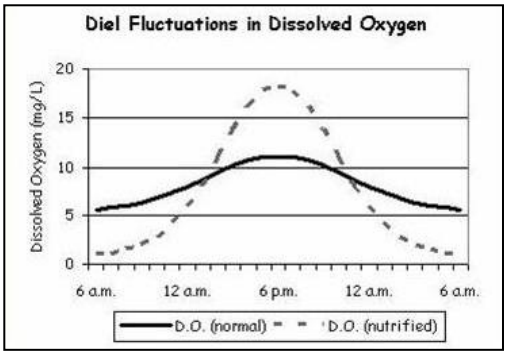
NCF-Envirothon
Sample Aquatic Ecology Test Questions

1. (2 pts) If a biologist took a sample of the stream and found little besides plant-eating fish, what might you suspect is the reason for that?

Either there is a bioaccumulating toxin, like mercury, killing the predators OR there is fertilizer pollution that is causing an overabundance of aquatic vegetation and the ecosystem is skewed toward grazers. (Two points for either of these answers.)

2. (4 pts) Using the diagram below, describe how nutrients cause extreme fluctuations in dissolved oxygen and how this impacts aquatic life.



Nutrients promote aquatic plant and algae growth (1 point), which produce oxygen through photosynthesis during the day (1 point); however, plants decay and use up oxygen at night. Ponds and streams with heavy growth of aquatic plants or algae blooms may experience very low dissolved oxygen levels in the morning (1 point). This impacts aquatic life, especially macroinvertebrates, by shifting communities from pollution- or oxygen-sensitive organisms to more tolerant species (1 point).

3. (5 pts) What are benthic macroinvertebrates, and why are they used as water quality indicators? What equipment is used to collect samples of benthic macroinvertebrates?

Benthic macroinvertebrates are invertebrates that live in benthic environments (bottoms of lakes, rivers, streams and wetlands). They include insect larvae, clams, snails, water mites, sideswimmers, water beetles, nematodes, and tubelaria. Examples: mosquito larvae, mayfly nymphs, etc. (2 points)

We study them because they are sedentary, easy to sample and handle, and numerous (i.e. provide a sufficient sample size for data analysis). Benthic macroinvertebrates are indicators of water quality, as some species are more tolerant to pollution than others. (For example, mosquito larvae are highly pollution tolerant, whereas mayfly larvae are sensitive to pollution.) (2 points)

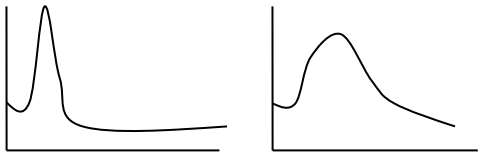
Biologists may use a kick net or a D-frame net for collecting benthic macroinvertebrate samples. For quantitative samples, the Surber sampler may also be used. (1 point)

4. (8pts) Identify the 8 macroinvertebrates in the vials.

1. **___ Mayfly (Ephemeroptera)_____**
2. **___ Stonefly (Plecoptera) _____**
3. **___ Dobsonfly or Hellgrammite (Megaloptera) _____**
4. **___ Amphipod (Amphipoda)_____**
5. **___ Leech (Hirudinea) _____**
6. **___ Water Penny (Coleoptera) _____**
7. **___ Caddisfly (Trichoptera) _____**
8. **___ Cranefly Larva (Diptera) _____**

1 point for each correct identification of common name or order, total of 8 points

5. (5 pts) There are 2 hydrographs below. One of them is an urban hydrograph and one of them is a forested hydrograph. Label each one of them with identification and explain why there is a difference. *Hint: time is on the x axis and water level is on the y axis.*



1st one is urban (1 point for correct identification). 2nd one is forested (1 point for correct identification) Impervious surfaces speed the water to the stream causing a fast peak and then low base flows return quickly since there is less groundwater coming into the stream due to lack of infiltration. (3 points for correct explanation)

6. (5 pts) What kind of response would you see in a stream if the trees in the surrounding area were cleared?

Channel widening and deepening from erosion, less habitat, more runoff, more turbid water, higher stream temperatures, erosion

7. (4 pts) Describe what turbidity is, what causes it (give one example caused by humans and one natural cause), and how increased turbidity affects aquatic species and humans.

Turbidity describes the level of 'murkiness' in water, as a result of sediment (referred to as TSS, total suspended solids). Phytoplankton can cause turbidity in open water, but it can also be caused by clays and silts from shoreline erosion, re-suspended bottom sediments,

and organic material from stream or wastewater discharges. Dredging and channelization within waterways can increase turbidity, as can flooding and increased water flow. Bottom-feeding fish, such as carp can increase turbidity by stirring up sediments from the benthic zone. Increasing the turbidity of waterways can clog the gills of fish and benthic invertebrates and can prevent egg and larval development. People don't like the appearance of turbid waters. Additionally, it is expensive for water treatment plants to remove the sediments and disinfect drinking water supplies.

8. (10 pts) Using the provided equipment (YSI probe), measure the following parameters: temperature, pH, dissolved oxygen, conductivity and salinity. Briefly state why measuring each of these parameters is important.

Measurements will be confirmed before testing (1 point for each correct measurement, and 1 point for each correct explanation – total of 10 points)

Temperature: Water temperature is a physical property expressing how hot or cold water is. Water temperature influences other water parameters, including pH, conductivity, dissolved oxygen, conductivity, and density. Temperature also determines aquatic organisms' metabolic rate and biological activity. At higher water temperatures, more photosynthesis and decomposition occurs. Many aquatic organisms also have a range of tolerance to temperature. For example, brook trout live in cold water streams, and an increase in water temperature as a result of climate change may negatively affect the population of this species.

pH: pH is a measure of the concentration of hydrogen atoms (H+) within a liquid. A high concentration of hydrogen atoms (H+) represents a highly acidic solution, whereas a high concentration of hydroxyl ions (OH-) represents a highly basic (alkaline) solution. A pH of 7 is considered neutral. It is important to measure pH because most aquatic organisms can live within a limited pH range, usually of 6.5 to 9. A change in pH up or down can reduce the survival and reproduction of aquatic organisms. Changes in pH can also change the solubility of nutrients, such as phosphorus. Increased acidity is often caused by an increase in the concentration of carbon dioxide in water. Acid rain is rain with a pH of less than 5, and contains sulfur dioxides and nitrogen oxides released by burning fossil fuels.

Dissolved oxygen: Dissolved oxygen is the amount of oxygen dissolved in the water. Fish, invertebrates, algae, and aquatic plants all require oxygen. If DO becomes too low, then it can limit species existence and survival within water systems. In addition, microbes such as bacteria and fungi require DO to decompose organic matter.

Conductivity: Conductivity is the ability of water to conduct electrical energy. Conductivity is a direct measurement of the concentration of ions present in water, including dissolved salts and inorganic substances, including alkalis, chlorides, sulfides, and carbonate compounds. The conductivity measure increases with increasing quantities of ions present in the water. Conductivity is measured to provide baseline data about the water quality, as it remains relatively stable over time. If a major change occurs within the watercourse,

such as flooding, evaporation or pollution, it can have impacts on the water quality, and this change can be observed as a change in water conductivity. For example, agricultural runoff or sewage leaks increase conductivity because of the chloride, phosphate, and nitrate ions that they release into the water.

Salinity: Salinity is the total concentration of all salts in water. It contributes to the conductivity of the water. Salinity measurements are much higher for saltwater, but freshwater also contains sodium, magnesium, sulfate, calcium, potassium, bicarbonate, and bromine. The geology surrounding the watercourse will often determine the salts present in the water; for example, clayey soils are a source of dissolved salts in the water. Higher measures of salinity increase the density of the water, and haloclines (stratification of water by salinity) can occur along with thermoclines (stratification by temperature). Freshwater fish and other aquatic species have adapted to freshwater systems, so they cannot survive in saltwater (which is highly saline water).

9. (5 pts) Many people enjoy swimming in lakes and rivers in the summer, but sometimes the water can contain high quantities of a biological contaminant. Local health units routinely sample water at the beaches for this parameter. State what this parameter is, and its upper limit at which point it becomes a health concern and the water is considered unsafe for swimming. Explain what might cause the water to contain high levels of this parameter.

1 point for identifying biological containment, 1 for upper limit, 3 for explanation. The beach is routinely tested for *Escherichia coli* (*E. coli*) bacteria. A beach is posted as unsafe for swimming when the count of E. coli bacteria is greater than 100 colony forming units per 100 mL of water (100 cfu/100 mL). Causes of high *E. coli* counts: 1) release of organic waste/sewage into receiving waters (beaches). 2) During heavy storm events, wastewater treatment plants do not have the retention capacity to treat all the incoming water. Overflow is released without treatment, resulting in rising levels of *E. coli*. 3) Old drainage systems have combined storm and sanitary sewer lines. During heavy storms, these overflow and combine, releasing E. coli into waterways.

10. (5 pts) Compare and contrast the differences between lentic and lotic systems. List the major types of water bodies in each system and the biotic and abiotic characteristics of each.

LENTIC: 3 major groups: wetlands, ponds, lakes. Minimal unidirectional water flow. Relatively low oxygen levels. Warmer water temperatures. No current so organisms found in lentic systems do not have the need for adaptive measures to remain in place. Complex and intricate food webs. Thermally stratified.

LOTIC: 2 major groups: streams and rivers. Unidirectional water flow. Higher oxygen levels. Cooler water temperatures. Organisms adapted to protect them from current/to anchor themselves i.e. rooted vegetation (not free-floating), animals have dorsal-ventrally

flattened bodies to be more streamlined, invertebrates grasp to rock or build tube-shaped homes to hide from current. Simpler food webs. Depending on the size of river, lotic systems are not as stratified as lentic systems

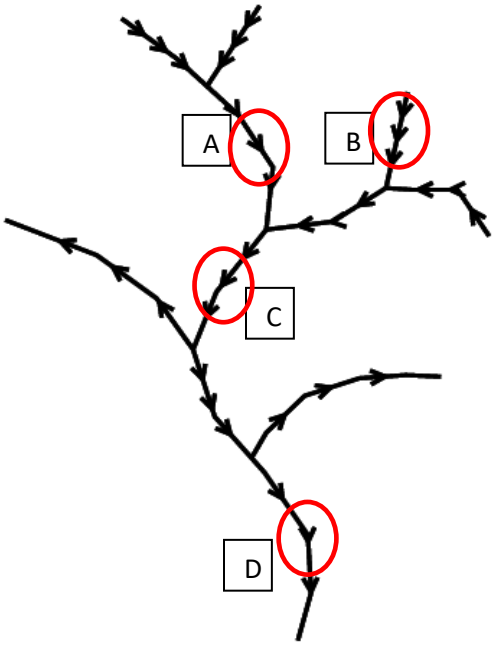
11. (10 pts) Imagine yourself as a rangeland manager tasked with advising landowners on Best Management Practices for this watershed. Use the provided topographic map to:

a. (1 pt) Using 'X' to define the outlet, outline the boundary of the main watershed with a red line.
b. (1 pt) Mark our current location with a red circle.
c. (2 pts)On the contour map, show the expected extent of surface water (the stream network) in the main watershed on a typical summer day using blue pencil line.
d. (3 pts) Using the provided gridded overlay, determine the total area of the watershed. Each cell is ~400,000 ft^2 or 40,000 m^2. Show units.
Watershed area=_____
e. (3 pts) If roughly 1 foot (or 0.3 meter) of total precipitation falls in a typical year (combining rain and snow-water equivalent), what is the total volume (in cubic feet or cubic meters) of water entering our watershed in a year? Show units.

Total volume of input Water = _____

Answers dependent on site

12. (4 pts) Name the stream order of the streams on the picture. Write the correct answer in the blanks below.



A. _____ C. _____

B._____ D. _____

ANSWERS:

a. **Second order**
b. **First order**
c. **Third order**
d. **Third order**

13. (4 pts) Provide <u>two</u> (2) examples point source pollution affecting aquatic ecosystems and <u>two</u> (2) examples of non-point source pollution affecting aquatic ecosystems.

Point source pollution

1)_____
_____

2)_____
_____

Non-point source pollution

1)_____
_____

2)_____
_____

POINT SOURCE POSSIBLE ANSWERS: sewage discharge from a wastewater treatment plant, chemical discharge from a chemical plant (any example that can be traced to its source)

NON-POINT SOURCE POSSIBLE ANSWERS: oil and gas from roadways, fertilizers, pesticides, herbicides, animal waste, sediment, air pollution that combines with water vapor

14. (4 pts) Beavers have remarkable impacts on their environments through building dams. Beaver dams, just like human-built dams, change the environment behind the dam. This change can be positive and/or negative. Provide **two** examples of when and how a beaver dam can be positive and **two** examples where it can be negative.

POSITIVE

- **During times of drought, the ponds provide water for wildlife, livestock, and agricultural irrigation.**
- **Their ponds provide valuable habitat for waterfowl and other wildlife.**
- **Dams help raise and stabilize the water table of the area.**
- **Their ponds help control erosion and sedimentation.**
- **Their ponds can improve water quality by removing excess nutrients, trapping sediment, toxic chemicals, and solid pollutants.**
- **Their ponds often provide abundant recreational opportunities for sportsmen through hunting, fishing, and trapping.**

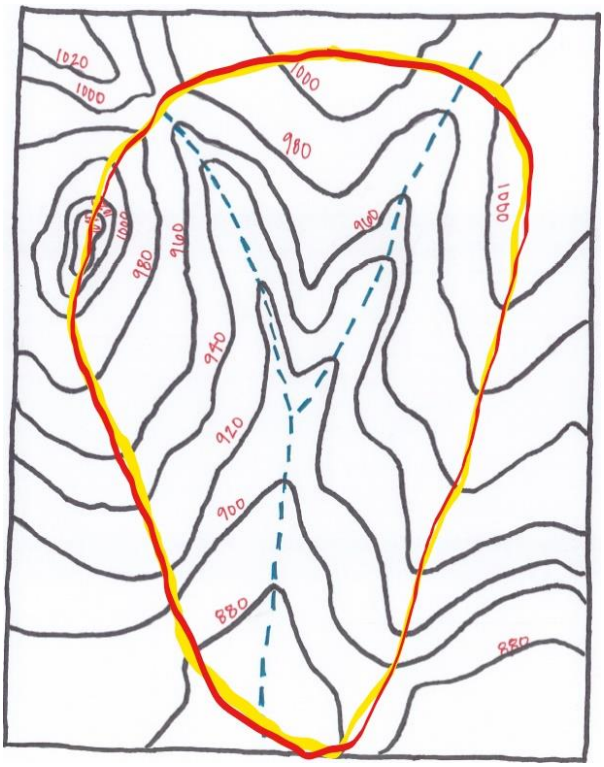
NEGATIVE

- **Dams can block drainage ditches and road culverts, which may cause flooding in agricultural fields and urban and suburban areas.**
- **Dams can flood forested land, which may kill valuable timber.**
- **Dams may also destroy harvestable timber by feeding on the inner bark of trees.**

15. (4 pts) List four (4) functions of forested riparian buffer zones.

1) reduce pollutants and filter runoff, 2) improve air quality and lower ozone levels, 3) maintain stable water flows, 4) help sustain natural channel morphology, 5) help maintain water and air temperature by providing shade, 6) stabilize stream banks, 7) provide most of the organic carbon and nutrients to support aquatic food web, 8) provide sources of large woody debris for the stream channel, 9) help reduce the severity of floods, 10) facilitate the exchange of groundwater and surface water, 11) provide critical wildlife habitat and travel corridors

16. (4 pts) Nicole needs to delineate a watershed for a local farmer. Using this topographic map, delineate this watershed. Draw or Outline the watershed on the map.



Watershed delineation is in red/yellow

17. (4 pts) Besides filtering pollutants, list four other important ecological functions provided by wetlands.

1) help recharge groundwater, 2) cleanse/filter water of debris, sediments and pollutants, 3) control floodwaters, 4) support fisheries, 4) provide habitat for wildlife and waterfowl, 5) sanctuaries for rare and endangered species, 6) provide economic, educational recreational and aesthetic value for people, 7) store excess flood water during times of flooding, 8) sources of water for livestock and 9) crop irrigation

18. (4 pts) Most aquatic life zones can be divided into layers based upon depth. Environmental factors that determine the organisms present in these layers include: List four (4) in the blanks below.

1) Temperature, 2) sunlight, 3) dissolved oxygen, 4) available nutrients, 5) pH

19. (4 pts) Provide **two** (2) examples of animal adaptations (insects included) and **two** (2) examples of plant adaptations that help flora and fauna inhabit fast flowing streams.

Animals	**Plants**
• Many of the insects have flattened bodies that will offer less resistance to the swift current. • Trout and other fish as well as some insects have a streamlined body shape to reduce resistance. • Many aquatic insects live on rock surfaces where friction creates a thin layer of slow current. • Some insects live in small cavities, under rocks, or burrow into tiny crevices or cracks in rocks or logs. • Some insects build their own secure little homes, called casings, made up of sand or pebbles attached by silken threads on the underside of rocks. • The ability to obtain oxygen from dissolved oxygen through gills. • Some creatures live in fountain moss.	• Thread-like filamentous algae are held to rocks by special holdfast cells. • Box-like algae, called diatoms, produce a slimy secretion to stick to rocks. • One form of moss, fountain moss, grows under the crest of miniature waterfalls created by the rocks in a riffle. • Strong roots

20. (5 pts) The Biotic Index is a scale showing the quality of an aquatic environment based on the type of macroinvertebrate organisms living there. Different organisms can tolerate different levels of pollution and so they are good indicators of water quality. Aquatic sampling, keys, and calculations are used to determine the biotic index of an ecosystem. Using the information below, determine the Biotic Index Rating.

You've sampled a section of stream and identified the different species of organisms. You must now record the species found in the appropriate pollution tolerance group. Make sure you total the number of species in each group. Multiply the number in each group by the index value. Add the totals for all three groups to obtain the Biotic Index Value. Report the Biotic Index Rating below. (You **MUST** show your work).

	Group 1: Pollutant Sensitive	Group 2: Semi-tolerant	Group 3: Pollutant tolerant
# Found	**3**	**3**	**1**
X value	X 3	X 2	X 1

Sampling Results:

Dobsonfly larva
Crayfish (adult)
Pouch snail
Stonefly (nymph)
Dragonfly (nymph)
Caddisfly
Whirligig beetles

Totals	**9**	**6**	**1**
Biotic Index Value: **16**			

Cumulative Index Values and Biotic Index Ratings:

23 or more = Excellent

17-22 = Good

11-16 = Fair

0-10 = Poor

Biotic Index Rating: **Fair**