

# Rain Forests and the Water Cycle

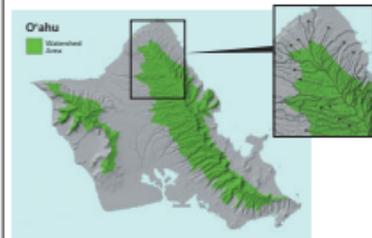
## The Watershed is Our Collection Basin

Rainfall is only one part of the water cycle equation. O'ahu also interacts with the skies to funnel water from the atmosphere back to land. The island's topography, augmented by a healthy, balanced natural ecosystem, catches, collects and stores water.

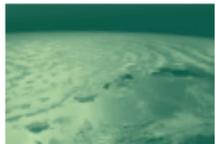
## What is a Watershed?

A watershed is an area of land, such as a mountain or a valley, that catches and collects rainwater. Topography influences whether rainwater moves toward the sea via rivers and streams or via movement underground.

O'ahu has two main watersheds: one in the Ko'olau Mountains and another on the crest of the Waianae Range. The Ko'olau run perpendicular to the Northeast trades and experience the heaviest rainfall. The Waianae peaks, though higher, sit in the Ko'olau rain shadow and receive less rain, even on their windward slopes.



Above: Rain falling along O'ahu's upper slopes and ridges flows downhill toward the sea. From the summit, water flows to both sides of the island with a greater volume of water falling on windward slopes.



Right: The island chain seen from space.

## What is a Rain Forest?

A rain forest is a forest ecosystem in which rainfall is abundant throughout the year. The covering in the forest catches rain and dew and stabilizes the upper soil layers, letting rainwater filter through to deeper layers. Forest growth also stabilizes stream banks, limiting erosion debris in surface flow.

The heavily forested regions on the mountain tops of each island are Hawaii's primary watershed areas.



## Glossary of Basic Hydrology Terms

**Aquifer:** an underground bed or layer of earth, gravel, or porous stone that yields water

**Dew:** water vapor that condenses on solid surfaces that have cooled below the condensation point of water

**Artesian well:** a well drilled through impermeable strata to reach water; pushed by pressure from the underground aquifer, this water naturally rises to the earth's surface

**Boiling point:** the temperature at which a liquid boils; for water this is 212 degrees Fahrenheit (100 degrees Celsius)

**Desalination:** removal of salt from seawater using a semi-permeable membrane; the membrane prevents

the passage of salts as the water is forced through it

**Dew point:** temperature at which water vapor condenses into cloud droplets

**Dike:** underground water barrier formed of nonporous, dense volcanic bedrock (basalt); can form water storage chambers

**Evaporation:** conversion of liquid water through heat energy into water vapor

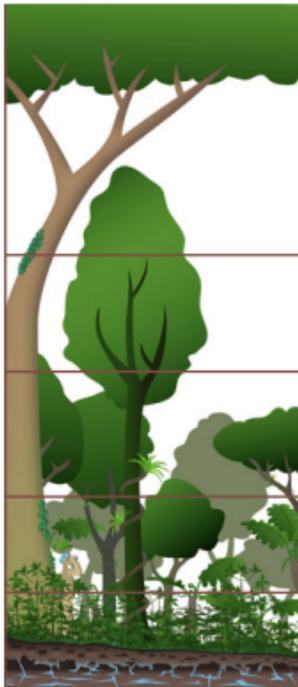
**Fog drip:** water vapor which condenses on cooler surfaces such as rocks and plants without falling to earth as rain

**Ghyben-Herzberg lens:** freshwater aquifer below a tropical ocean island; rainwater percolates through the island and floats above the surrounding seawater; this ground-water forms a root shape beneath the island and floats above the surrounding seawater

**Groundwater:** any water beneath the earth's surface; or a region of subsurface water that forms a saturation zone in which all pore spaces are filled with water

## The Hawaiian Rain Forest is the Ultimate Watershed Cover

Hawaii's native forests have evolved over millions of years to become highly effective watershed covers. Vegetation in the forest fills every level. It soaks up rainfall like a giant sponge, allowing water to drip slowly underground and into streams.



**Emergent Trees**  
Koa, 'ohi'a

These trees are the first to intercept heavy raindrops, absorbing the energy of their fall. Tree leaves pull moisture from passing clouds via condensation (fog drip). Water runs from leaves, down branches, to plants at lower levels.



**Canopy Trees**  
Oh'i'a

Canopy trees catch the majority of raindrops as well as additional fog drip. Water flows along branches to the trunk; bark texture slows the rate of flow.



**Subcanopy Trees & Shrubs**

This level absorbs tree drip from the layers above, holding much of the water in its vegetative structure and passing some flow along stems to the ground. Subcanopy plants keep the air near the ground water-saturated, slowing evaporation from the ground layer.



**Understorey**

These ferns and shrubs absorb additional water from higher plants as well as the energy of dripping water.



**Ground Cover**

Mosses, small ferns such as lōe a Māui, 'āhaha

**Hydrologic:** concerning water on the earth's surface, in the soil and underlying rocks and in the atmosphere

**Intermittent stream:** surface water that flows seasonally or only after heavy storms

**Non-potable:** water that is not of drinking water quality, but which may still be used for many other purposes, depending on its quality

**Orographic lifting:** winds push moist air up against mountains or cliffs to produce clouds and precipitation

**Perennial stream:** permanently flowing water, fed by consistent rainfall

**Potable:** drinkable water of excellent quality, conforms to state and federal requirements

**Precipitation:** rain, snow, dew, frost, sleet, or hail condensed from atmospheric water vapor (clouds) and falling to earth

**Rain shadow:** area sheltered from prevailing winds and rain by adjacent high ground or mountains and hence an area of low rainfall

**Spring:** water that emerges from an underground source to feed streams or release freshwater directly into the ocean

**Surface water:** water flowing or collecting at the level of the earth's surface, such as streams, rivers, springs, or lakes

**Transpiration:** evaporation of water from the surface of a plant

**Water table:** level under the ground in permeable or porous rock below which the ground is completely saturated with water

## What Happens When the Rain Forest is Degraded?

When a forest is degraded, rain falling on bare earth causes erosion. The water-retaining upper soil layers are washed away, leaving behind less permeable clays. Water runs off this impermeable surface rather than filtering down to replenish the aquifer.

Streams that emanate from deforested mountains flood during rains. When the rains stop, these streams run dry. The loss of stabilizing tree and plant roots results in landslides. Debris carried by streams ends up in ocean coastal areas, causing siltation of reefs.

When a native forest is eroded and damaged, opportunistic foreign species invade. While these new plants can stabilize bare ground, the watershed cover they create is not as effective as that of the native forest.



This eroded, barren tract used to be a healthy native rain forest. The thinned vegetation now offers few layers to intercept rainfall and the remaining root systems are insufficient to hold the soil, so erosion is worsened. Runoff is greater and more water is now lost to evaporation due to the lack of shade and wind protection. Weedy grasses move in to take advantage of exposed soil.