RIVER SYSTEMS AND LANDFORMS (1)
RIVER DRAINAGE BASINS AND RIVER BEHAVIOUR

1. Introduction
2. Rivers and drainage basins
3. River discharge
4. The river basin system
5. Hydrographs and floods
Human impacts on the global water system.
Source: Vörösmarty et al., 2004, Humans transforming the global water system, *Eos* 85, 48.
WHAT IS A RIVER?

A river is a body of water flowing downslope in a physically distinct channel.
Formation of river channels from sheetflow, rills and gulleys. See also Christopherson, 2012, p. 402.
Development of rills in a slope above McIntyres Bluffs, shore of Lake Ontario.
Source: SUNY Oswego Geology Dept., photo by Sharon Gabel.
Rills in a farm field.
Rills in Capitol Reef National Park.
Gulleys and rills can eventually erode topsoil significantly; river channels may eventually form.

Source: Geography Dept., Union College, Schenectady NY.
Drainage basins, rills and gulleys.

Drainage basins scale.

Drainage basins and continental divides.

Closed basins: internal drainage and exotic streams.

Source: Salt Lake Tribune.
The Colorado River drainage basin.
The Colorado River drainage basin.
The Colorado River delta, September 8 2000.
Source: NASA’s Visible Earth.
DRAINAGE DENSITY

Total length of stream channels \( \text{(km)} \)

Total area drained by channels \( \text{(km}^2\text{)} \)

High drainage density

Low drainage density
DRAINAGE DENSITY

Total length of stream channels (km)
Total area drained by channels (km²)

Depends on:

• erodibility of surface
• erosiveness of flow
Very high drainage density in Badlands National Park, South Dakota.
Source: photo by Drew Milsom, Physics Department, University of Arizona.
An example of radial drainage: Mt. Rainier, Washington.

Source: Mt. Rainier National Park.
Radial drainage on Mt. Rainier, WA. Source: GoogleEarth
An example of trellis drainage: the Shenandoah River basin.
Source: Virginia Department of Game and Inland Fisheries.
An example of trellis drainage: the Shenandoah River basin. Source: Virginia Department of Game and Inland Fisheries.
RIVER DISCHARGE

\[ Q = w d v \]

Discharge Width depth velocity

Also expressed as \[ Q = a v \]
Measuring discharge in a straight section of river.

Cross-sectional area (width times depth)

Zone of fastest flow
Channel shape affects river velocity: 1941 flood of the San Juan River near Bluff, UT.

Source: Christopherson, 2012, p. 408.
Channel shape affects river velocity: 1941 flood of the San Juan River near Bluff, UT. 
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THE RIVER BASIN SYSTEM

Overland flow (surface runoff)

Soil

Bedrock

Groundwater flow

Precipitation

Interception

Through flow
The same waterfall 24 hours earlier.
Hydrographs showing the effects of urbanization.