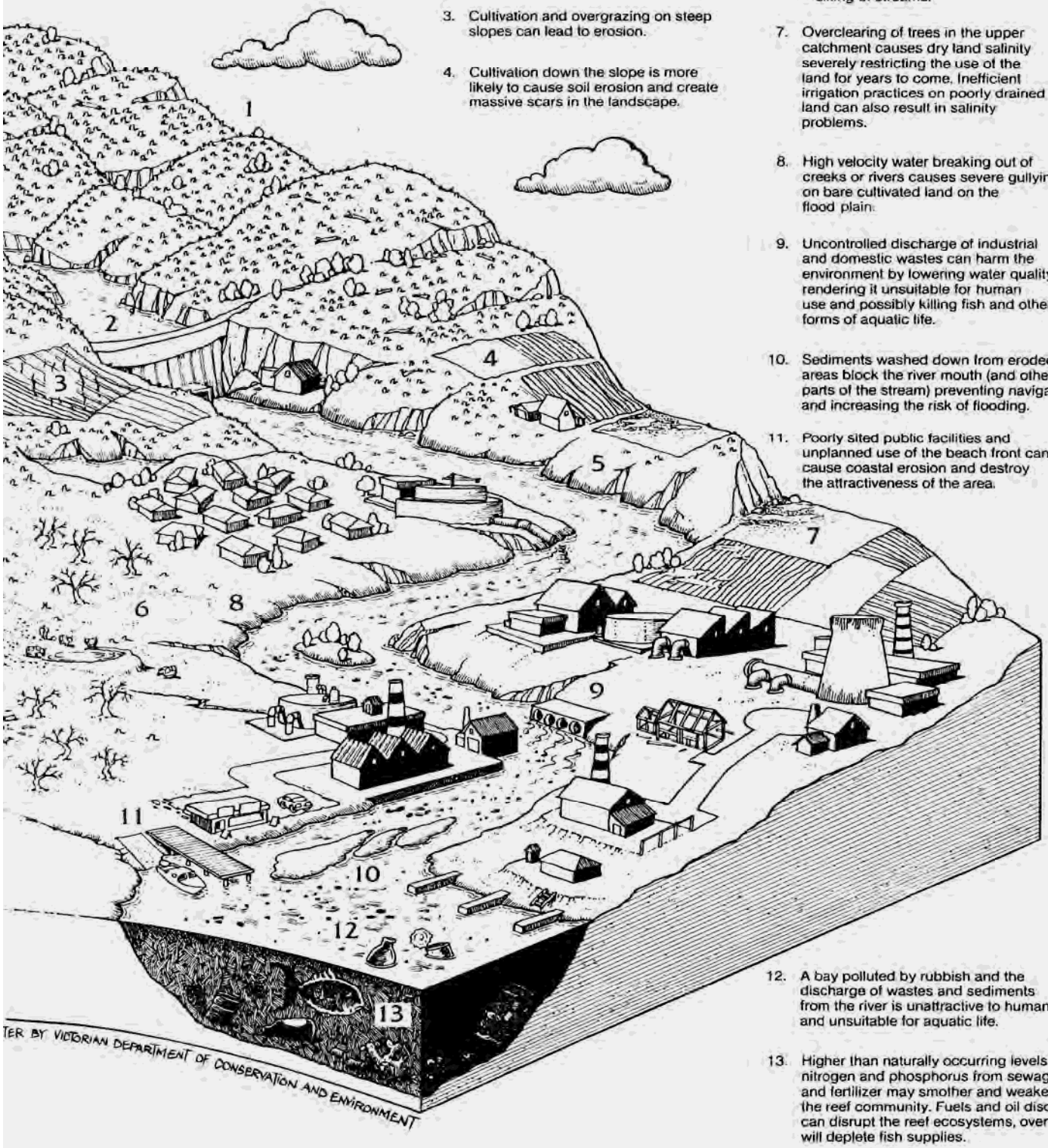
LIVES IN A
ENT AREA

1. Overclearing of forests on steep slopes exposes the land which in turn leads to landslips and erosion of the soil which is eventually washed into the streams.

2. Poor quality dirty water results from soil being washed into the storage from the cleared hills. The storage gradually becomes filled with silt.

3. Cultivation and overgrazing on steep slopes can lead to erosion.

4. Cultivation down the slope is more likely to cause soil erosion and create massive scars in the landscape.



5. When trees are not maintained along stream banks or on farms soil suffers from erosion by water and wind.

6. Poorly maintained farm land contributes to
   - erosion
   - declining yields and farm income
   - deteriorating quality of farm water supplies
   - silting of streams.

7. Overclearing of trees in the upper catchment causes dry land salinity severely restricting the use of the land for years to come. Inefficient irrigation practices on poorly drained land can also result in salinity problems.

8. High velocity water breaking out of creeks or rivers causes severe gullying on bare cultivated land on the flood plain.

9. Uncontrolled discharge of industrial and domestic wastes can harm the environment by lowering water quality rendering it unsuitable for human use and possibly killing fish and other forms of aquatic life.

10. Sediments washed down from eroded areas block the river mouth (and other parts of the stream) preventing navigation and increasing the risk of flooding.

11. Poorly sited public facilities and unplanned use of the beach front can cause coastal erosion and destroy the attractiveness of the area.

12. A bay polluted by rubbish and the discharge of wastes and sediments from the river is unattractive to humans and unsuitable for aquatic life.

13. Higher than naturally occurring levels of nitrogen and phosphorus from sewage, soils and fertilizer may smother and weaken the reef community. Fuels and oil discharge can disrupt the reef ecosystems, overfishing will deplete fish supplies.

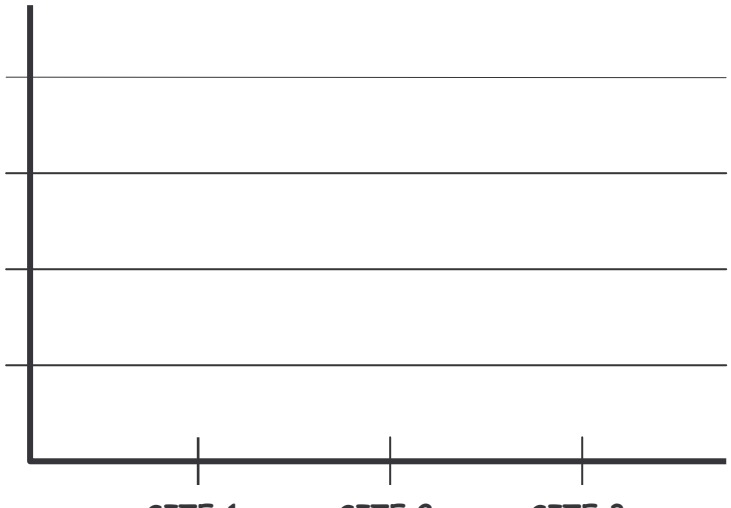
TER BY VICTORIAN DEPARTMENT OF CONSERVATION AND ENVIRONMENT

Water Flow

*measured in m/s

Record the water flow for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the water flow readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

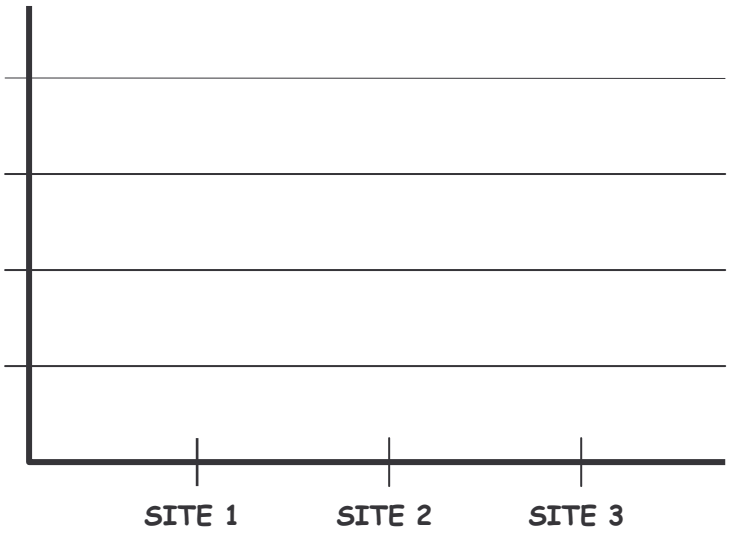
_____

Turbidity

*measured in Nephelometric Turbidity Units (NTU's)

Record the Turbidity for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the Turbidity readings for each site.

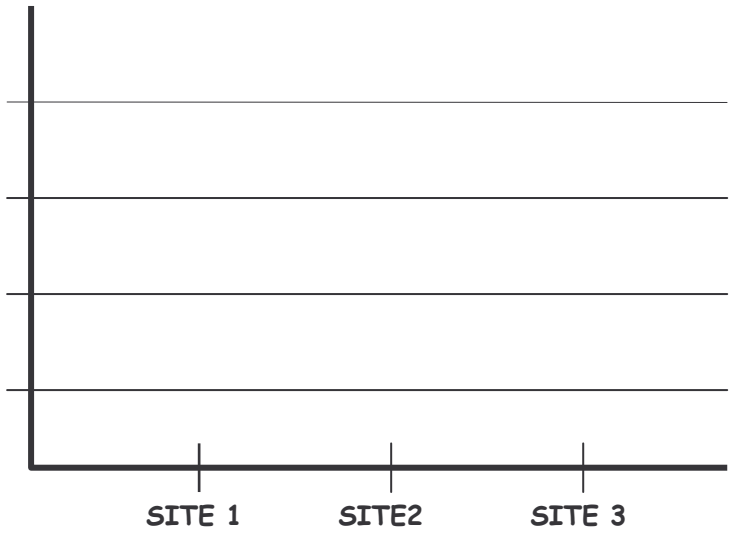


Question: What are the results of your findings?

pH

Record the pH for each site		
SITE 1	**SITE 2**	**Site 3**

Graph the pH readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

_____

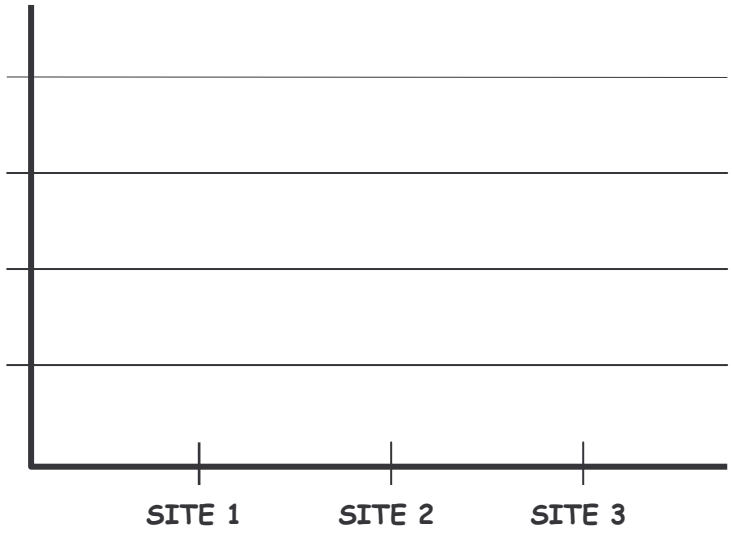
_____

Phosphorus (PO_4)

*measured in mg/l

Record the Phosphorus for each site		
SITE 1	**SITE 2**	**SITE 3**

Graph the Phosphorus readings for each site.



Question: What are the results of your findings?

_____

_____

_____

_____

_____

_____

Extension Questions

1. Did you find any water quality parameters that were outside the trigger values (see water quality guidelines on next page)?

   _____
   _____
   _____
   _____

   If so, what would have been a contributing factor for this reading?

   _____
   _____
   _____
   _____

2. Explain any variation that may have affected your results.

   _____
   _____
   _____
   _____

   How could you minimise this error?

   _____
   _____
   _____
   _____

3. Based on your finding how would you assess the health of this river?

   _____
   _____
   _____

4. What could be done to improve the health of this river?

   _____
   _____
   _____
   _____

The following table includes examples of some of the key water quality indicators and related numerical criteria (default trigger values) selected from the ANZECC 2000 Guidelines, relevant to assessing and monitoring the health of aquatic ecosystems. To use and interpret these guidelines, see the ANZECC 2000 Guidelines. The booklet "Using the ANZECC Guidelines and Water Quality Objectives in NSW" explains key terminology and concepts used in the guidelines, in the context of NSW policy.

Aquatic ecosystems	
Indicator	**Numerical criteria (trigger values)**
Total phosphorus	• Upland rivers: 20 µg/L • Lowland rivers: 25 µg/L for rivers flowing to the coast; 50 µg/L for rivers in the Murray-Darling Basin • Lakes & reservoirs: 10 µg/L • Estuaries: 30 µg/L
Total nitrogen	• Upland rivers: 250 µg/L • Lowland rivers: 350 µg/L for rivers flowing to the coast; 500 µg/L for rivers in the Murray-Darling Basin • Lakes & reservoirs: 350 µg/L • Estuaries: 300µg/L
Turbidity	• Upland rivers: 2–25 NTU • Lowland rivers: 6–50 NTU • Lakes & reservoirs: 1–20 NTU • Estuaries: 0.5–10 NTU
Salinity (electrical conductivity)	• Upland rivers: 30–350 µS/cm • Lowland rivers: 125–2200 µS/cm
Dissolved oxygen	• Upland rivers: 90–110% • Lowland rivers: 85–110% • Freshwater lakes & reservoirs: 90–110% • Estuaries: 80–110% Note: Dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability.
pH	• Upland rivers: 6.5–8.0 • Lowland rivers: 6.5–8.5 • Freshwater lakes & reservoirs: 6.5–8.0 • Estuaries: 7.0–8.5 Changes of more than 0.5 pH units from the natural seasonal maximum or minimum should be investigated.
Temperature	See ANZECC 2000 Guidelines, table 3.3.1.
Biological assessment indicators	This form of assessment directly evaluates whether management goals for ecosystem protection are being achieved (e.g. maintenance of a certain level of species diversity, control of nuisance algae below a certain level, protection of key species, etc). Many potential indicators exist and these may relate to single species, multiple species or whole communities. Recognised protocols using diatoms and algae, macrophytes, macroinvertebrates, and fish populations and/or communities may be used in NSW and interstate (e.g. AusRivAS).

NOTES