

# Modeling Improvements to My Schoolyard

## Introduction

**Essential Question: How can I improve my watershed... starting with my schoolyard?**

In this activity you will analyze your school's property using online modeling software and develop plans to reduce the amount of **runoff** from your school's property. Runoff can be detrimental to the health of a **watershed** as it can wash pollutants off the surface of the ground and carry them into local waterways. Runoff can also create **erosion** and increase the amount of sediment suspended in the waterways which makes the water "murky" and can clog the gills of organisms that breathe dissolved oxygen from the water. **Conservation practices** (also known as best management practices or BMPs) are actions and decisions made during the design, preservation, construction, and management of built areas to reduce negative impacts on the environment. As people develop the land by building houses or other structures they cause an impact on the watershed. Certain construction choices (green building design) and land management practices can preserve the health of a watershed by intercepting **precipitation** to minimize runoff and the transportation of pollutants into streams and rivers.

Conservation practices that can be built into green buildings and grounds might include: rainwater capture for use in irrigation or flushing toilets, waterless toilets, low flow faucets and showers, composting of leftover food scraps, green (vegetated) roofs, rain gardens, rainwater retention basins or bio-swales, **porous** sidewalks or parking lots (materials with connected pores that are **pervious** and allow water to **infiltrate** into the ground), constructed wastewater wetlands, planting of trees along streams, restrictions on use of fertilizers or harmful cleaning chemicals, no-till agriculture, cluster housing, etc. For more information on conservation practices (BMPs) at Stroud Water Research Center, visit our website: <https://stroudcenter.org/about/facilities/mec/>.

## Learning Objectives

- Students will identify buildings and land areas as **pervious** and **impervious**, and discover various green building and **conservation practices** that improve **watersheds** by increasing **infiltration** and decreasing **runoff**.
- Students will model possible changes in conservation practices and **land cover** on their school's property and describe the impact of these changes on their local watershed.
- Students will design a watershed plan for their schoolyard that maximizes the health of the watershed by implementing conservation practices and land cover changes.

## Part I

### Identifying Current Conditions

Your first job will be to assess the impact of your school's property on the local watershed and then create proposals for how to reduce this impact. First we need to consider the state of your school's property as it is today. Using the map that your teacher provides, work in pairs to identify the boundary of your school's property and then map the pervious and impervious areas at your school.

- Use a red pencil to shade in the areas on your map of the School’s property that are **impervious** (water cannot infiltrate) such as pavement, sidewalks, roofs, etc.
- Use a brown pencil to shade in areas that are **pervious** to water and covered in vegetation.
- Use a green pencil to shade in areas where conservation practices (BMPs) have already been incorporated onto your school’s property (examples: green roofs, rain gardens, rain barrels, etc.).
- Create a key on your map to define the various shaded areas on your map.

## Prediction

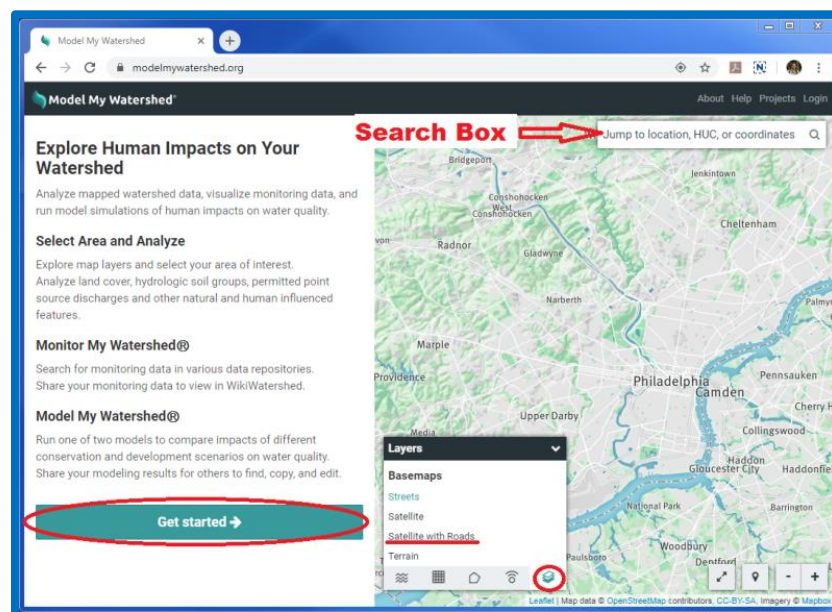
Use a blue pen to indicate the places on your map of the school’s property where you **predict** you may be able to implement conservation practices (BMPs) to reduce runoff and increase infiltration.



## Part II

### Introducing the Site Storm Model

The [Model My Watershed® – Site Storm Model](https://www.modelmywatershed.org) is an interactive watershed-modeling app that allows users to delineate an area of land, identify and analyze specific characteristics (land cover, soil group, climate, terrain, etc.) from professional data bases, model stormwater runoff and water quality impacts, and compare the effects of various conservation or development scenarios. On a computer, go to [ModelMyWatershed.org](https://www.modelmywatershed.org) to open the Model My Watershed® App and investigate your school grounds.

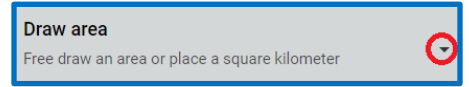


[Click here to start the Model my Watershed® App](https://www.modelmywatershed.org)

- In the left panel, click on “Get Started.”
- Type in the address for your school in the search bar in the top right corner of your map.
- In the bottom left corner of the map you will see a “Layers” control box. Click on the furthest icon to the right in the bottom of this dialogue box to select the “Basemaps” tab and select “Satellite with Roads.”



- Zoom in or out and drag the map to show all of your school's property in the map viewing area.
- In the left panel, click on the black down arrow in "Draw area" and select "Free draw" to create a polygon of the property for your school. Begin by clicking on one corner of your school's property. Moving clockwise click at each of the corners around the edge of your school's property until you click on the first mark to close the polygon. Your school's property will be delineated and the model will automatically analyze the area and give you base information on the area you selected. If you make a mistake, click on "Change area" at the bottom of the left panel and try again.
- Click the tabs in the analyze box to learn about your school's property, and record the information below.



### Recording Data from the Analyze Box

- What is the total "Selected Area" for your school's property? \_\_\_\_\_ m<sup>2</sup>
- Select the land tab and record the Land Cover types and percentages of coverage your your school:

_____	_____ %	_____	_____ %
_____	_____ %	_____	_____ %
_____	_____ %	_____	_____ %
_____	_____ %	_____	_____ %
_____	_____ %	_____	_____ %

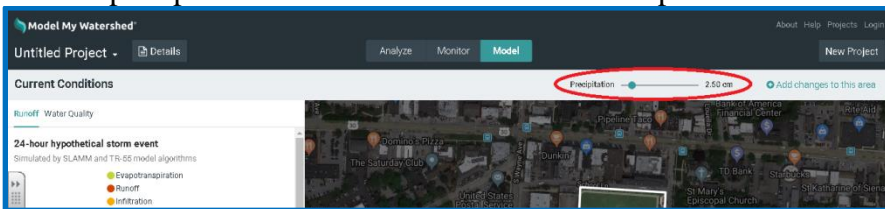
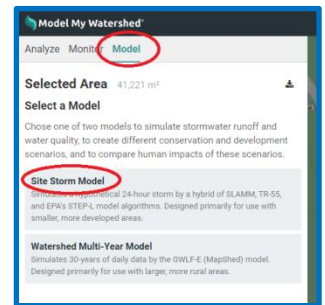
- Select the "Soil" tab and record the predominant Soil Group: \_\_\_\_\_

## Part III

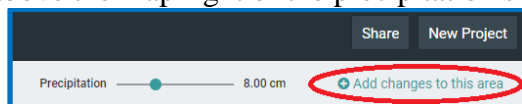
### Land Cover Model Comparison

Now we will use the Site Storm Model to investigate how changing the current land cover conditions at your school to a forest would affect stormwater runoff and water quality in the local watershed.

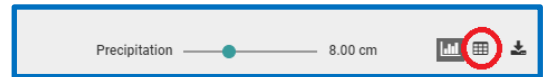
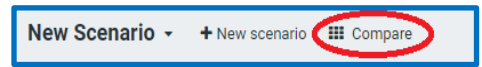
- In the left panel "Analyze" pane select the "Model" tab, and then choose "Site Storm Model" to run a simulation of a 24 hour storm event on your school's property.
- Move the precipitation slider in the bar above the map to **8.0 cm**.



- Click on "Add changes to this area" in the bar above the map right of the precipitation slider.



- Then click on “Compare” in the top of the panel on the left of the map.
- Click on the data table icon in the top menu to the right of the precipitation slider to toggle to an easy to read table of the data.



4. Record the Water Depth results for the first two land cover scenarios, “**Predominantly Forested**” and “**Current Conditions**” in the data table below.

Land Cover Scenario	Evapotranspiration (cm)	Runoff (cm)	Infiltration (cm)
Predominantly Forested			
Current Conditions			

- Toggle back to the Combined Hydrology graphs by clicking on the “graph” icon to the right of the precipitation slider.



5. Look at the results for evapotranspiration, runoff, and infiltration in the data table, as well as the Combined Hydrology graphs, and compare the “Current Conditions” at your school with the “Predominantly Forested” scenario. Make some observations about the two scenarios and include data on how evapotranspiration, runoff, and infiltration changed as a result of the land cover change.

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

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## Part IV

### Modeling Conservation Practices at My School

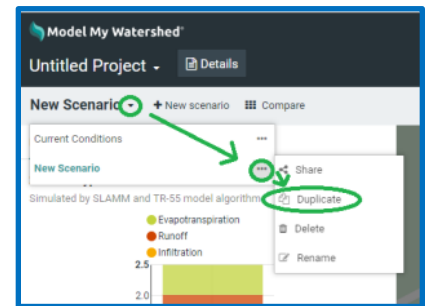
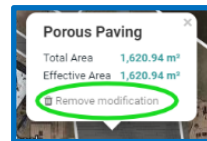
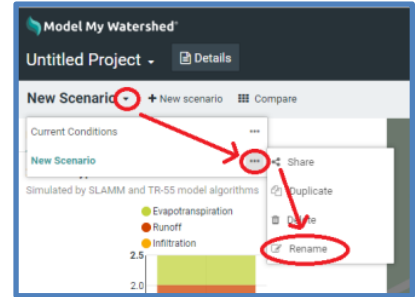
Now you will use the Site Storm Model to explore and model some Conservation Practices that could be added to your school’s property to reduce runoff and improve infiltration.

- Close the “Compare” window by clicking on the  in the top right hand corner.
- Click on the teal colored  button to view the practices that you could add to the scenario. Hover the cursor over each Conservation Practice to learn more about them.

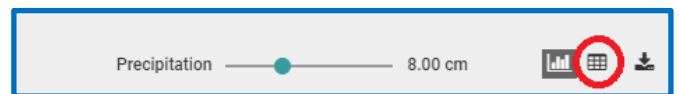
- Start by adding a **Green Roof** to the tops of some of the buildings at your school (flat or low slopes only) by selecting “Green Roof” and then click on one corner of your school’s roof in the map (zoom in to make it easier to see the features of the roof). Moving clockwise, click along the edges of the roof at each of the corners until you click on the first mark to close the polygon and define where the Green Roof would be installed. The simulation will install the Green Roof and the data in the model will update. Repeat this process until you have changed all of the flat roofs at your school to Green Roofs.
- When you are finished adding Green Roofs, click on the down arrow next to the “New Scenario” Title in the top left, move the cursor to the three dots to the right of “New Scenario” in the drop down menu and click on the three dots to “Rename” your project “Green Roofs.”



- Then click on **+ New scenario** again to add a different plausible Conservation Practice to your school’s property. Each time you select **+ New scenario** the model will return to the original “Current Conditions” scenario.
- To “Add” multiple Conservation Practices while saving each scenario separately, return to the “Scenario” dropdown menu and select “Duplicate.” This will create a duplicate scenario upon which you can add more Conservation Practices. Likewise, if you want to remove some practices, you can make a copy of a scenario, duplicate and rename the copy, then click on a Conservation Practice to see the area involved and to “Remove” the modification.



- Create up to three scenarios for various plausible combinations of proposed Conservation Practices at your school. Develop a “best plan” for integrating Conservation Practices onto your school’s property to protect your watershed by minimizing runoff and maximizing infiltration and evapotranspiration. Be sure to consider the current activities at your school and propose installations of Conservation Practices only in areas where they will not interrupt normal activities.
- When you are finished, click on the **Compare** button above the left panel to analyze the results of the proposed scenarios. You can delete excess scenarios by clicking on the three dots next to the scenario you want to remove, and choosing “Delete.”
- Toggle to the data table by clicking on the data table icon to the right of the precipitation slider to fill in the data below.



Conservation Plans	Predominantly Forested	Current Conditions	Green Roofs			
Runoff (cm)						
Evapotranspiration (cm)						
Infiltration (cm)						

## Analysis

6. Which scenario that you developed created the best outcome for protecting your watershed with the least runoff and the most infiltration?

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7. Are there any compromises or additional features you might need to include to assure that important activities (e.g., parking, access to areas, sports fields, etc.) could still happen at your school?

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## Conclusion

Q: Describe the land conservation practices (BMPs) that you included in your “best plan” and explain why you chose these features. Which conservation practices are appropriate for areas on your school site? Explain how and why your design will improve your watershed. (Hint: Consider the size of the areas, types of conservation practices, costs to implement the practices, and impact on usage of the areas).

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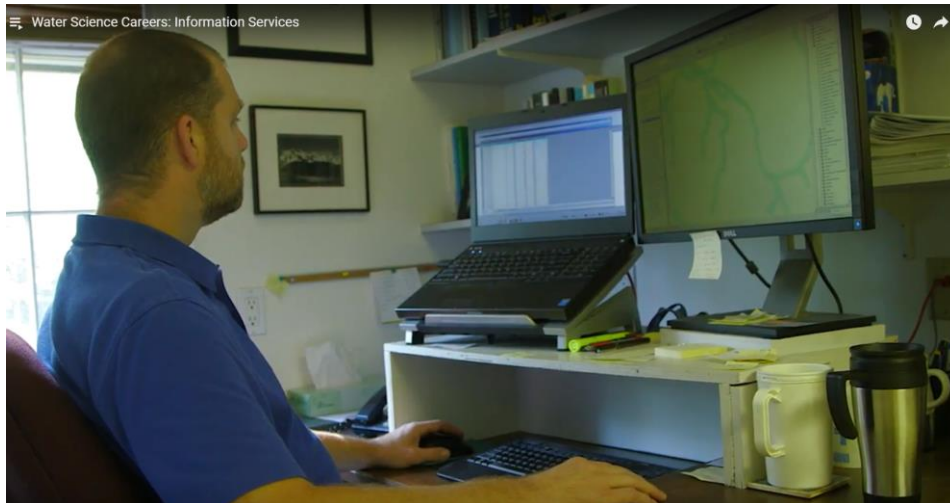
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## STEM Career Extension

What is an Environmental Data Manager & GIS Specialist? Navigate to <https://youtu.be/f8nhf8q2yJA> and watch a video about how STEM education and skills led Dr. Dow to an exciting career at Stroud Water Research Center.



What does an Environmental Data Manager & GIS Specialist do to help further the research of watershed scientists and educators? What background knowledge and experiences were critical in helping Dr. Dow complete his work? How is Dr. Dow's work connected to developing plans to install Conservation Practices?

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