



Where is All of Our Soil Going?

**A Supplement for the
Middle School Curriculum**

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NCDEQ - Land Quality Section

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Erosion & Sediment Word Match Answers

EVALUATION FORM

Teacher and Student Guides for Where is All of Our Soil Going?

Please take a few minutes to fill out this form and send it to the address below. Your constructive criticism will help us improve our educational material and provide you with a better product.

Demographics:	Class/group size:	Grade or age of class/group:	
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Word Match	Did you use it? Yes or No	Circle Rating Poor 1 2 3 4 5 Excellent	Additional Comments:
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Or mail to: Land Quality Section
1612 Mail Service Center
Raleigh, NC 27699-1612

For the Instructor: Intro to Erosion and Sedimentation

1. What is erosion?

Answer: A naturally occurring process, creating streams and rivers. There are two different types of natural erosion, wind and water.

- a. What is wind erosion?

Answer: movement of soil particles by wind

- b. What is water erosion?

Answer: movement of soil particles by water;

2. What is sedimentation?

Answer: Sedimentation is the deposition of soil particles that have been transported by water or wind and is a natural process. Both of these processes can be accelerated by man through everyday activities. Let's first examine the factors that influence erosion.

3. What factors influence erosion?

Answer: Soil characteristics, surface cover, topography, and climate.

- a. What soil characteristics impact erosion and sedimentation?

Answer: Texture, organic material content, soil structure, and permeability.

Review of soil characteristics as they relate to erosion and sedimentation principles:

- i. Texture - sand, silt or clay

Clayey soils bond together so the erosion potential is less. Fine sandy or silty soils are most easily erodible.

- ii. Organic material content

Organic material or humus increases the water holding capacity of a soil, reducing the erosion potential.

- iii. Soil structure - refers to the shape and arrangement of soil particles

A stable, sharp, granular structure resists erosion, absorbs water and promotes plant growth. Compacted or clayey soils have slow rates and high erosion rates.

- iv. Permeability - refers to a soil ability to transmit air and water.

High permeability rates reduce the soils potential for erosion by absorbing the water.

- b. How does surface cover impact erosion?

Answer: A ground cover or surface cover protects the soil from splash erosion and surface erosion by runoff. It provides a rough surface for

runoff to slow velocities and allows greater infiltration, both of which reduce the erosion potential of a soil. Vegetative roots hold soils in place. While impervious areas such as paved roads, parking lots and roofs protect the soil surface they are covering, they don't allow infiltration. Impervious areas increase runoff and increase the erosion potential downstream.

- c. How does Topography impact Erosion?

Answer: The size and the shape of the watershed affect the erodibility of soils. Slope length and steepness affect runoff velocities and, therefore, the erosion potential.

- d. How does Climate Impact erosion?

Answer: The frequency, intensity and duration of rainfall are factors that affect infiltration, runoff and the erosion potential of a soil. For example, a rainfall event that produces 2 inches of rain in 10 minutes will have a higher rate of runoff and erosion than a rainfall event that produces 2 inches of rain in 24 hours.

Optional Activity *Enviroscape demonstration*

Optional Activity *Travel to an eroded intermittent branch. *

4. How do we reduce the erosion potential?

Answer: Focus on the factor that CAN be changed: Surface cover.

The best and most economical way to halt erosion is to provide a ground cover to protect the soil. You can't change the climate. You could change the topography by grading the land. You could change the soil characteristics by amending the soil with organic matter or another soil type. However, doing those activities would require extensive land work and could potentially increase the erosion rate by further disturbing the soil.

5. How do we reduce sedimentation

Answer: Sedimentation occurs after erosion takes place. Stopping erosion will halt sedimentation. But when the soil surface MUST be disturbed, accelerated erosion can be controlled and sedimentation prevented. Let's look at how sedimentation works.

- a. What are the mechanics of sedimentation?

Answer: Some of the soil that enters a flowing creek continues to move along with the current of the stream. Heavier or larger soil particles, such as sands, move along the bottom and settle out onto the bottom quicker than smaller soil particles, such as clays. Clay particles are very fine and will stay in suspension longer than other soils. Soil in suspension in the water cause turbid (or muddy) water. Given enough time once the water

has stopped flowing, though, clay will settle out. Given this information, let's discuss problems associated with sedimentation.

b. Why is sedimentation a concern?

Answer: Flooding, habitat loss, fish kills, increased consumer costs.

i. Flooding

Sediment in creeks, rivers and lakes can fill in these structures, providing less room for water movement. For example, if a creek was 3 feet deep and filled in one foot on the bottom with sediment, only a 2-foot deep creek would be available for handling water. If the water can no longer flow through the creek, it will spill out onto the banks and cause flooding. The creek is no longer able to handle the same amount of water flowing through it.

ii. Habitat loss

Many small amphibians and fish live on the bottoms of ponds and creeks in cracks and crevices between rocks, limbs and other structures. As sediment settles on the bottom of a pond or creek, it fills in these places. The rocky bottom is then covered with a smooth layer of sediment.

iii. Fish kills

Also, fish lay their eggs in beds on the pond floor as well. Sediment covers the eggs and smothers them. As we saw earlier, when soil enters a waterbody some of it can stay in suspension. Clayey soils stay in suspension longer than sandy soils. The soil in suspension makes the water look "muddy," dark colored, or turbid.

All plants need sunlight for photosynthesis to produce food for the plant. In turn, the photosynthesis process creates oxygen that the fish need. If the sunlight cannot penetrate the turbid water to reach the plants, the plants cannot photosynthesize and there is less available oxygen in the water for the fish. Finally, sediments can clog the gills of fish and other aquatic amphibians, making it more difficult for them to take up oxygen. The delicate balance of the pond or creek is altered, and fish are killed.

iv. Increased consumer costs

For us as consumers, we see an increase in the cost of our drinking water. Water loaded with sediments must be to remove those sediments before we can drink it. Sediments can also increase the costs of cogeneration (producing electricity) and irrigation.

Optional Activity *turbidity demo with jars and soil*

Collect various soil textures and mix with water in a jar to demonstrate the varying times for soil particles to settle on bottom.

6. The Sedimentation Pollution Control Act

The Sedimentation Pollution Control Act was passed as a law in 1973. It requires sites to control erosion and keep off-site sedimentation from occurring. The SPCA also requires:

- a. That sediment be retained on your site;
- b. Approved sediment and erosion control plans for sites disturbing more than 1 acre;
- c. 25-foot-wide buffers along trout streams;
- d. Stabilized slopes; and
- e. That erosion and sediment control measures will be installed and the land stabilized after grading is complete.

7. Erosion and Sediment Plan

The Erosion and Sediment Control Plan

We will be designing an erosion and sediment control plan for McDonalds Restaurant. Before designing that plan, though, we will talk about how to read maps.

8. Contours and Flow Direction

- a. What are topographic maps and contour lines?

Answer: A topographic map, topo map, uses contour lines to show elevations, or height above sea level. Contour lines join points of equal elevation above a specific reference, such as sea level. Think of a contour line as an imaginary line on the ground that takes any path necessary to maintain a constant elevation.

Topo maps show hills, valleys, lakes and other waterbodies. They also show roads, buildings and towns.

- b. How are topo maps used?

Answer: Outdoor enthusiasts, such as hikers, use topo maps for direction, locations of streams and hills. Builders and developers use them to lay out roads, buildings and other developments.

- c. How do you determine flow direction?

Answer: Water ALWAYS flows downhill. So if you can identify elevations on the topo map, specifically the high points and low points, you can find out which way the water from a storm will flow.

9. The erosion and sediment control plan

The plan encompasses more than just the drawing. It also includes a construction sequence, vegetation plan, design calculations and detail drawings.

a. Construction Sequence

Erosion and Sediment measures should be installed as trees are being cut and right before the ground has been disturbed. These measures should be installed BEFORE the site is graded. Measures should be installed from the lowest points to the highest points to prevent offsite sedimentation from occurring.

Once construction begins, the measures must be maintained until the site has been stabilized with a permanent ground cover. After each rain storm, the measures should be inspected, sediment removed and repaired, if needed. Any sediment removed from the measures needs to be spread over the site above the measures.

Once the construction is finished, the surrounding disturbed areas have to be stabilized. In most cases, the soil is stabilized with grass or is landscaped. The site is not complete until the site has a good stand of grass or has been stabilized permanently.

b. Vegetative Plan

The vegetative plan covers the types of grass that will be planted at the site. In NC, fescue is grown most though it is not best suited for this area. It is a cool season grass, meaning it grows best when the weather is cooler. Fescue goes dormant in the hot summer months, but it stays green all winter long. The grasses best suited for Raleigh and eastern areas are warm season grasses, such as bermuda and zoysia. These grasses grow best in hot weather. However, they go dormant in the winter and turn brown.

The vegetative plan also tells the contractor how much fertilizer, lime and seed to apply per acre. The lime and fertilizer are tilled into the soil to aid the grass in getting established. After the seed has been applied, straw mulch is spread on top to preserve soil moisture, reduce the rain erosion potential and to keep the seed from washing away. The vegetative plan notes how much mulch must be spread.

Developing the Erosion and Sedimentation Plan (ESCP)

Notes: The ESCP explains and defines the proposed project. This plan must be filed with state and local governments in order to obtain the proper permits to begin construction. This process insures that efforts to control erosion and sedimentation are well planned

and sufficient for the project before construction begins. Students will complete an ESCP for a project and will see firsthand how information is collected. Divide your class into teams of 3 to 4 students and have them complete this exercise.

Optional Activity: *Matching Worksheet*

Activity: *Erosion and Sediment Control Plan *

For Additional Information on Erosion and Sedimentation Control,

Visit NC Department of Environmental Quality Website:

[NC DEQ Erosion and Sediment Control](#)

Or contact the current Sediment Education Engineer/Specialist:

[DEQ DEMLR Contact Information](#)

Sediment Education Engineer/Specialist

Land Quality Section

1612 Mail Service Center

Raleigh, NC 27699-1612

Part # 1 The Narrative

The first part of this plan is the narrative. The narrative provides a written description of the project, site, adjacent property, soils and planned erosion and sedimentation control practices. Carefully read the narrative below. In the blanks provided select the best word to complete the paragraph. Each word will be used only once.

bottom
eroded
flooding
sediment
fence
Guilford
pond
pine
sloping
control
acre

Project Description

The purpose of the project is to construct a McDonalds fast-food restaurant with associated paved roads and parking lots. Approximately one acre will be disturbed during this construction period. The site is located within the city limits of Greensboro in Guilford County.

Site Description

The site has gently sloping topography. The site is now covered with grasses and the surrounding area is covered by a stand of mixed hardwood and pine trees 25 to 80 feet tall.

Soils

The soil in the construction zone is clay with some sandy loam mixed in. This soil type is fairly easily eroded, especially with the steep slopes involved with this project. Steps will be taken to ensure that erosion control measures will be effectively installed and that a groundcover is established as soon as possible.

Planned Erosion and Sedimentation Control Practices

1. *Grass-lined Channel* - This channel is lined by vegetation and is designed to convey runoff water without damaging the area, flooding or depositing sediment in

inappropriate areas. This practice is used along roadsides, property boundaries and for drainage in low-lying areas.

2. *Sediment Basin* -

A basin or pond that is strategically located to catch water runoff and is used to prevent sedimentation in off-site streams, lakes and drainage ways. The pond will collect water that contains a high concentration of sediment and will store the water until the sediment is able to drop out and concentrate in one area versus contaminating other waterways.

3. *Sediment Fence* -

This is a fence composed of a filter fabric that is buried at the bottom in the soil and then stretched and supported by posts. It is used to retain sediment from small disturbed areas by reducing the velocity of sheet erosion. This allows the sediment to build up behind the fence. When necessary, the sediment is disposed of properly by distributing the soil over a land area.

Part # 2 Construction Schedule

The construction schedule establishes a plan for the sequence of events to take place during a construction phase of the project. Below are five steps of a construction schedule. Read each step carefully, determine the proper series of events and label them accordingly, the first step being #1 and the last #5.

_____ **5** _____ Remove temporary erosion control measures.



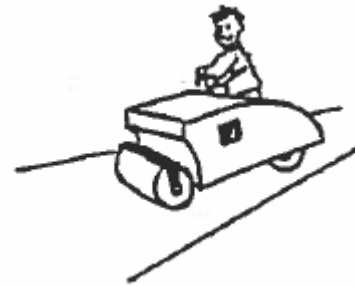
_____ **1** _____ Create and submit ESCP to obtain plan approval and other applicable permits.



_____ **3** _____ Clear vegetation to begin construction.



_____ **4** _____ Pave roads and parking lots after construction of building is complete.



_____ **2** _____ Install sediment basin as first construction activity.



Part # 3 Maintenance Plan

The maintenance plan explains how the erosion and sediment control measures are going to be checked and fixed if they are not working properly. If a sediment basin fills up with sediment, then they must be cleaned out to work properly.

The following is an example of a maintenance plan. Read it carefully and then answer the questions.

1. All erosion and sedimentation control measures must be checked after every rainfall that is heavy enough to produce runoff. Even if there is no heavy rainfall, the structures must be checked at least once a week. Any repairs that are needed must be done immediately to maintain erosion control.

2. The sediment basin will be cleaned out when the level of sediment reaches 2 feet below the top of the riser. If the sediment basin does not drain properly, then the gravel will be cleaned or replaced.

3. Sediment will be removed from the sediment trap and inlet protection device when the storage capacity is half filled.

4. Sediment will be removed from behind the sediment fence when it becomes about 0.5 feet deep at the fence. The sediment fence will be repaired as necessary.

5. All seeded areas will be fertilized, reseeded as necessary, and mulched to maintain a vegetative cover.

It is scheduled that each Monday morning the control structures are checked to make sure they are working properly.

On Wednesday there is a two-hour downpour that produces some runoff.

On Friday there is a light sprinkling of rain that lasts 15 minutes.

a. During this week, how many times do you need to check your control structures? Why?

Two Times. Once on Monday because that is the date of your scheduled maintenance and once on Wednesday (after the storm) because of the 2 hour downpour; it is not necessary to check on Friday because it was only a light sprinkle.

b. What must be done if the sediment basin stops draining properly?

The gravel will be cleaned or replaced.

c. You must remove the sediment behind the sediment fence when it is 0.5 feet deep.

Part # 4 Vicinity Map

The vicinity map shows what lies in the area of the proposed construction project. Study the map and then answer the questions below.

What is the closest road intersection to the construction site?

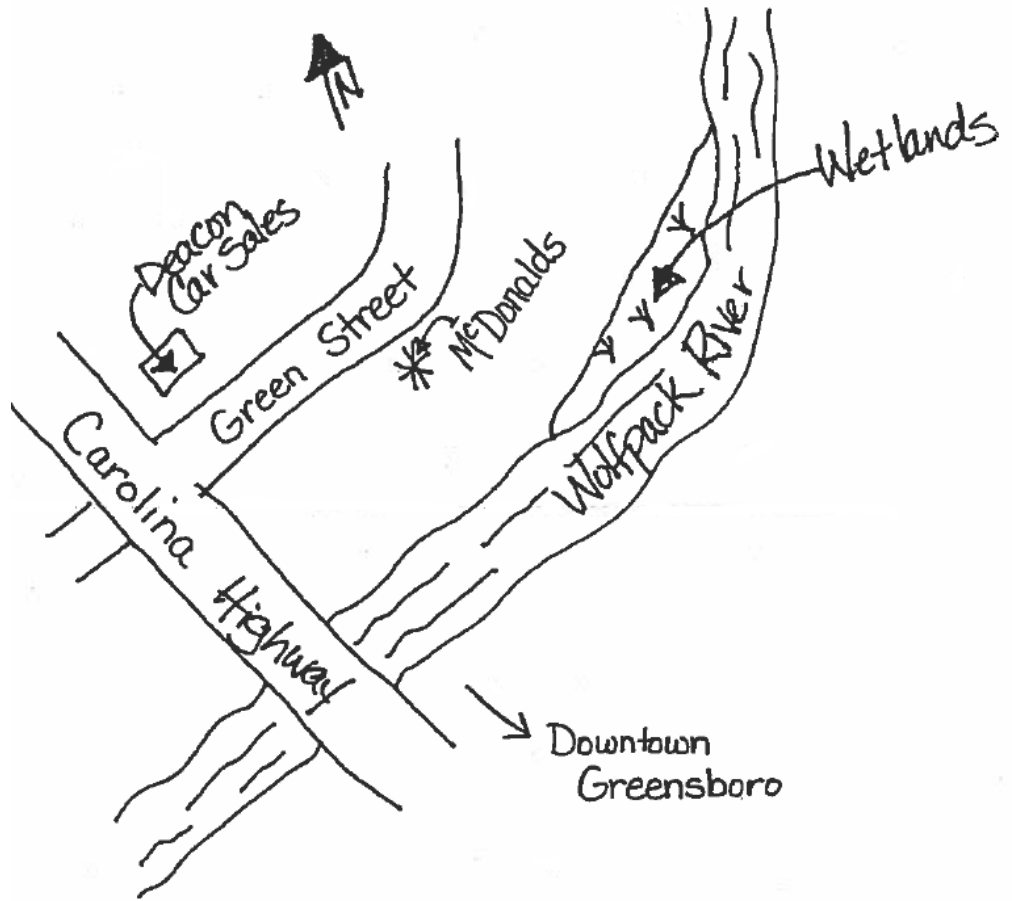
Carolina Highway and Green Street

What water source is most likely to be impacted by the new construction?

Wolfpack River

What is the closest city to the construction site?

Greensboro



Location Map for the proposed
McDonalds Restaurant

Part # 5 Site Topo Map & Development Plan

There are many different types of maps. Maps are used to depict an area through symbols and lines and words. A street map is familiar to most people and the type of map used most often to navigate through city. However, a street map would be of no use in an area with no roads or towns. A **topography (topo) map** uses the shape of the land and the natural contours of slopes and valleys to depict an area. Look at the enclosed map. The topo map has features similar to a street map, such as a legend which tells the meaning of the symbols used in the map, a scale and a north arrow. Instead of streets, a topo map uses contour lines to define the lay of the land. Contour lines tell how many feet above sea level a point is. Each contour line represents a set amount of feet. On the map provided each line represents two feet.

Therefore, there is a two-foot difference, higher or lower,

between each set of lines.

1. Locate the highest point on the map. Place a dot on your map to show this point.
2. Locate the lowest point and mark it with a "*" on your map.

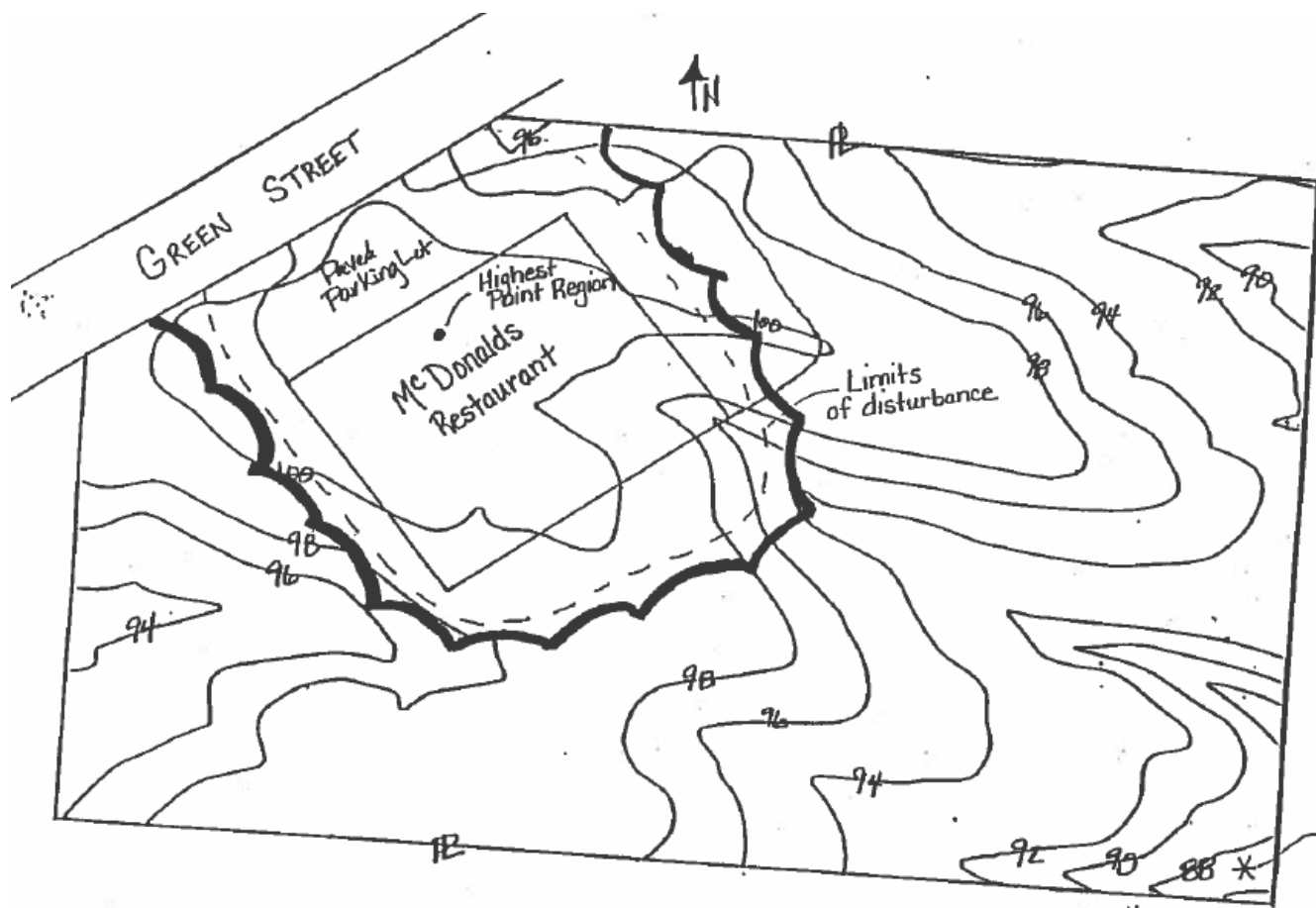
The **Site Development Plan** utilizes a topo map to show how a building or parking lot will fit with the landscape. The map enclosed is a plan of a McDonalds restaurant which could be built on the land represented by the topo map. The plan helps the contractor see how much land will be disturbed by the building, if the building will fit on the property, and how the building and parking lots will lie in reference to the shape of the land.

1. Given the property boundaries and the tree line, with a colored pen mark the limits of disturbance or construction limits. This barrier will become the area within which the soil will be disturbed

and where control measures will need to be constructed.

2. Each time something is added to the map the legend should be updated with the correct symbol and label.

****See map key for answers to part 5****



Proposed Development Plan for McDonald's

Legend:

- ▭ Property Line
- ~ tree line
- - - construction limits

* KEY *

Scale:

1 inch = 50 feet

Part # 6 The Erosion and Sedimentation Control Plan

The Sediment and Erosion Plan once again builds upon the topo map and the Site Development Plan to define the sediment and erosion control structures necessary to stabilize the soil. Using the control measures shown below, place a symbol in the box on the map where the measure should be located. Work with your team to place the control measures in the best location to control erosion and sedimentation!

XXXX Silt Fence

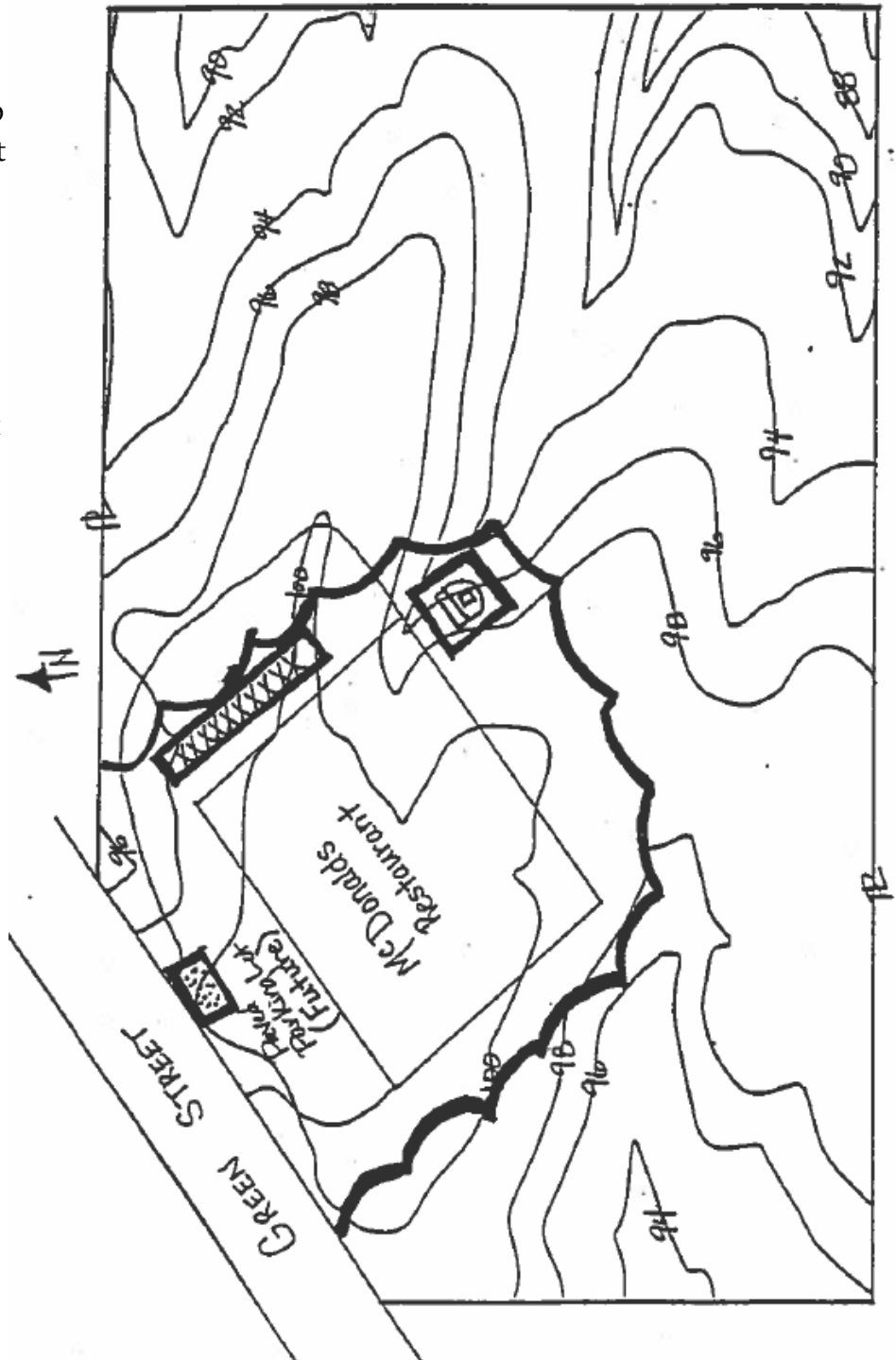


Sediment Basin

Bonus:



Rock (Riprap)



EROSION & SEDIMENTATION WORD MATCH



Directions: Write the letter of the word's definition next to the word



Words

Definitions

- | | |
|-------------------------|---|
| <u>M</u> Water Body | a. water cannot infiltrate into the soil |
| <u>N</u> Contour | b. when soil stays suspended in the water, making it “muddy” |
| <u>C</u> Sediment | c. soil that reaches waterways or other property by erosion |
| <u>H</u> Runoff | d. Sediment in our rivers and streams is water _____ |
| <u>O</u> Sand | e. Applied after an area has been seeded |
| <u>K</u> Climate | f. The most natural and best erosion control practice |
| <u>I</u> Sediment Basin | g. The movement of soil by wind, water, or gravity |
| <u>A</u> Impervious | h. Water from storms that flows across the land surface |
| <u>B</u> Turbidity | i. Used to keep sediment from leaving a construction site |
| <u>D</u> Pollution | j. An Erosion & Sediment Control plan is required when one or more acres are _____ |
| <u>E</u> Mulch | k. Determines the amount of rainfall an area will get, and how warm an area will be |
| <u>G</u> Erosion | l. Type of small, fine soil particles |
| <u>F</u> Grass | m. Stream, creek, river, pond, or lake |
| <u>J</u> Disturbed | n. Topographic maps show _____ lines to represent elevations. |
| <u>L</u> Clay | o. Type of large, granular particles |