

Green City, Clean Waters: Following Nature's Lead

School Site Calculation Worksheet

Name: _____

Date: _____

In this activity, your group will:

- calculate the total area of a Philadelphia schoolyard
- calculate the pervious and impervious area of the yard
- calculate how many gallons of water run off of the schoolyard in a 1-inch rainstorm
- choose Best Management Practices (BMPs) to reduce the runoff

Materials:

- Schoolyard Map
- Yellow tracing paper
- Calculator (2 per group)
- Tape
- Ruler
- Pencils with erasers (1 per person)
- This worksheet

Tips for success:

- Remember that for a square or rectangle, $L \times W = A$ (Length x Width = Area). You can break up or “decompose” the map into squares and rectangles to make your work easier.
- Estimation is your friend! Your calculations may not agree exactly with those of other groups, but they should be close enough to be reasonable.
- Teamwork makes the dream work! Suggested roles:
 - Measurement Master: Uses ruler to measure length and width of each map section, in inches
 - Scale Sleuth: Uses map scale to convert inches (on map) into feet (in the real world)
 - Multiplication Maven: Uses Scale Sleuth's feet data to find area, in square feet
 - Team Lead: Checks everyone's work, keeps everyone on task, and picks up the slack

Part I: Calculate the Total Area of a Philadelphia Schoolyard

1. Tape the map to the desk so it does not move.
2. Tape the yellow tracing paper on top of the map so it does not move.
3. *Measurement Master*: Trace the perimeter of the schoolyard. Measure its length and width in inches.
 - a. Length on map: _____ inches
 - b. Width on map: _____ inches
4. *Scale Sleuth*: Use the scale to convert these measurements into feet. Scale: _____ inches = _____ feet
 - a. Length in real-world: _____ ft
 - b. Width in real-world: _____ ft
5. *Multiplication Maven*: Find the total area of the schoolyard. _____ ft x _____ ft = _____ ft²
6. Compare your answer to other groups' answers. Was your answer close to theirs? _____

Part II: Calculate the Pervious and Impervious Area of the Yard

1. Find all of the pervious surfaces on your map. Examples include grass, soil, trees, drains, and anything else that allows rainwater to infiltrate through the surface instead of running off.
2. Draw a rectangle or square around each pervious surface. **DO NOT INCLUDE ANY IMPERVIOUS SURFACES IN YOUR RECTANGLE** such as concrete, asphalt, brick, or steel.
3. *Measurement Master*: Measure the length and width of each pervious rectangle on the map in inches. Record these in the data table below. You may not need to use all 10 sections.
4. *Scale Sleuth*: Use the map scale to convert each measurement into feet. Record these in the data table.
5. *Multiplication Maven*: Find the real-world area of each rectangle, using $L \times W = A$. Record in data table.
6. *Team Lead*: Check everyone's work and keep them on task! If anything else needs doing - it's your job!

Pervious Area Data Table

Section	Length on map (in)	Width on map (in)	Length in ft	Width in ft	Area (L x W)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
TOTAL PERVIOUS AREA					

7. *Team Lead*: Add up the right-hand column of the table to find the Total Pervious Area.
 - a. Check to see if your answer is reasonable. The total pervious area should be LESS than the total schoolyard area you calculated in Part I.
 - b. You can also check your work against the answers of other groups in your class. Remember that because of estimation, answers may not be exactly the same, but they should be close.
8. *Team Lead*: Find the total impervious area by subtracting:

	ft ² (total schoolyard area from Part I)
—	ft ² (total pervious area from Part II)
	ft ² (total impervious area)

Part III: Calculate Gallons of Rainwater Runoff in a 1-inch Rainstorm

Now that you have calculated the pervious and impervious area of the schoolyard, it's time to see how much water that translates into. A typical rainstorm is called a 1-inch rainstorm because one inch of water falls on each unit of ground area. However, because we are using feet and not inches, we will convert:

$$1 \text{ inch} = \frac{1}{12} \text{ of 1 foot} = 0.083 \text{ feet}$$

Therefore, in a typical rainstorm, 0.083 feet of rain falls on each unit of ground area.

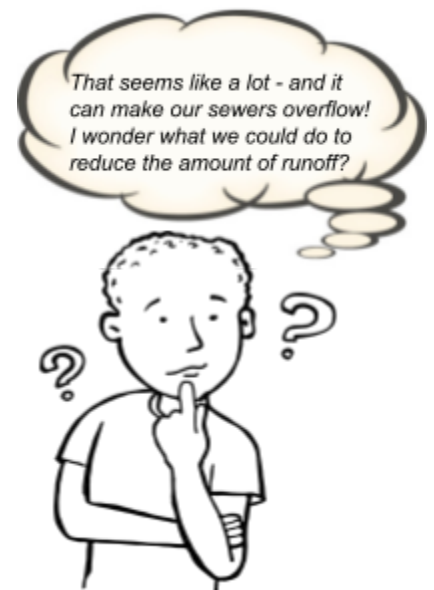
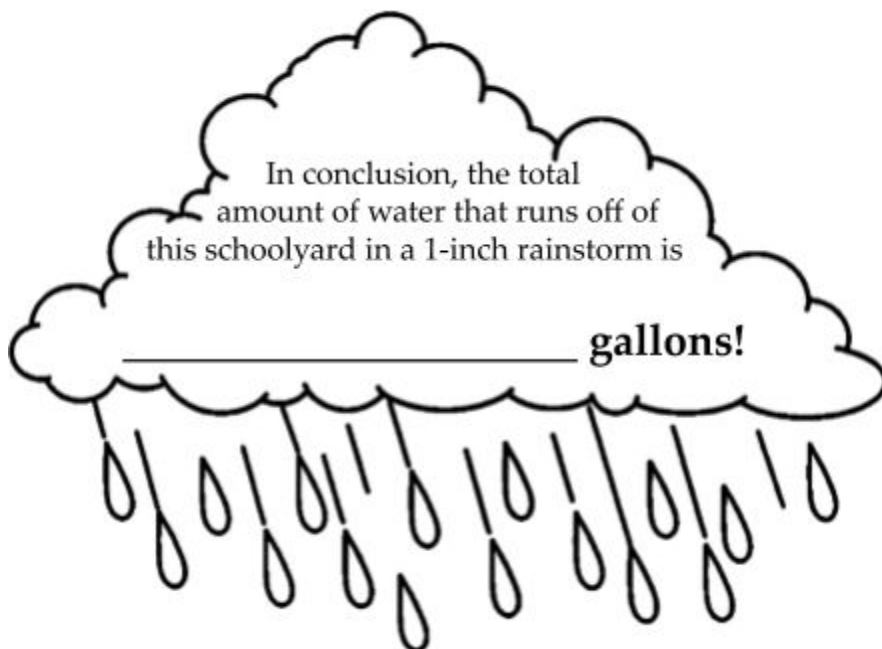
You may recall that Volume = Length x Width x Height (L x W x H). Another way to think about this is Volume = Area x Height or Volume = Area x Depth. So we can easily calculate the volume of runoff, using the total impervious area that you calculated in Part II, and using 0.083 feet as the depth.

$$V = \frac{\text{Total Impervious Area}}{\text{ft}^2} \times \frac{1\text{-inch rainstorm}}{\text{ft}} = \frac{\text{Volume of runoff, in cubic feet}}{\text{ft}^3}$$

- ❖ **Check your work!** Since you multiplied by 0.083, which is less than 1, your answer for "Volume of runoff" should be *less* than your Total Impervious Area. Check your answer against other groups' work to see if it seems reasonable.

Most people are not used to thinking of "cubic feet of water" but rather think about gallons of water. It's easy to convert cubic feet into gallons, because each cubic foot of water = 7.5 gallons.

$$V = \frac{\text{Volume of runoff, in cubic feet}}{\text{ft}^3} \times 7.5 \text{ gallons per ft}^3 = \frac{\text{Volume of runoff, in gallons}}{\text{gal}}$$



Part IV: Use Best Management Practices to Reduce Runoff

Now that your group has found the total amount of runoff, think for a moment about what that means. Everytime it rains, that is the amount of water that runs off of the hard surfaces in the schoolyard and into the sewers, carrying sediment and pollution with it. That water can cause sewer drains to overflow, causing flooding and bringing sewage above ground! So what can be done to solve this problem? Actually, there are many options. Ask your teacher for the “Green Stormwater Infrastructure” cards to see some of the possibilities. Then, with your group, choose the options that you think are best and most cost-effective!



Current gallon total= _____

BMP	Size (ft ²) or Quantity	Gallons Captured
Total Gallons Captured:		
New Gallon Total:		