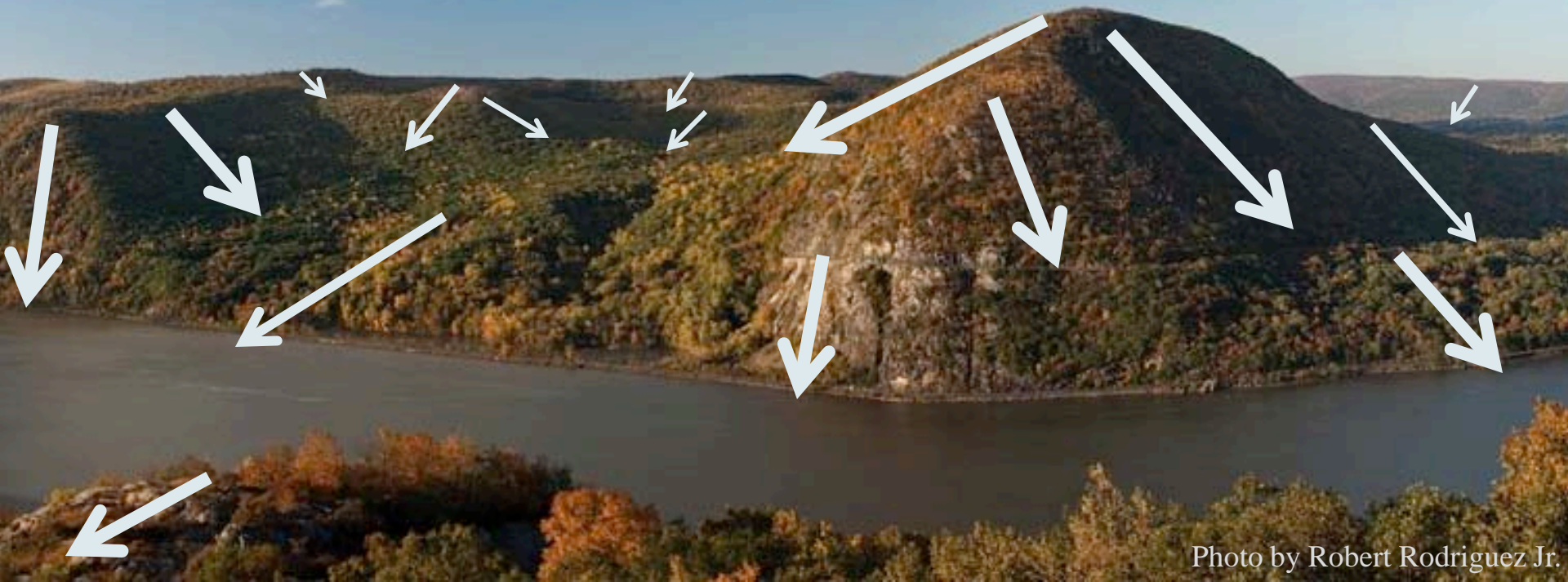




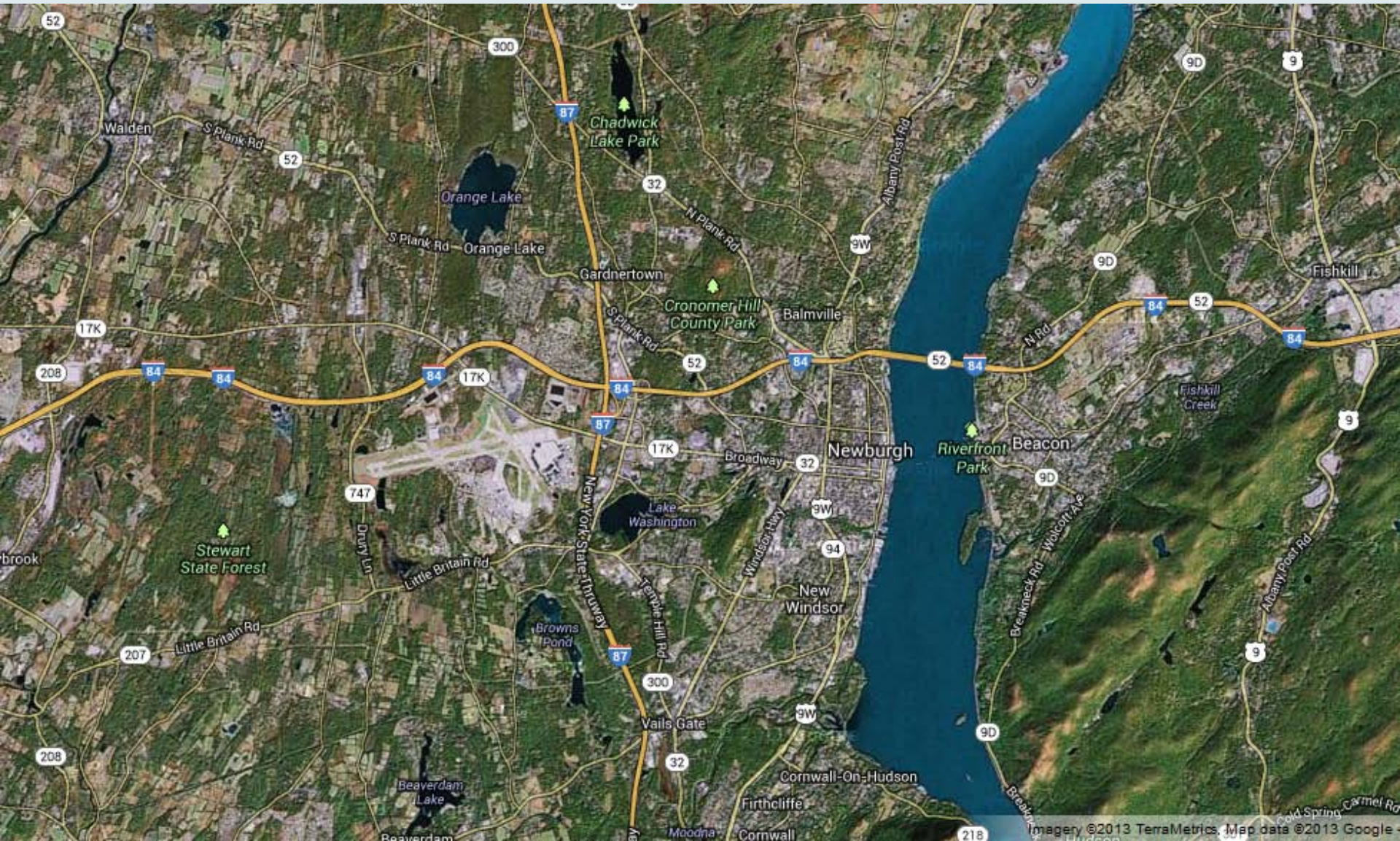
A water-what?



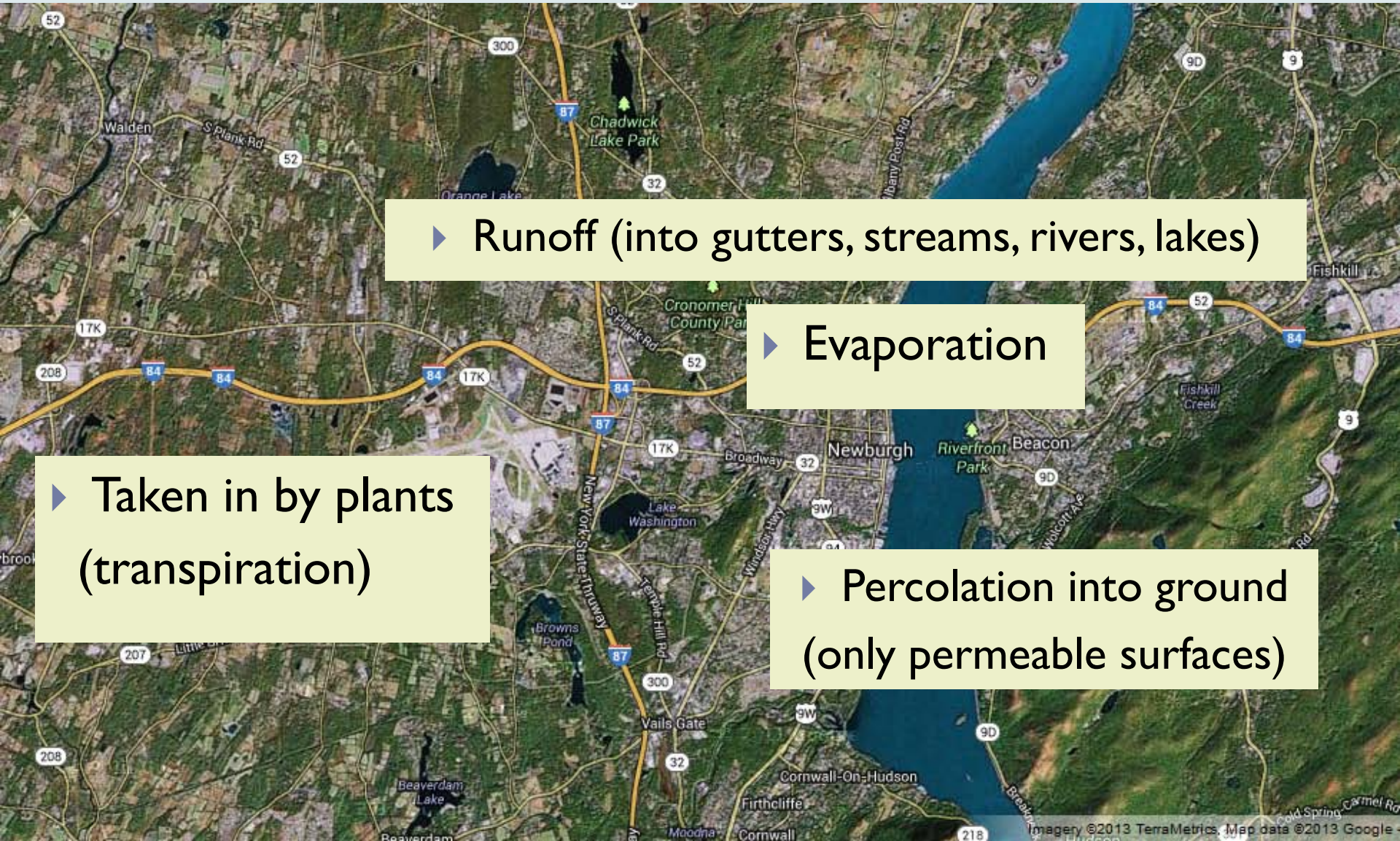
A watershed!



What happens to water when it hits the ground?



What happens to water when it hits the ground?



▶ **Runoff (into gutters, streams, rivers, lakes)**

▶ **Evaporation**

▶ **Taken in by plants (transpiration)**

▶ **Percolation into ground (only permeable surfaces)**

You may think that every drop of rain that falls from the sky, or each glass of water that you drink, is brand new, but it has always been here and is a part of The Water Cycle.



The Water Cycle

The heat of the sun provides energy to make the water cycle work.

The sun evaporates water from the oceans into water vapor.

This invisible vapor rises into the atmosphere, where the air is colder.

The water vapor condenses into clouds.

Volcanoes emit steam, which forms clouds.

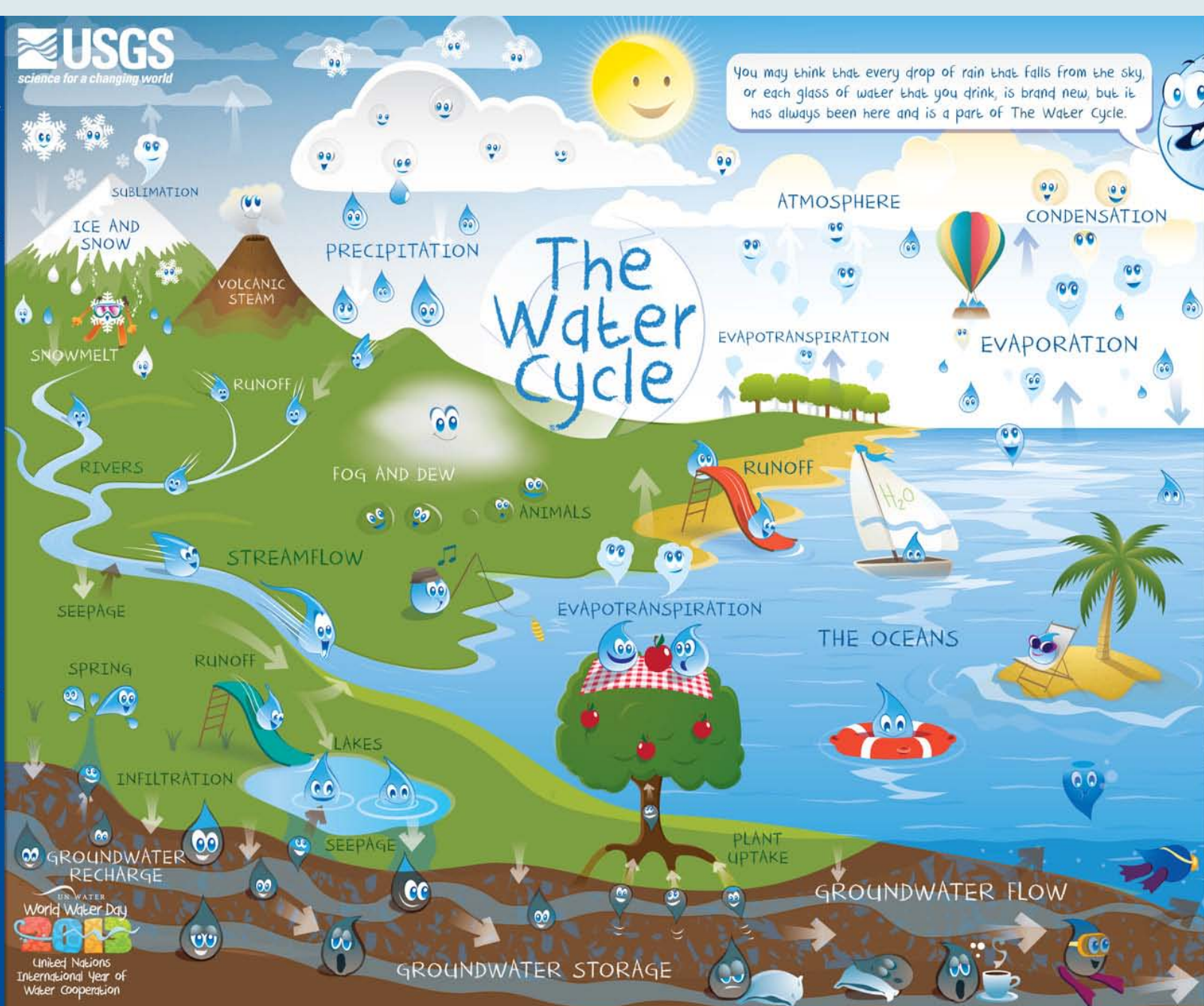
Air currents move clouds all around the Earth.

Water drops form in clouds, and the drops then fall to Earth as precipitation (rain and snow).

In cold climates, precipitation builds up as snow, ice, and glaciers.

Snow can melt and become runoff, which flows into rivers, the oceans, and into the ground.

Some ice evaporates directly into the air, skipping the melting phase (sublimation).



Rainfall on land flows downhill as runoff, providing water to lakes, rivers, and the oceans.

Some rain soaks into the ground, as infiltration, and if deep enough, recharges groundwater.

Water from lakes and rivers can also seep into the ground.

Water moves underground because of gravity and pressure.

Groundwater close to the land surface is taken up by plants.

Some groundwater seeps into rivers and lakes, and can flow to the surface as springs.

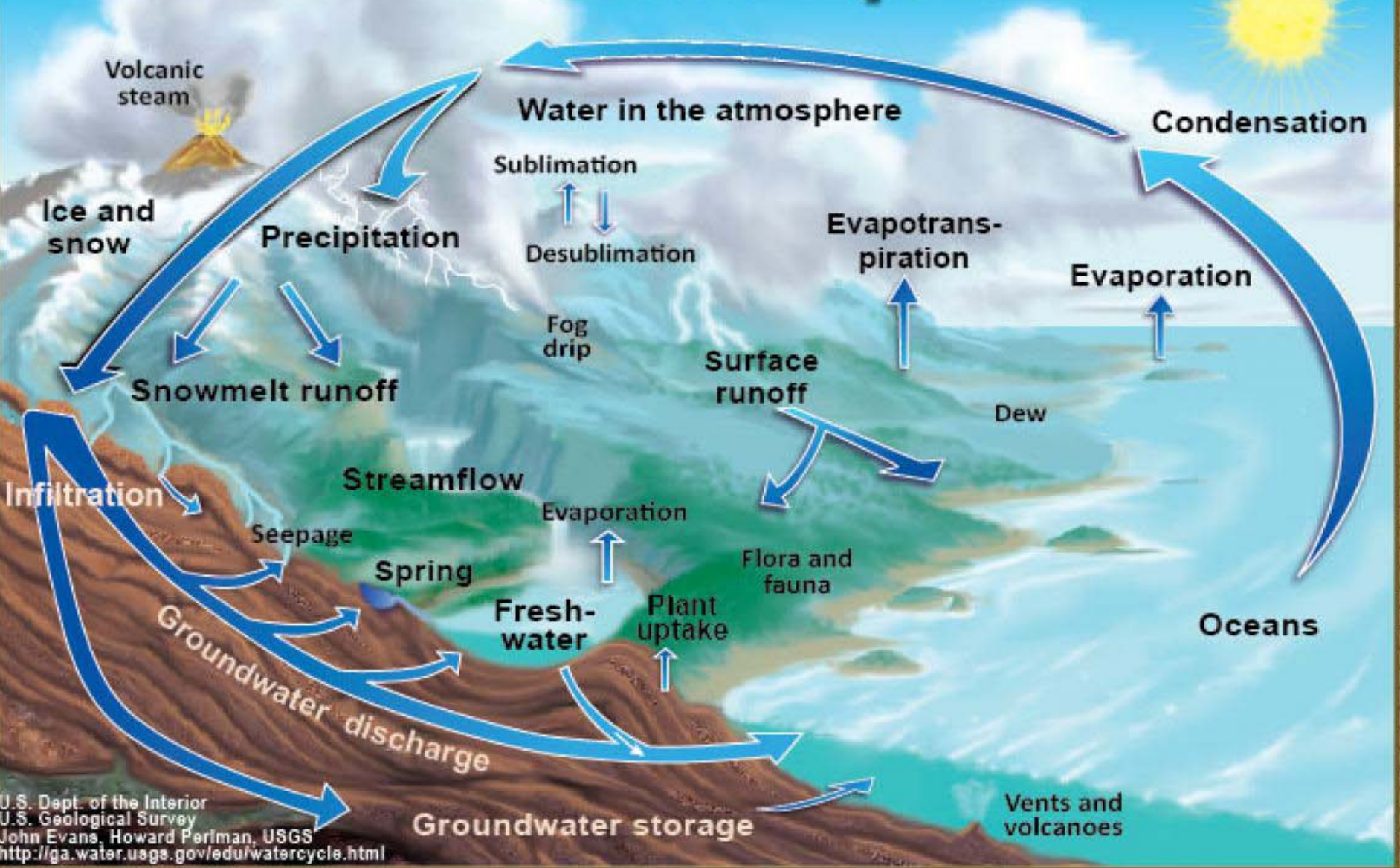
Plants take up groundwater and evaporate, or transpire, it from their leaves.

Some groundwater goes very deep into the ground and stays there for a long time.

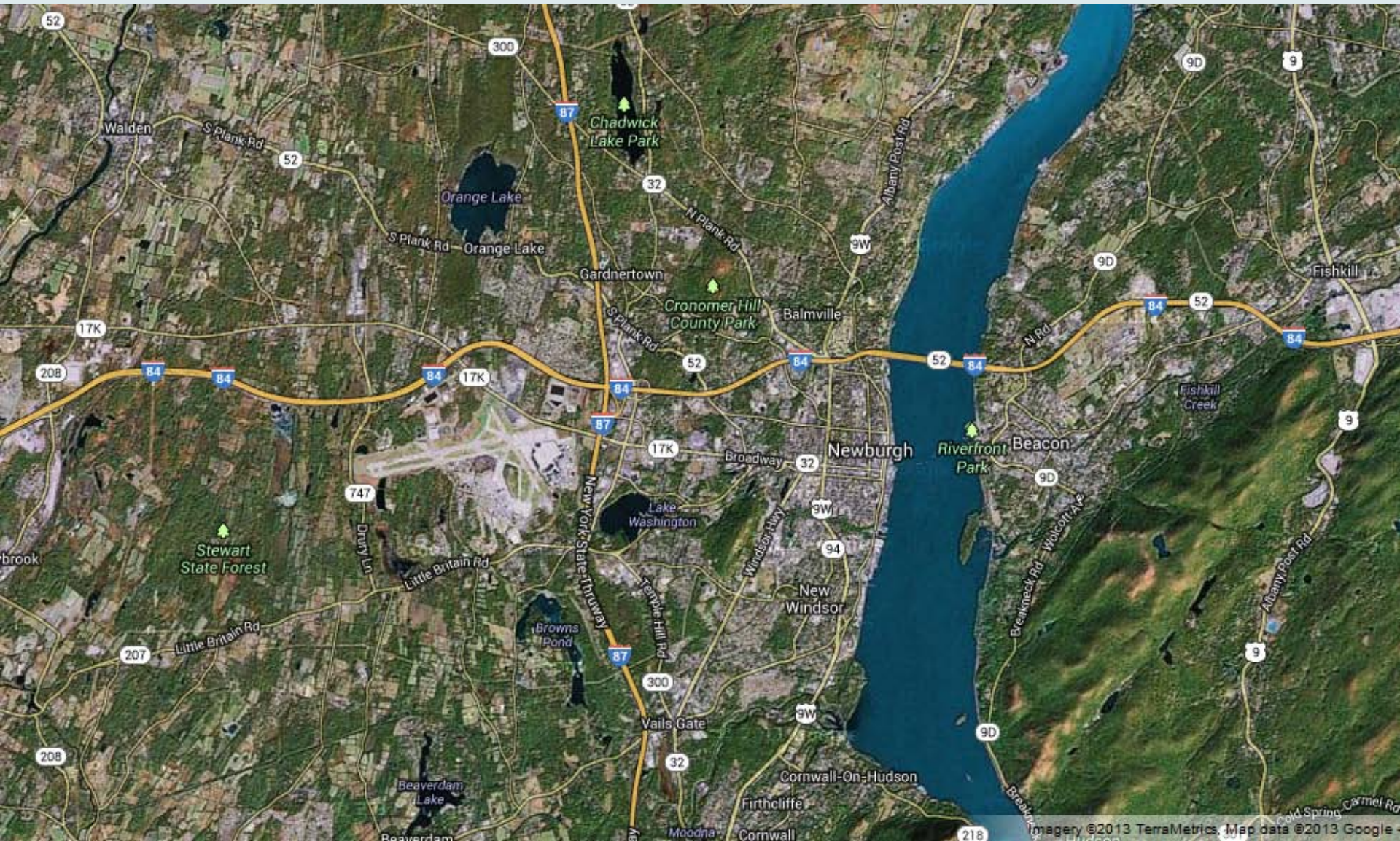
Groundwater flows into the oceans, keeping the water cycle going.

UN WATER
World Water Day 2015
United Nations
International Year of
Water Cooperation

The Water Cycle

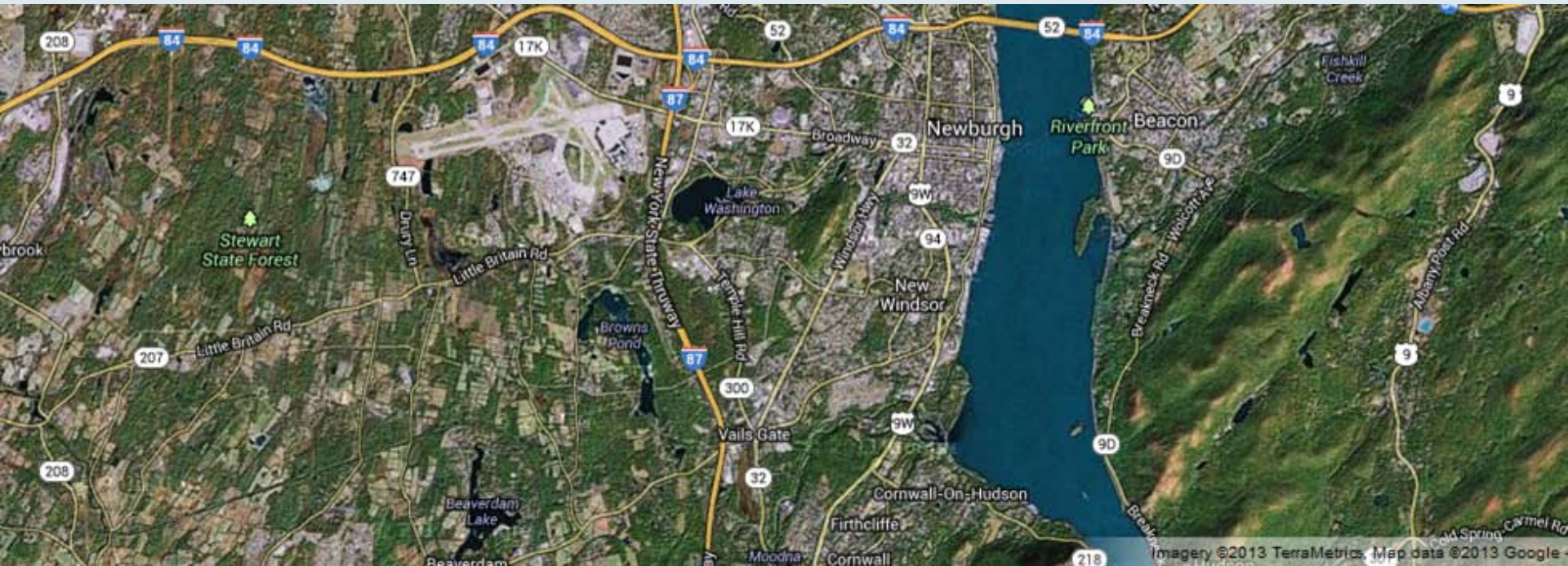


What determines what happens to water when it hits the ground?

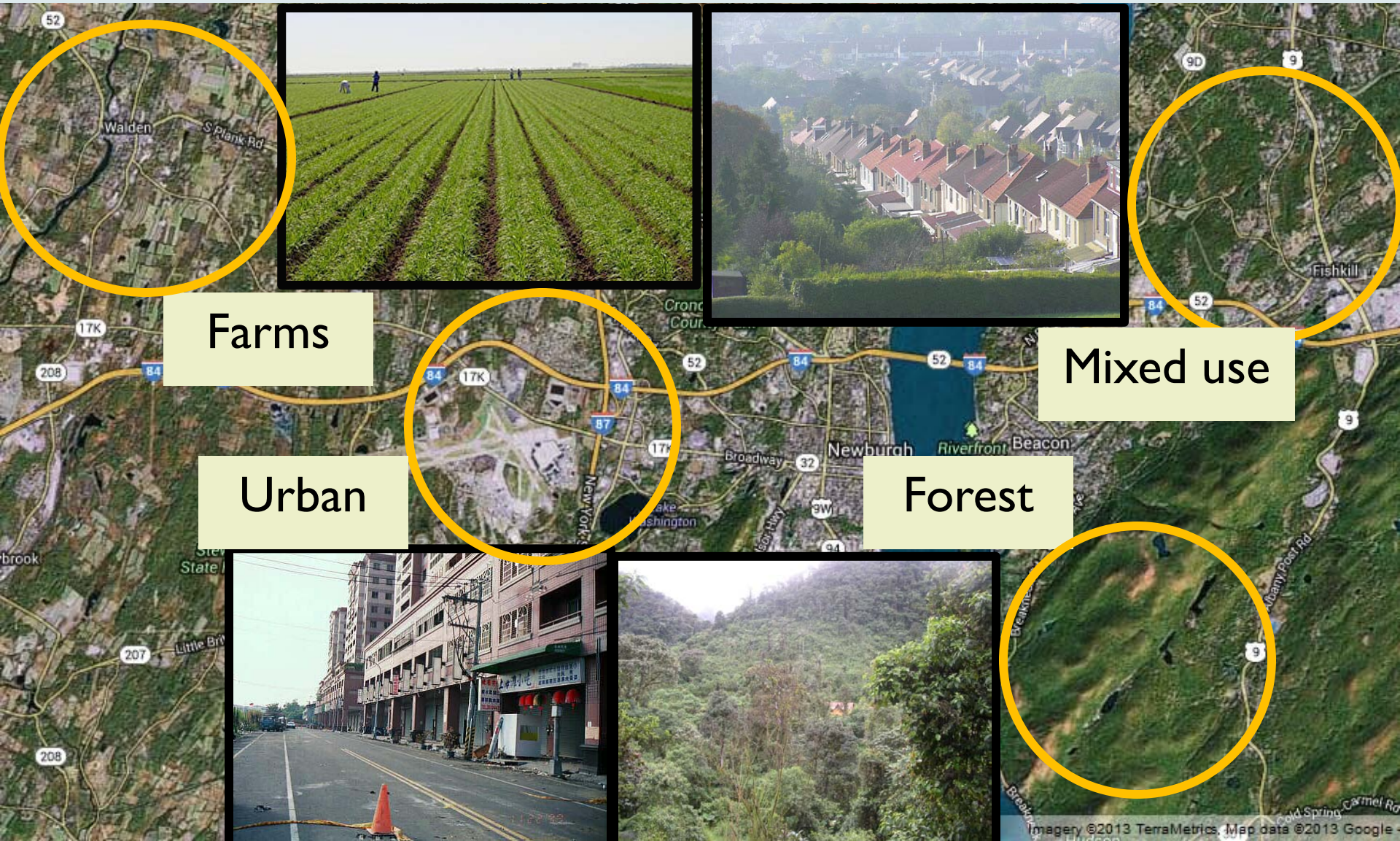


Land cover

- ▶ A description of what's on the surface of land
- ▶ Often described by the type or lack of vegetation
- ▶ Examples: agriculture, urban, hardwood forest, conifer forest, grass



What determines what happens to water when it hits the ground?



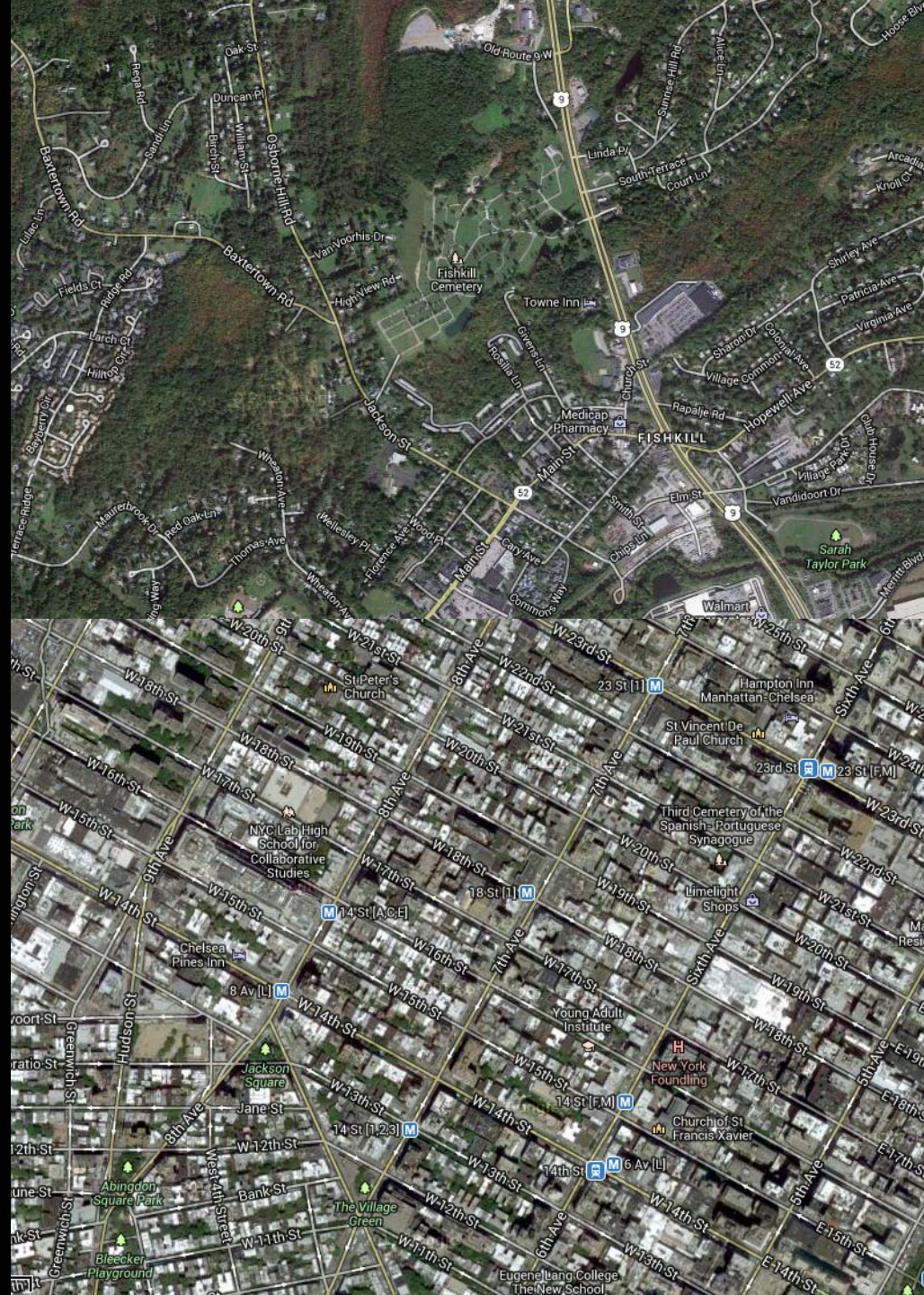
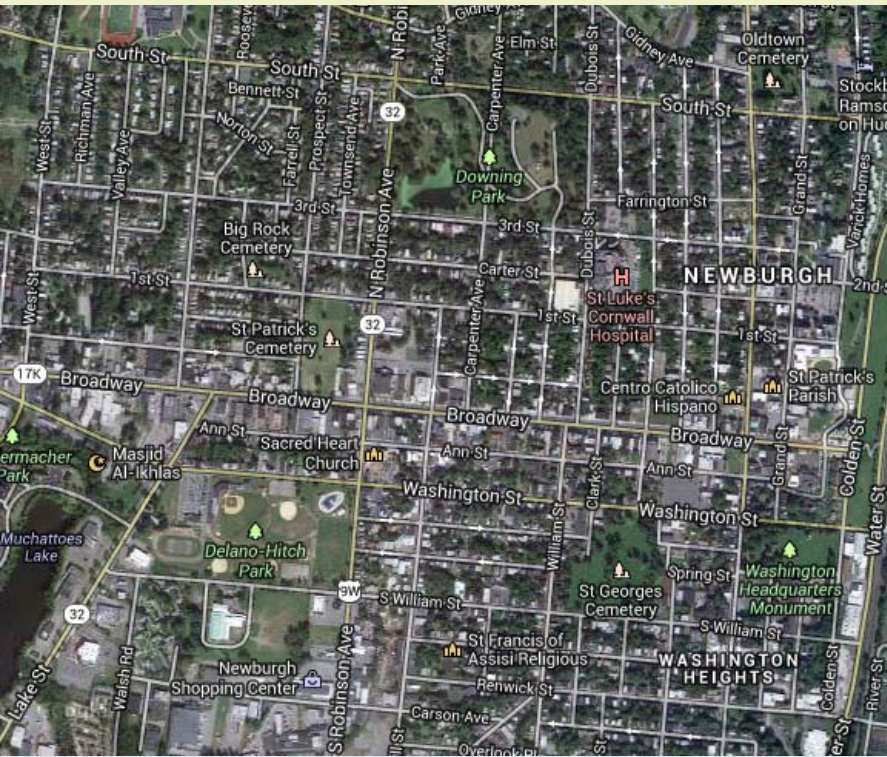




Farms

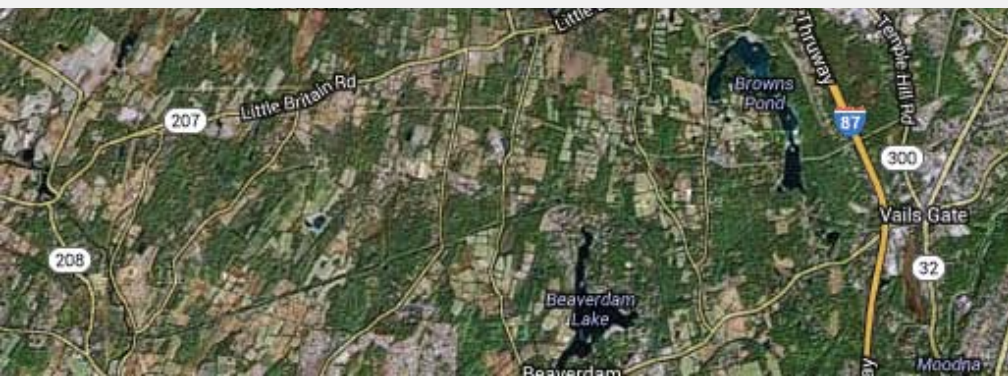
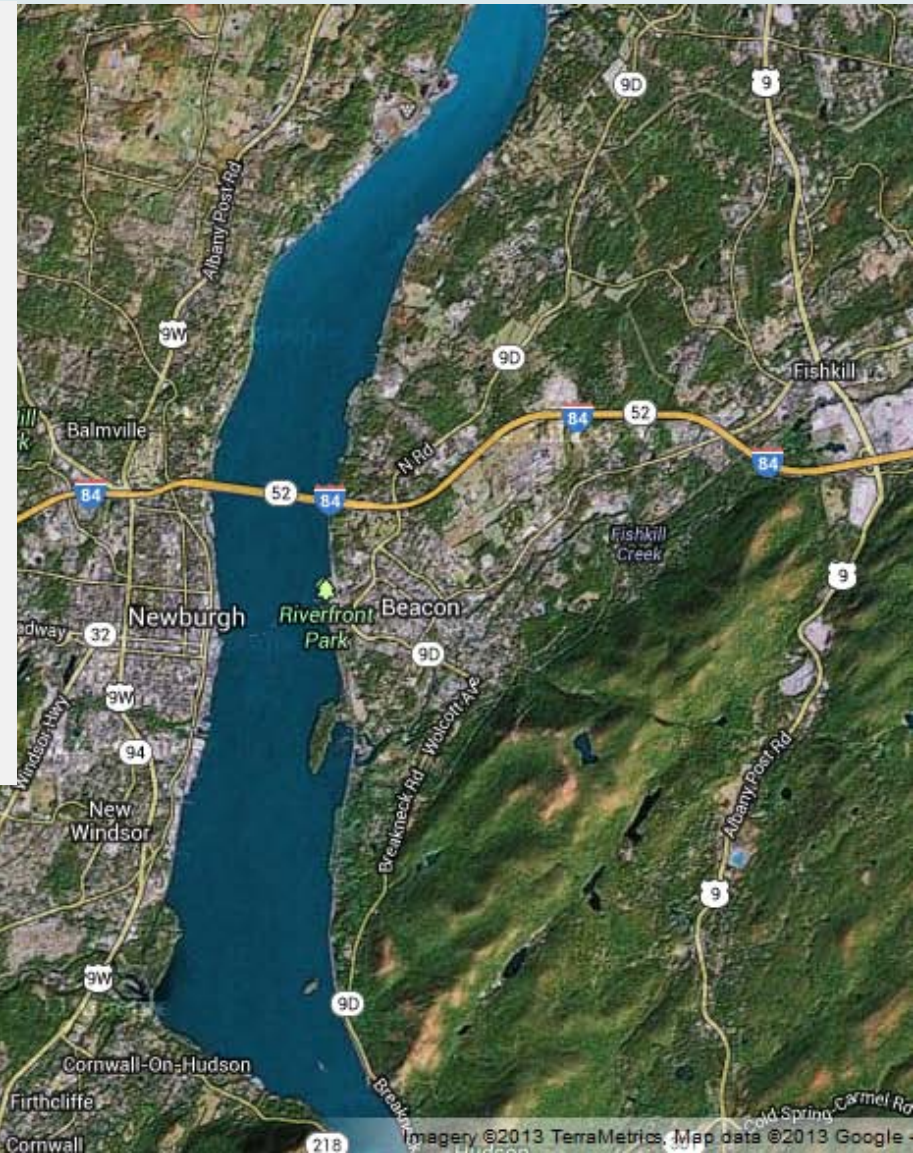


An urbanization gradient



Variables that affect water behavior

- ▶ Rate of precipitation/melt
- ▶ Permeability of land cover
 - ▶ Type of soil/stone
 - ▶ Saturation of soil
- ▶ Vegetation type
- ▶ Elevation grade

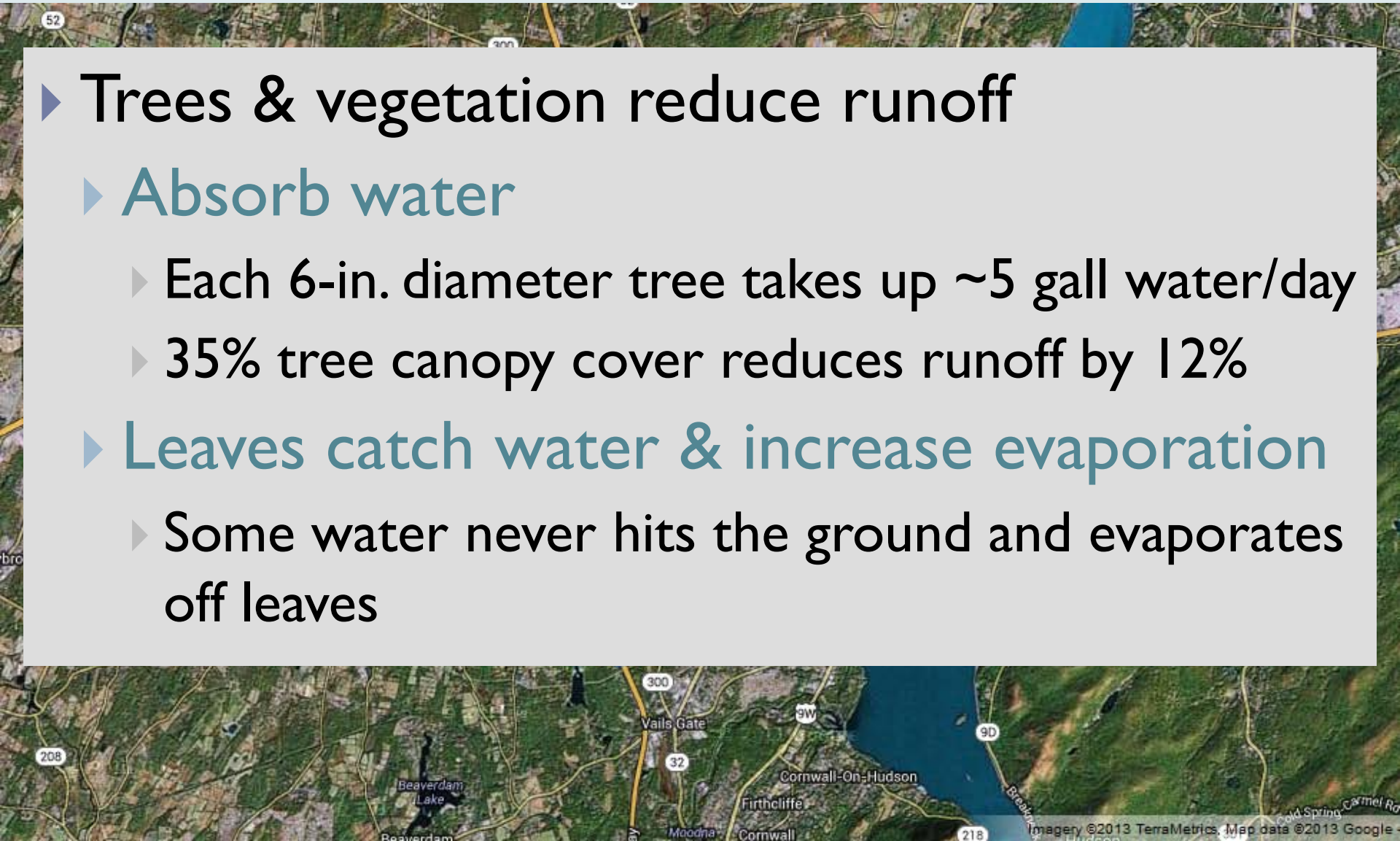


Permeability

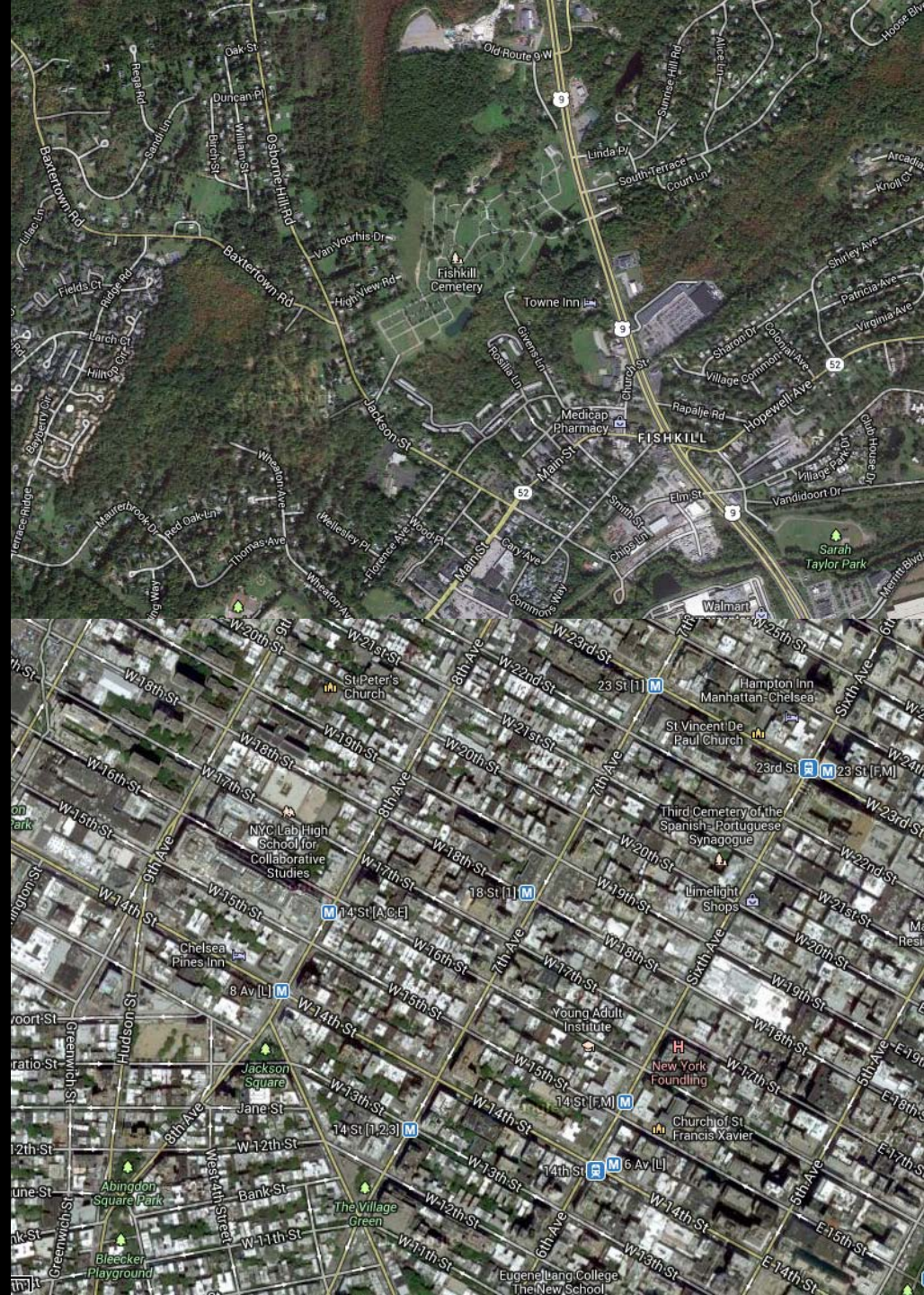
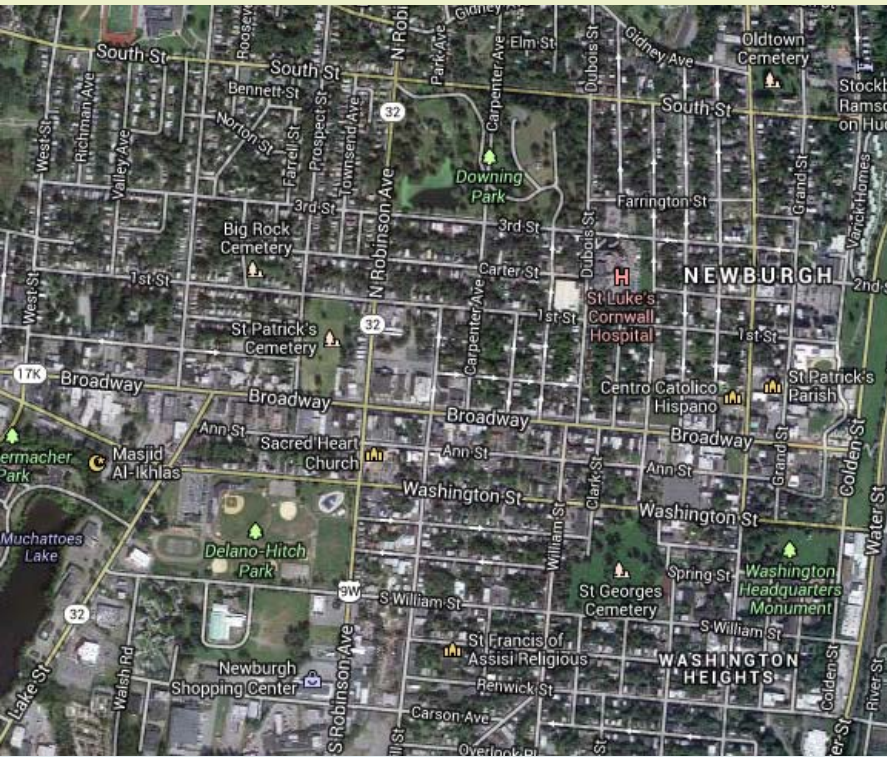
- ▶ **Permeability:** How well water filters through a substance
- ▶ Gravel: Very high permeability
- ▶ Sands: High permeability
- ▶ Silt: Low permeability
- ▶ Clay: Very low to impermeable
- ▶ Asphalt/cement: **Impermeable**

Vegetation

- ▶ Trees & vegetation reduce runoff
 - ▶ Absorb water
 - ▶ Each 6-in. diameter tree takes up ~5 gall water/day
 - ▶ 35% tree canopy cover reduces runoff by 12%
 - ▶ Leaves catch water & increase evaporation
 - ▶ Some water never hits the ground and evaporates off leaves



An urbanization gradient





Characterized by:

- ▶ ...forest!
- ▶ Permeable soils
- ▶ Few buildings/roads

When it rains...

- ▶ Trees absorb a lot of water
- ▶ Soil allows percolation into groundwater
- ▶ Downhill runoff into natural, vegetated channels and streams
- ▶ Trees and vegetation control soil erosion and limit stream turbidity

Bonus: ▶ Trees and other plants filter out air & water pollutants

Land cover:
Forest



Characterized by:

- ▶ Permeable Soils
- ▶ Fields for crops/grazing
- ▶ Lots of vegetation
- ▶ Fewer trees

When it rains...

- ▶ Water percolates through soils & is often diverted to drainages/holding ponds
- ▶ Runoff picks up pesticides & fertilizers
 - ▶ nitrogen, phosphorus
- ▶ Erosion can cause sediment pollution & increase turbidity

Land Cover:
Agriculture

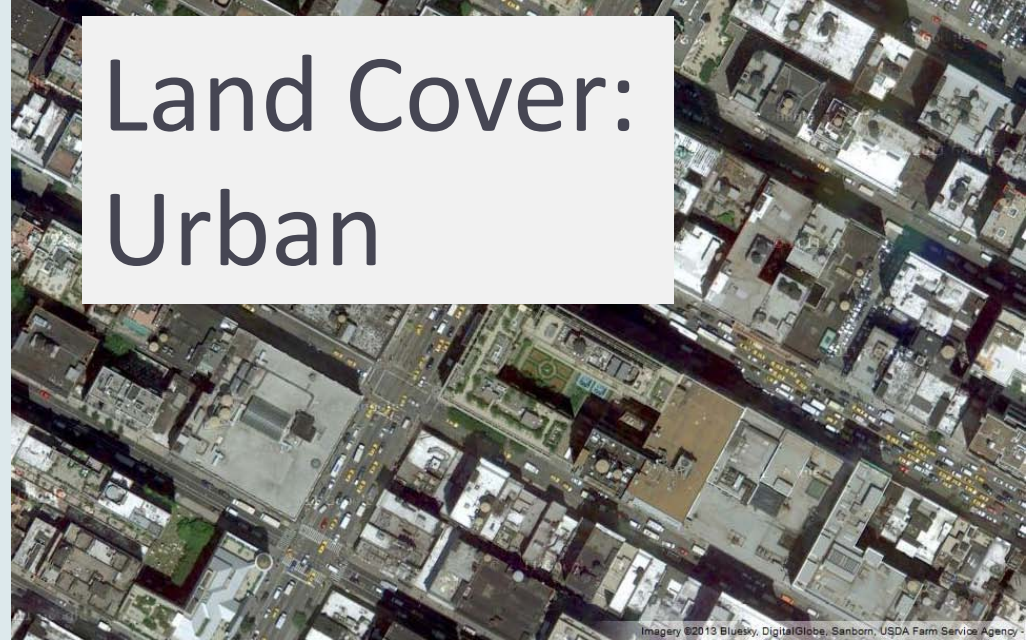


Characterized by:

- ▶ **impermeable surfaces**
 - ▶ Cement, asphalt, buildings
- ▶ Few trees and plants

When it rains...

- ▶ Impermeable surfaces = fast-moving water, and...
 - ▶ flash flooding
 - ▶ erosion along stream banks
 - ▶ pollutants wash into waterways
 - ▶ oil, gasoline, toxins, heavy metals, salt
 - ▶ water treatment plants become overwhelmed & stop treating water before releasing it into rivers /streams



Land Cover:
Urban

Characterized by:

- ▶ Mix of permeable & impermeable surfaces
 - ▶ Lawns, roads, buildings
- ▶ Often w/ many septic systems
- ▶ May have wells

When it rains...

- ▶ water runs off impermeable surfaces & percolates into soil
- ▶ Steep slopes can erode from fast-moving water
- ▶ Runoff carries pollutants from driveways/streets/sidewalks
 - ▶ fertilizer, pesticides, oil, and salts
- ▶ septic systems can overflow, contaminating wells & groundwater

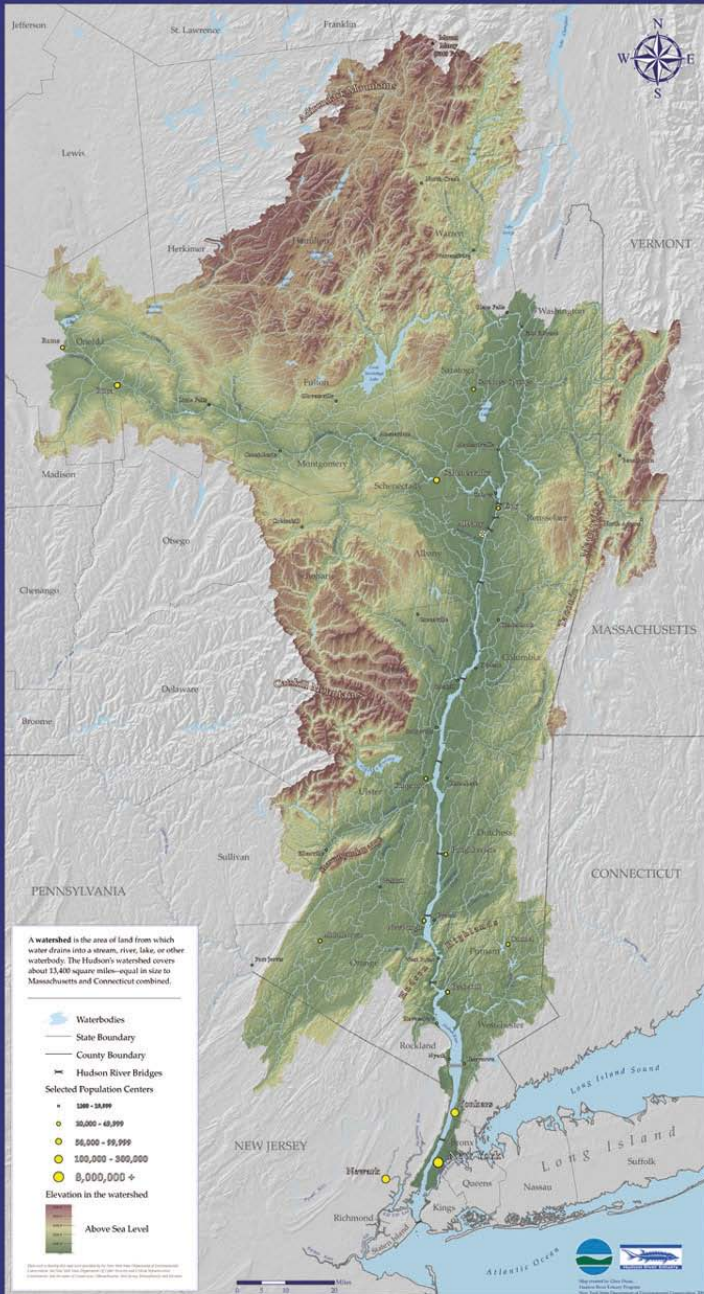


Runoff in Developed Areas

- ▶ Water funneled to treatment plants
- ▶ Highly polluted
- ▶ Often old infrastructure
- ▶ Pollution harms animals in streams and waterways.
- ▶ Standing water breeds mosquitoes and smelly algae



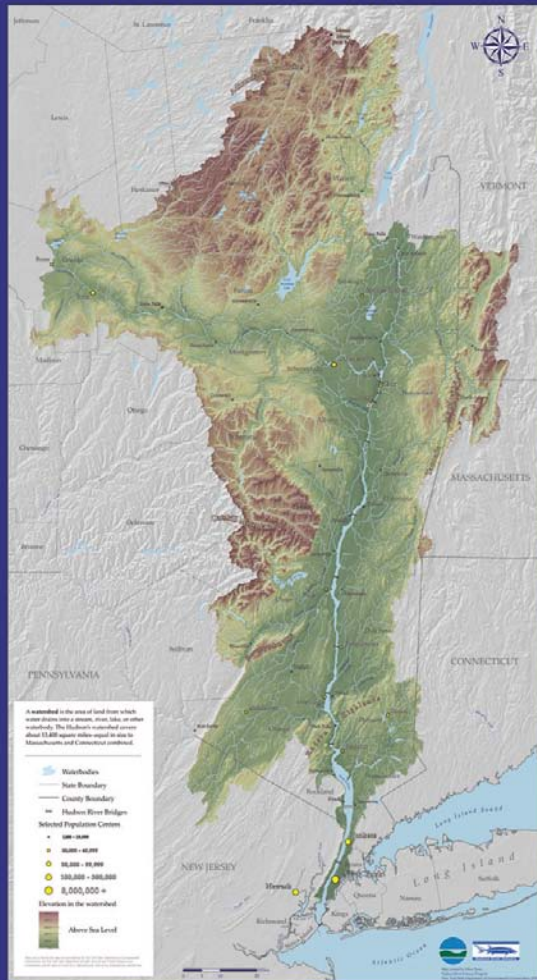
The Hudson River Watershed



Our watershed

Land cover and watershed health

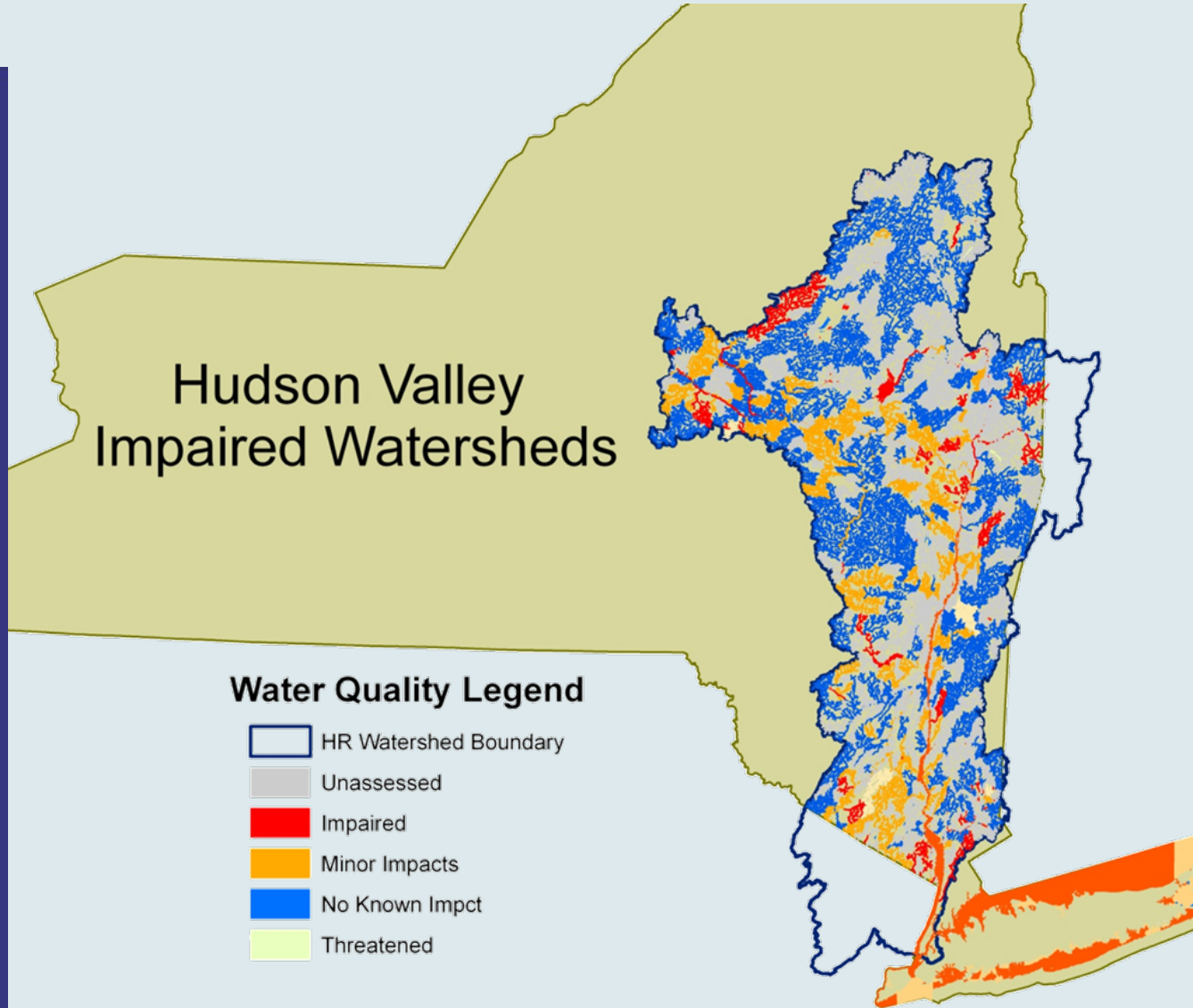
The Hudson River Watershed



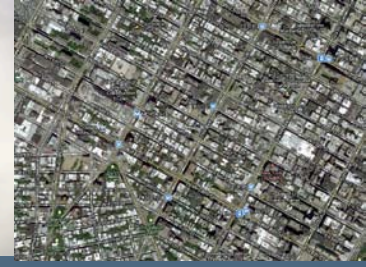
Hudson Valley
Impaired Watersheds

Water Quality Legend

- HR Watershed Boundary
- Unassessed
- Impaired
- Minor Impacts
- No Known Impact
- Threatened



In conclusion...



- ▶ Land cover type has BIG effects on water runoff
- ▶ We change the land cover everywhere we live & work
- ▶ Communities need to use their land wisely.

