Name:_____Date:_____Period:_____

PROJECT-BASED LEARNING:
DESIGN AND BUILD A RAIN GARDEN
Part 2: Site Investigation and Inventory

Activity B - Calculate Catchment Area Runoff and Determine Rain Garden Size

As a class, you will determine which method, process 1 or 2, to use to calculate the amount of runoff your rain garden will need to handle. Then follow the appropriate steps below. The catchment area is defined as the area that will contribute stormwater runoff to your rain garden. After determining catchment area, move to page 3 and calculate the catchment area runoff in order to determine the optimal rain garden size.

I. Determine Catchment Area (choose process 1 or 2)

Process 1, Field Measurements Method
Use this handout or your notebook to make your calculations.

1. Visit the project site and determine the dimensions of the catchment area that will contribute rainwater to your future rain garden. Measure the perimeter of the catchment area in feet. Sketch the approximate outline of the catchment area below and indicate the length of each side on your sketch.

2. Calculate the area.

   If the area is rectangular, multiply the **length by the width** to get the total square footage of your area.

   If the area is not rectangular, you may have to break it down into manageable rectangles and triangles in your sketch.

   a. Record the measurements of the perimeter of each of these polygons. Determine the area of each polygon. If you can't remember how to find the area of different polygons consult this website https://www.mathsisfun.com/area.html for help.

   b. Calculate the combined area of all of these polygons by adding them together to determine the total catchment area.

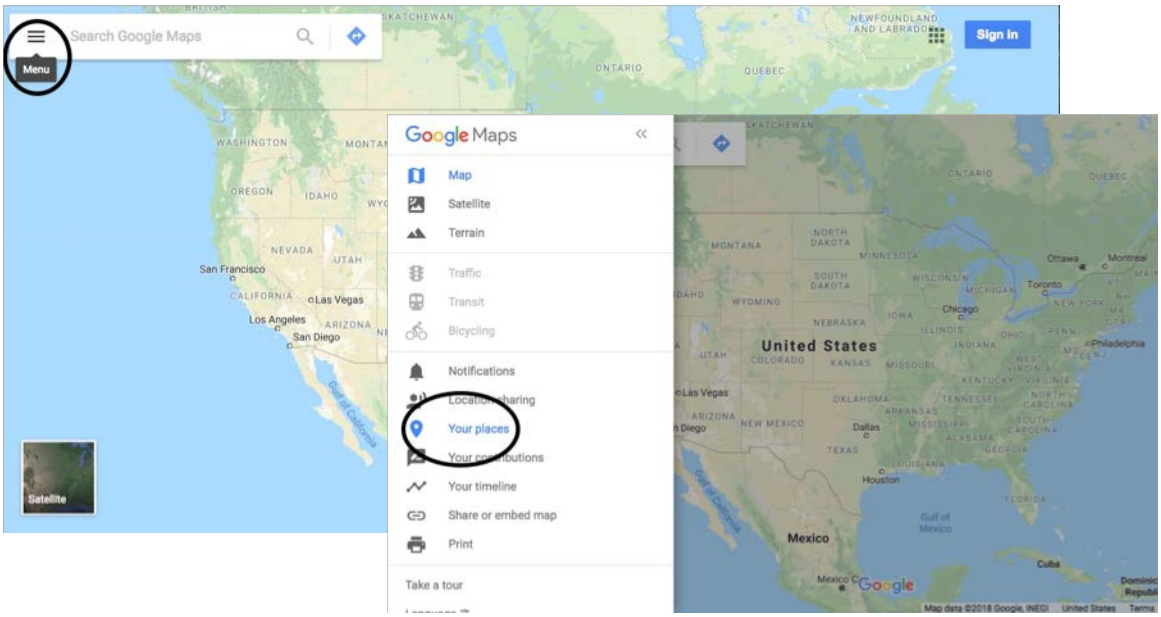
Record the catchment area here: _____ square feet

Process 2, Google Maps Method:

1. Create a Google account or use an existing Google account and go to https://www.google.com/maps/

2. Select the "menu" option in the upper left-hand corner of the Google Maps page.

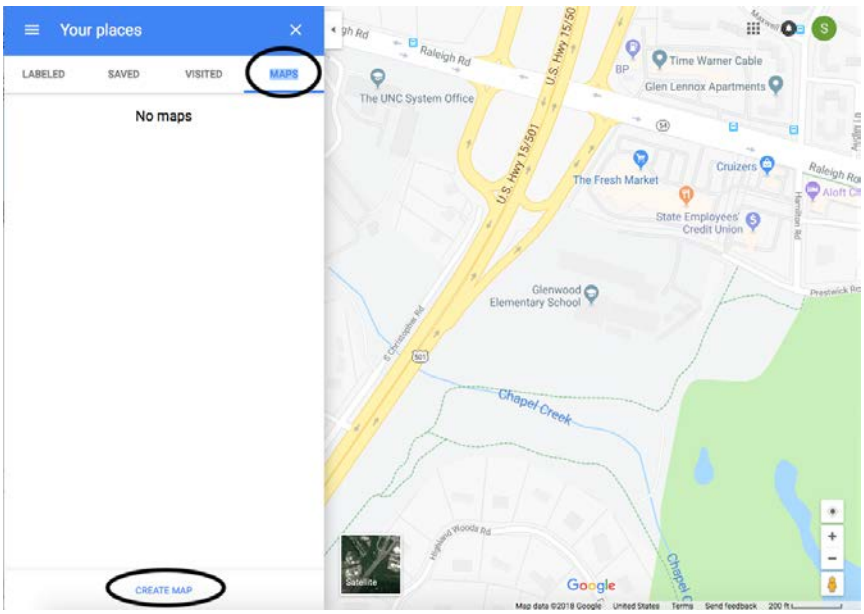
3. Select the "Your places" item from the list of options that appears.



4. Choose the "MAPS" tab just below the "Your places" heading in the upper left-hand corner of the new Google Maps page.

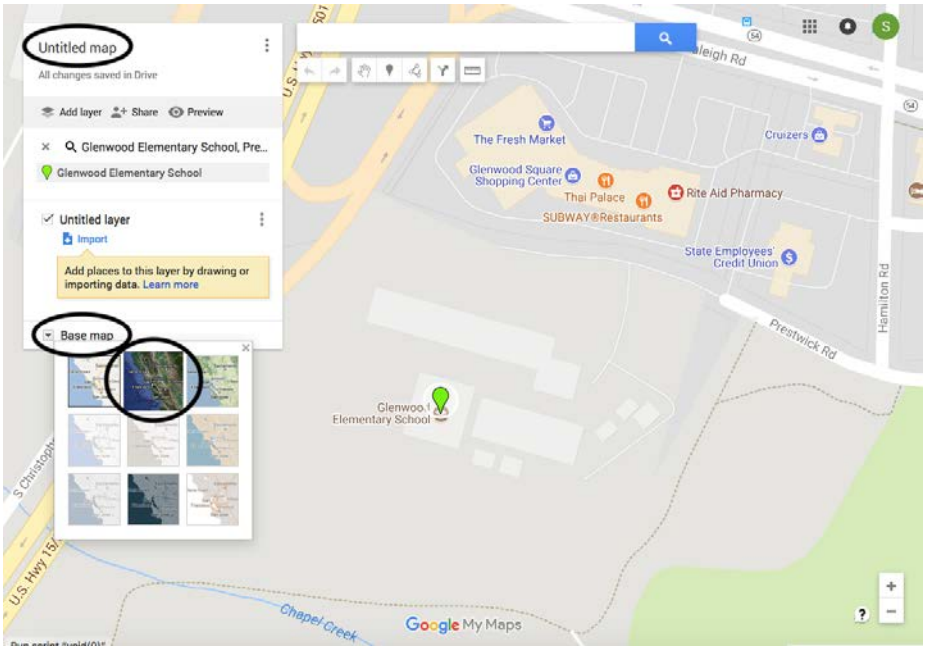
5. Click on "CREATE MAP" option at the bottom of the maps list. If you've made maps previously, you will see them listed here. If not, it will say "No maps" as in the image to the right.

6. After clicking "CREATE MAP", Enter the address of the rain garden location in the Google Maps search bar. The map will zoom into your project site.

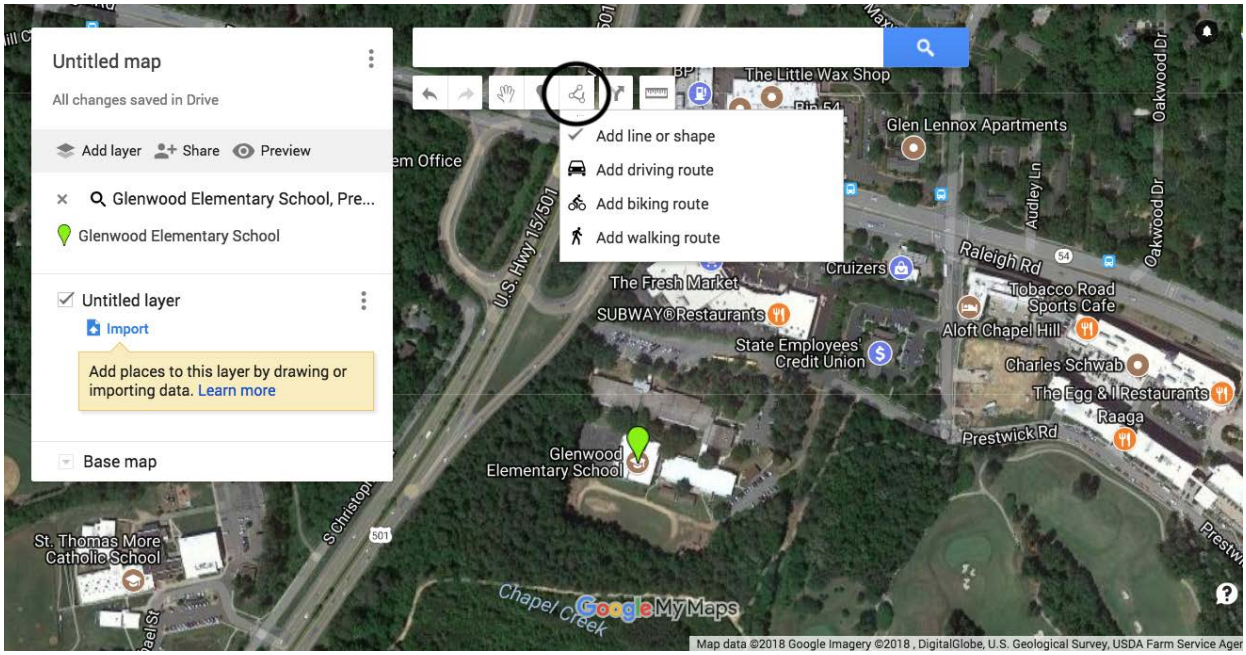


7. In the upper-left hand corner of the web page, you will see a window that is labeled “Untitled map”. Select the “Base map” option at the bottom of that window. You will see a selection of map types. You can also name the map and add a description by clicking on the words “Untitled map”.

8. Select “Satellite” so that you have an accurate satellite image on your screen, which will make measuring the edges of your catchment area easier to define.

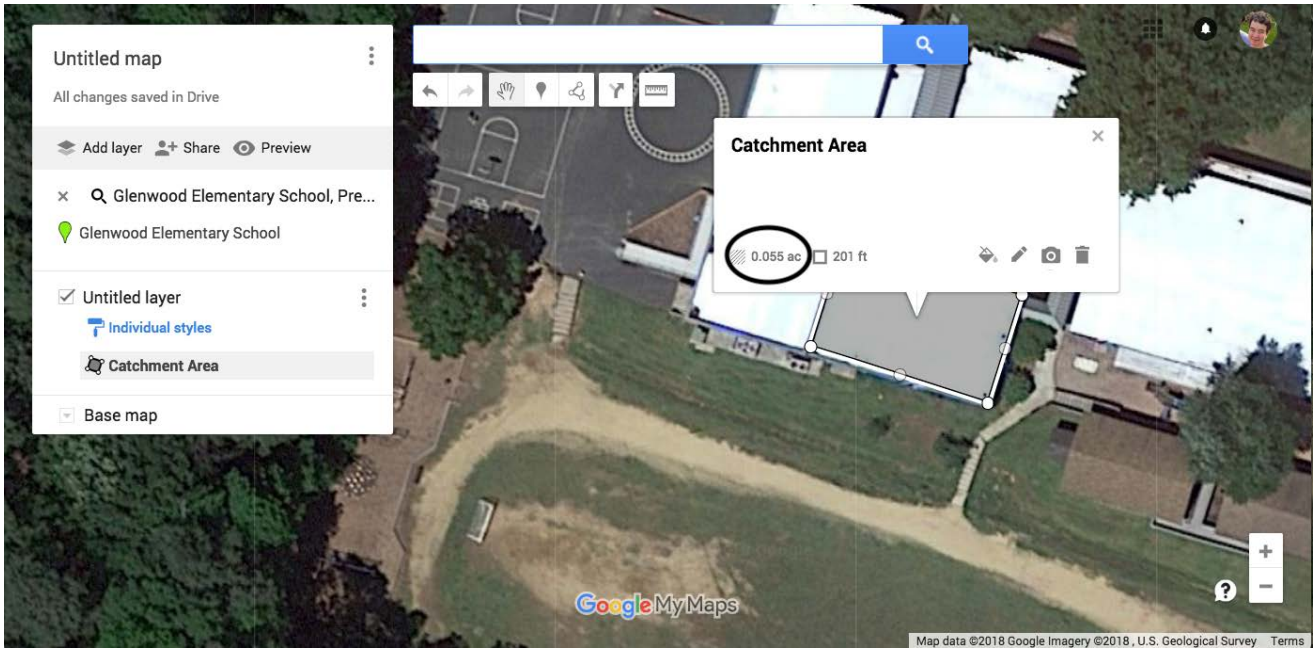


9. Use the “Draw a line” tool that is located just beneath the search bar at the top of the page. Draw a polygon around the catchment area of the site that will contribute stormwater runoff to the rain garden.



10. Once you draw the last line and close the polygon, select it and label it “Catchment Area”.

11. Click on the “Catchment Area” polygon and look at the information that is listed in the popup window. The window lists both the area of the site in acres or “ac” as well as the length of the perimeter of the polygon in feet or “ft”.



12. Convert the area in acres to square feet by multiplying 43,560 (the number of square feet in an acre) by the number of acres in your catchment area as stated on the map.

Record the catchment area here: _____ square feet

II. Calculate Catchment Area Runoff

Next, you will calculate the volume of rainwater that will fall on the catchment area during a "design storm," which assumes rainfall of 1-inch.

To know the number of cubic feet of water the rain garden will need to manage, we need to convert the 1-inch rainfall measurement for a design storm into feet:

1 inch = 1/12 of a foot (or 0.083 feet)

To get the total volume of stormwater that will be captured by your rain garden, multiply the total square footage of the catchment area that you found in the previous exercise by 0.083 feet.

V = Volume of stormwater captured by rain garden in design storm in cubic feet
C = Catchment area in square feet

V = C x 0.083 feet

In the space below, use this equation to solve for the volume in cubic feet of stormwater captured by your rain garden.

My rain garden will capture _____ cubic feet of stormwater.

III. Calculate Garden Size

Follow the steps to calculate the optimal size of the rain garden.

1. To determine the optimal dimensions for your rain garden, you'll need to know the ponding depth, which is the maximum depth of water above the soil surface. For this project, we will use a ponding depth of 6in or 0.5ft. Then, divide the volume in cubic feet that you calculated in the previous section by 0.5 feet. This is the optimal size of the rain garden.

   O = optimal rain garden size in square feet
   V = Volume of stormwater captured by rain garden in design storm in cubic feet

   $$\frac{V}{0.5 \text{ feet}} = O$$

   Example: For a catchment area that will collect a total volume of 200 cubic feet of runoff. Divide 200 cubic feet by 0.5 feet (the ponding depth):

   200 cubic feet/0.5 square feet = 400 square feet

   Show your work in the space below:

   The optimal size of my rain garden is _____ square feet.

2. Now that you know the optimal area, you can start thinking about whether you want to design a single or multiple basin rain garden. While you can certainly use a single basin to keep things simple, multiple basins might add more interest.

   a. For a simple, single basin design, you'll need to work backwards from the area you calculated in step one. To make the rain garden storage area into a square, since a square has the same distance on all 4 sides, take the square root of the area you calculated in step 1 to determine the dimensions of the rain garden.

      Example:

      For a rain garden with an optimal size of 400 square feet:
      Make the rain garden area into a square. Determine the length of the sides of the square by finding the square root of 400 square feet.
      $\sqrt{400}$ square feet = 20 feet

      The optimal size of this rain garden is 20 feet by 20 feet.
      Note that you can make this rain garden more complex as long as the total area adds up to 400 square feet. For example, you could design a rain garden system composed of four different "gardens" that are each 10 feet by 10 feet in area.

b. In the area below, draw the perimeters of a **single basin design** and **one multiple basin design** based on the optimal square footage of the rain garden you calculated in step 1.