Authored by:
Lilas Randrianarivony

Grow NYC
51 Chambers Street Room 228
New York, NY 10007
www.grownyc.org

The following unit covers GrowNYC's environmental education unit on Habitat Restoration and Water Health through a Watershed Education and Tree Stewardship Module.

Integrated into this 10 page document are detailed lesson plans of the four sessions of the water portions, which includes: the National Geographic "Thirsty World" map, Department of Environmental Protection and New York City watershed maps and the two watershed building lessons. Examples of the handouts distributed in classrooms will be available. Educational materials will vary depending upon grades being taught (middle-school vs. high school material). However, vocabulary and handouts will include basic earth and environmental science terms and concepts.

The materials needed to create the watershed models can be purchased from a stationary store (i.e.: Jam Paper, Pearl Paint) and discount stores (i.e.: Dollar Store, Jack's World). For the service project focused on habitat restoration through tree stewardship and adoption, the organization usually provides the tools for students to borrow for their class session such as trowels, cultivators, weeders, garbage bags, etc.

Such experiential hands-on activity in addition to the in-class curriculum is crucial for students as it enables them to see the lessons come to life by their actions. They will be able to increase their understanding of the natural environment and foster deeper relationships with their peers.

This program is conducted annually in the fall and spring at different schools located throughout New York City. For the fall program, around early fall around late September to mid-November is optimal for Tree stewardship portion, prior to the winter season. The spring program begins early March; in-class lessons are taught so the students can have some background information on current world water status as well as local water quality. Towards mid-March into mid-April, the two lessons on model-building and tree-mulching and planting will take place before the concluding activity with GrowNYC, the partner school and the community.

Habitat Restoration and Water Health:

Watershed Education and Tree Stewardship Modules

1) **Introduction -** Current World Water Status: "A Thirsty Planet" (National Geographic, September 2002)

Freshwater quality has been declining over the years, causing famine, diseases and ultimately death in the southern hemisphere where availability is scarce. With about 1,400 million km3 of water on Earth, with 97.5% is held in oceans, only 2.5% is fresh water available for agriculture, industrial and domestic use worldwide (a combination of groundwater and surface and atmospheric water). With the population at 6.2 billion in 2002, one third of the world lacked access to clean drinking water. Developing countries use ¾ of their water largely on agriculture: access to irrigation is central to crop productivity, food security and the livelihoods of small farmers (Cominelli, et al., 2009). In contrast, in the United States and Europe, only about 35% is for agricultural purposes whereas 50% of their water consumption is for industrial use (FAO 2002).

Figure 1: A Thirsty Planet

This 31" x 20" double-sided map shows the obvious decline in the world's water supply and quality. (Figure 1) Scattered on the maps, students can find facts about all four corners of the world and their water status: renewable water sources and usage per country; areas where water is a major concern. A review questionnaire is handed out focusing on general information, the Parana River Basin in South America, the Colorado River Basin, Lake Chad in Central Africa, the Tigris and Euphrates Watershed between Turkey, Syria and Iran, the Yantze River Basin in China, the Murray-Darling Watershed in Australia, and, finally, potential health risks we face because of water pollution.

Refer to Appendix 1.1: *A Thirsty Planet Review* Questionnaire.

2) <u>Local Water Quality</u>

a. Watersheds and Pollutants

A watershed is defined as "a geographic area whose rainfall, snowmelt, streams and rivers all flow or drain into a common body of water, such as a reservoir, lake or bay" (DEP). Efforts focus on preventing contaminants from human and animal activities as well as construction materials (pavement, cement, salts from roads…) from polluting the surface water supply, addressing both point and nonpoint pollution source. (Figure 2)

A point source, defined by the U.S. Environmental Protection Agency (EPA), is "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack" (Hill, 1997). *Effluent* is the discharge of one or more pollutants emitted by electronic or chemical factories. Some point source pollution may mix with urban runoff during rain events, picking up chemicals and more pollutants before entering the sewer system untreated.

Nonpoint sources is the result of rainfall or snowmelt moving over and through the ground (EPA). It picks up and carries organic and non-organic human and animal pollutants before depositing into the nearest water body. This remains as a threat to our water quality because of the diffused sources.

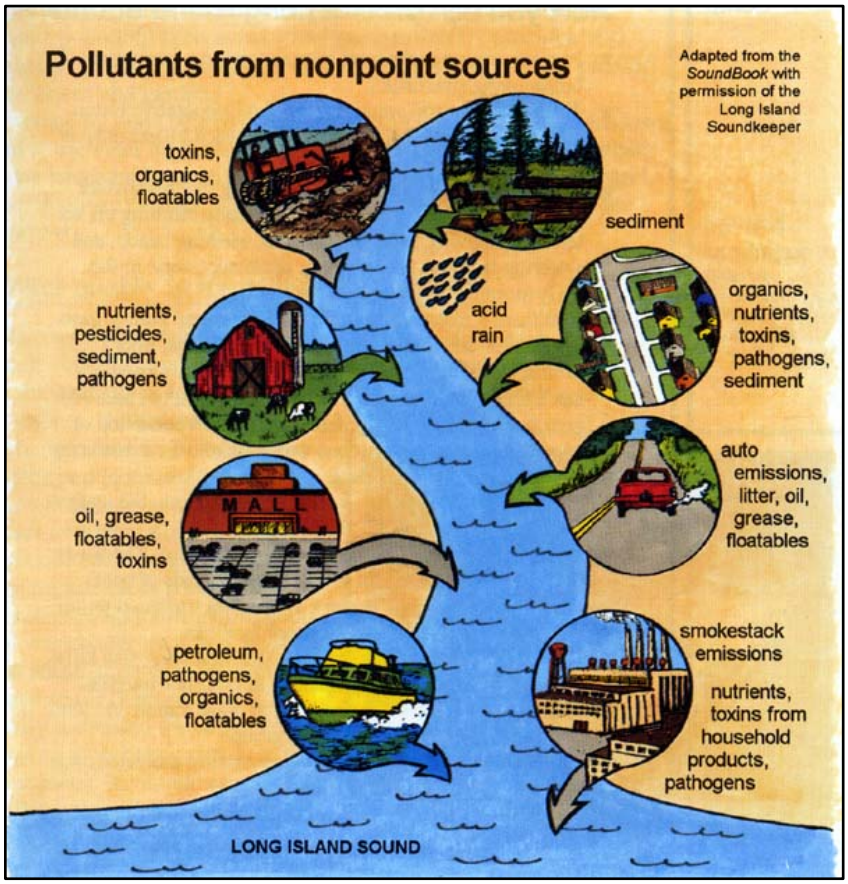

Figure 2: Sources of Nonpoint Pollution

b. Natural vs. Urban Watersheds

Watersheds are defined by topographic boundaries that direct rainfall and snowfall to drain in a common stream, river or lake. From the highest point of a watershed, small tributaries form feeding into small villages and farms and percolates downward. With gravity as the main physical force, water is continuously recycled through the evapotranspiration process.

Natural and urban watersheds share several distinct characteristics: "(1) upland zones that intercept, infiltrate, and transport rain as groundwater and surface water flow; (2) riparian zones that border surface water bodies, filter surface water runoff, and provide shade that can lower water temperature; and (3) surface water bodies, such as rivers and lakes, that provide habitat, food, and water to aquatic and terrestrial species" (City of Bellevue 2003).

Usually represented as narrow strips of land, riparian zones are ecosystems along stream, creeks or river margins. Due to its water-rich soils, riparian flora and fauna are different and extremely beneficial as compared to those found in nearby communities (Freitag and McGinley and Tollner 2010).

Refer to Appendix 1.2: *Natural Watershed* Figures.

c. Urban Development Consequences

Groundwater filtering through the soil is also part of the watershed. However, the lack of vegetation in urban areas and increase of impervious surfaces such as roads, cement and asphalt covering the soil in addition to buildings impedes natural filtration. This is the main cause of combined sewage overflow (CSO) following a rain or snowstorm where the sewer system flow exceeds average capacity. During the Habitat Restoration portion, we partner with other organizations such as TreesNY to help revitalize urban communities by planting trees and vegetation to minimize CSO events.

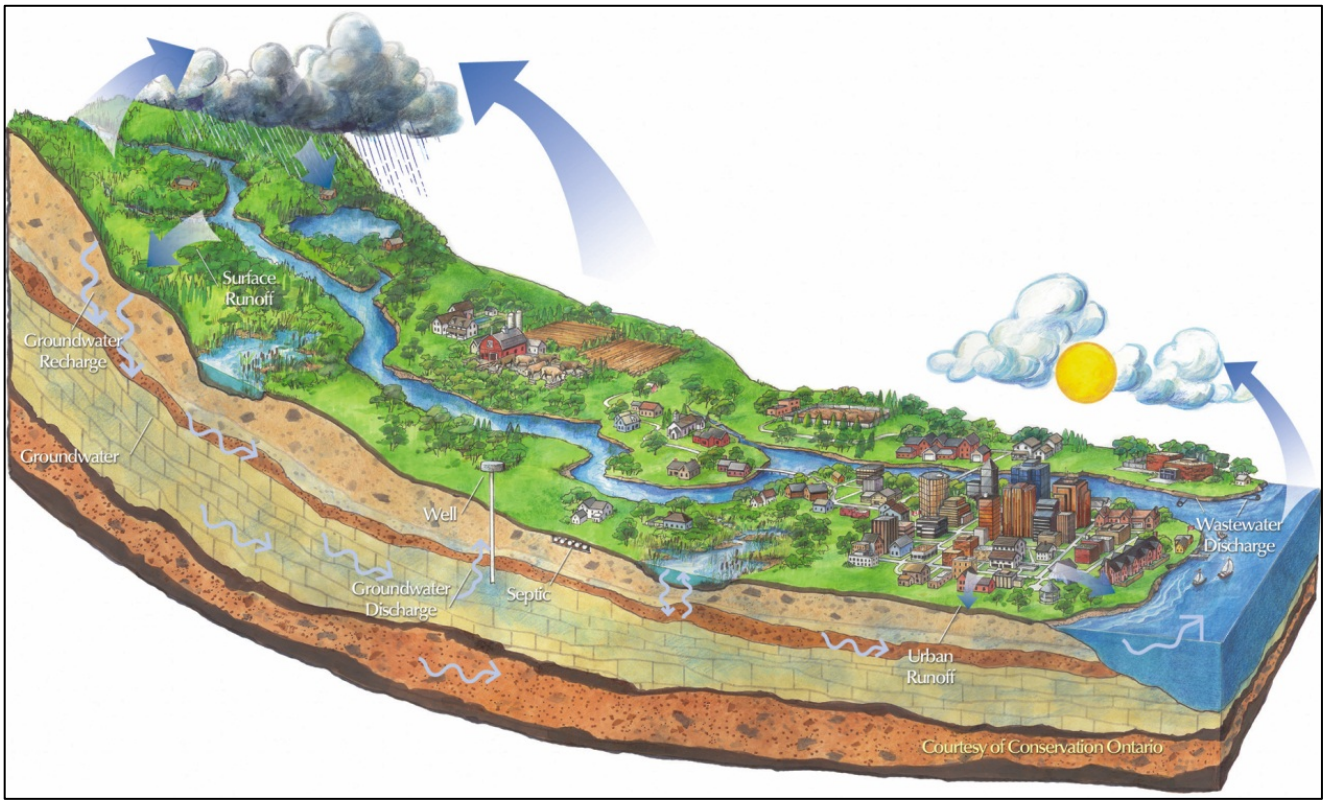

Figure 3: Urban Watershed Model and Hydrologic Cycle

Evapotranspiration: combined processes of evaporation and plant transpiration from the Earth's land surface to atmosphere

Runoff: excess water flowing over land once soil is infiltrated to full capacity from rain and melt water

Infiltration: process of surface water entering the soil

Impervious (surface): does not allow to pass through; an impenetrable surface (examples: pavements, roads, sidewalks…)

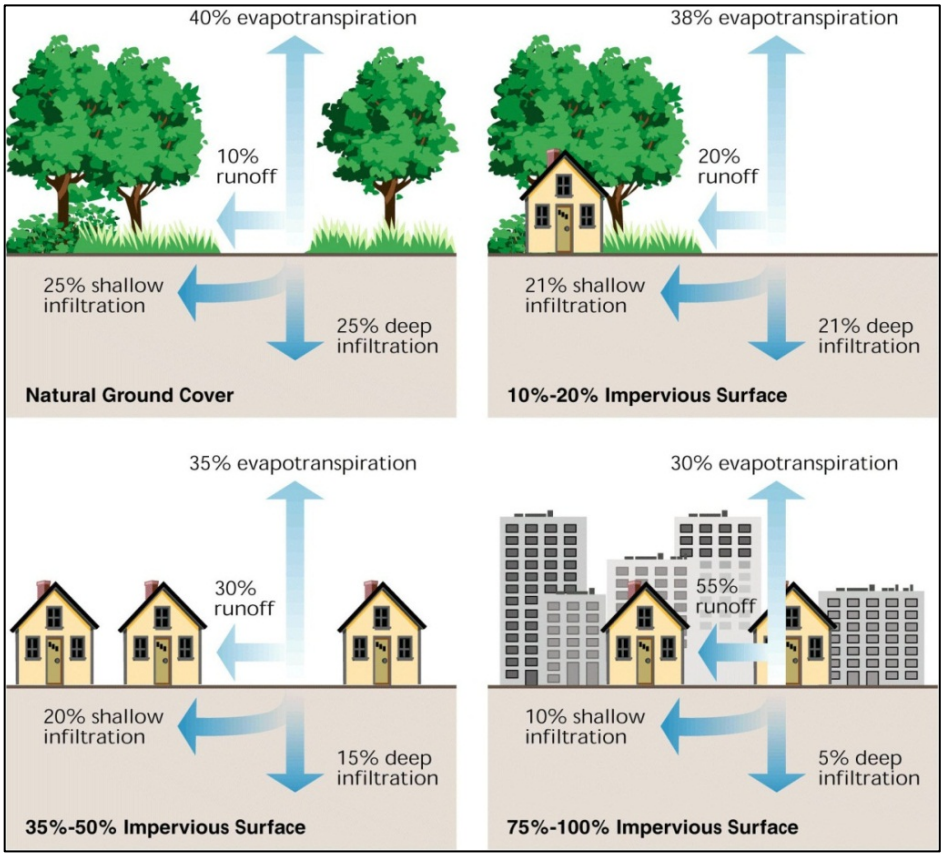

Figure 4: Urban Development Patterns

The consequences of urban development include difficulties such as natural infiltration as groundwater recharge. As seen in Figure 4, because of the amount of buildings and impervious infrastructures in a city like New York, in addition to the deficiency of trees and vegetation, there is only 10% shallow infiltration and 5% deep infiltration compare to natural ground cover (25% shallow, 25% deep).

An example of the processes of urban watersheds as represented below in Figure 5 show urban runoff flowing into the storm drain and sewer system where untreated storm water is released into a nearby stream.

Urban heat island is extremely common as well where temperatures in metropolitan areas are warmer than rural surroundings as these surfaces absorb incoming solar radiation and re-radiate it in the form of heat. “The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C)” (Urban Heat Islands: Compendium of Strategies, EPA).

Figure 5: Rainfall Pathway in Urban Watershed