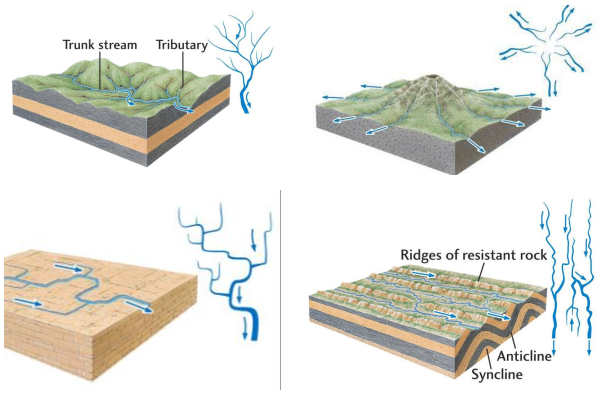
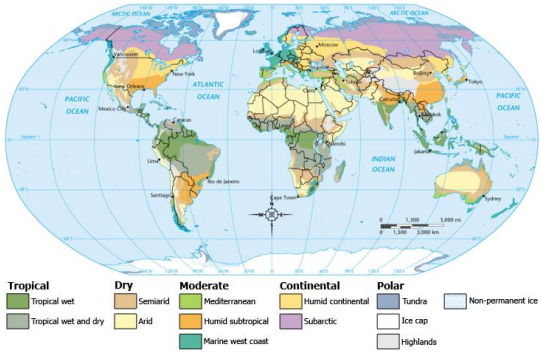
WATERSHED SHAPE FACTORS

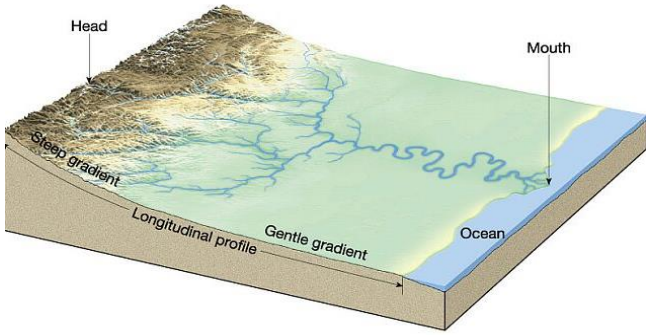
GEOLOGY



CLIMATE

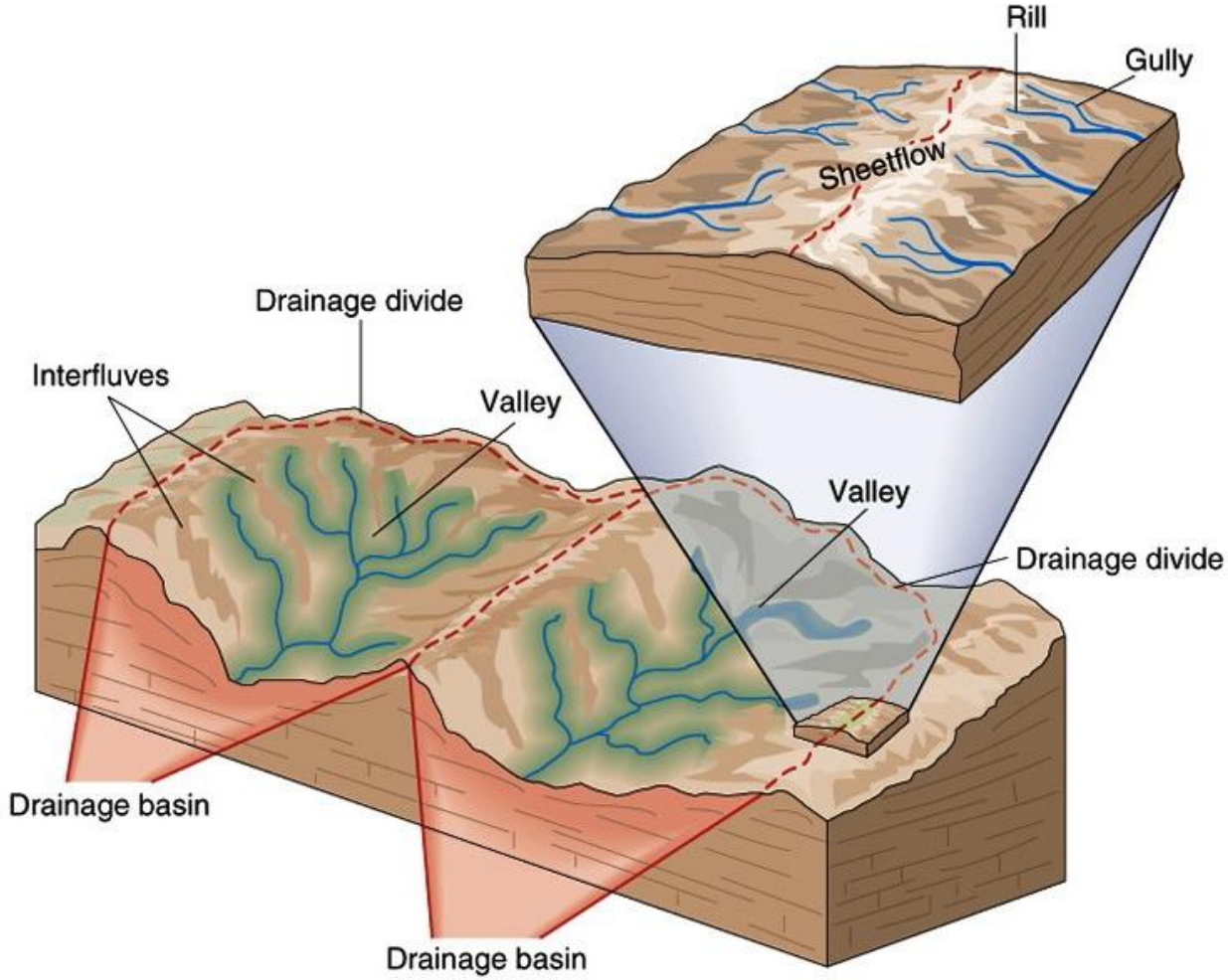


SLOPE



NATURAL PROCESSES & HUMAN IMPACTS

WATERSHED = CATCHMENT = DRAINAGE BASIN



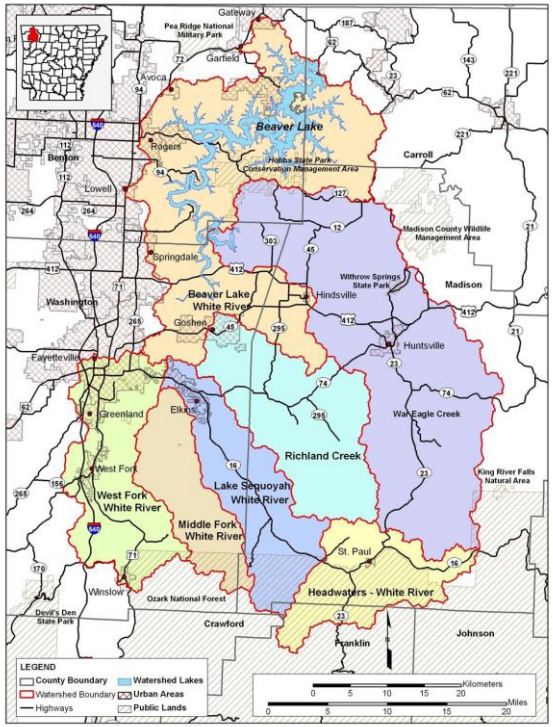
Source: http://www.sci.uidaho.edu/scripter/geog100/lect/11-rivers/11-rivers.htm

A watershed is an "area of land that drains water, sediment, and dissolved materials" to the lowest elevation point within it, such as a common water body or "outlet along a stream channel." (Paraphrased from Dunne and Leopold 1978).

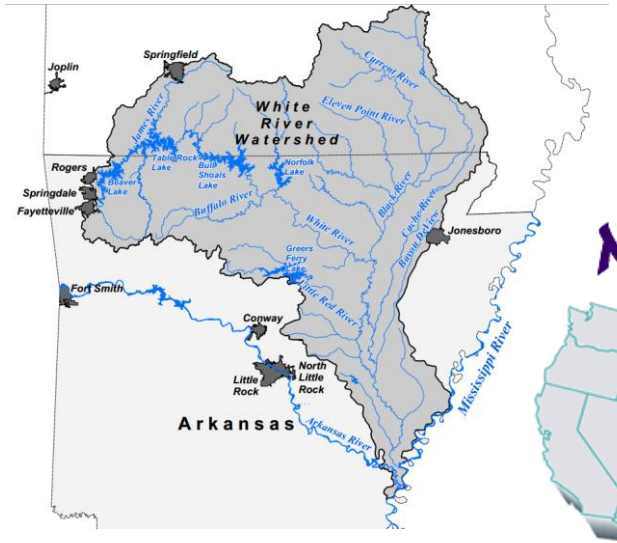
Source:
http://www.epa.gov/owow/watershed/wacademy/acad2000/stream/stream11.html

WATERSHEDS & Sub-Watersheds

THE BEAVER LAKE WATERSHED IS AN AREA OF LAND THAT COLLECTS AND DRAINS PRECIPITATION INTO BEAVER LAKE.



THE BEAVER LAKE WATERSHED IS A SUB-WATERSHED OF THE WHITE RIVER WATERSHED.



SOURCE: hillnholler.files.wordpress.com/2013/07/white-river-watershed.png

Like stacking bowls, a **WATERSHED** may be part of one that is larger and also have other smaller **"SUB-WATERSHEDS"** inside it.

THE WHITE RIVER WATERSHED IS A SUB-WATERSHED OF THE MISSISSIPPI RIVER DRAINAGE BASIN.

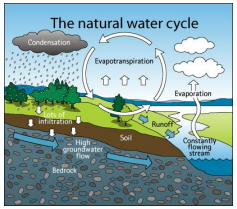
SOURCE: www.mississippiriveradventures.com/picts/Mississippi-map.gif

THE BEAVER LAKE WATERSHED INCLUDES SUB-WATERSHEDS OF 7 MAJOR STREAMS:

1) White River Headwaters
2) West Fork of the White River
3) Middle Fork of the White River
4) White River/Lake Sequoyah
5) Richland Creek
6) War Eagle Creek
7) Beaver Lake/White River

SOURCE: www.bwdh2o.org/files/45/2010_FINAL_Beaver_Lake_Watershed_Report.pdf

3 MAJOR FACTORS THAT SHAPE WATERSHEDS & STREAMS



www.sswm.info/category/concept/water-cycle

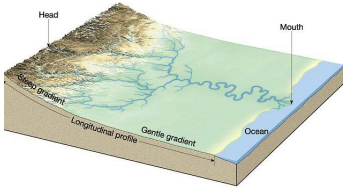
1. CLIMATE / WATER CYCLE

The average weather (including rainfall, temperature, wind) over a long time period that is characteristic of a region

earthobservatory.nasa.gov

2. GEOLOGY: "EARTH STUDY"

Science focused on the study of rock chemistry, composition, features, forms, and locations in order to gain understanding about Earth's dynamics, physical history, processes, shape, and structures



geophysics.ou.edu/geol1114/notes/running_water/running_water.html

3. SLOPE

An inclined surface of which one end or side is at a higher level than the other

SOILS & VEGETATION ARE ALSO SIGNIFICANT CONTROLLING FACTORS IN THE DEVELOPMENT OF WATERSHED & STREAM CHARACTERISTICS.

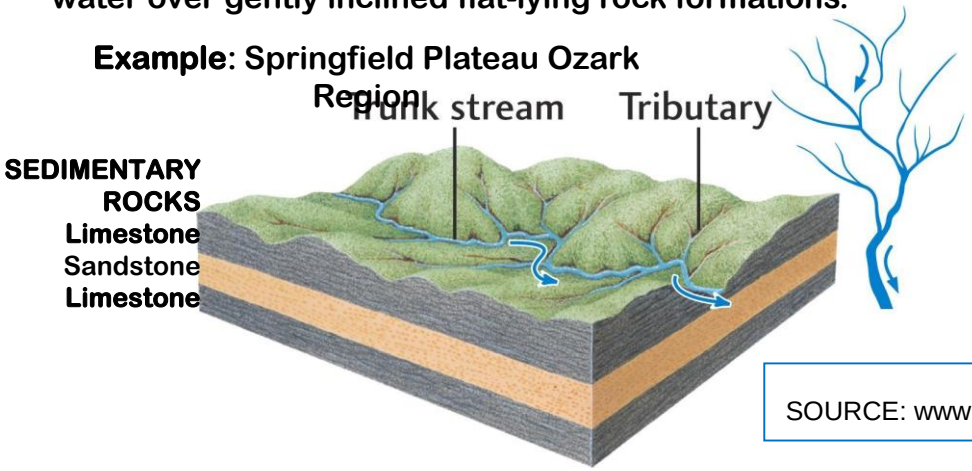
GEOLOGY & DRAINAGE PATTERNS

Shape of the stream systems draining a particular region

Dendritic: "Tree Trunk & Branches"

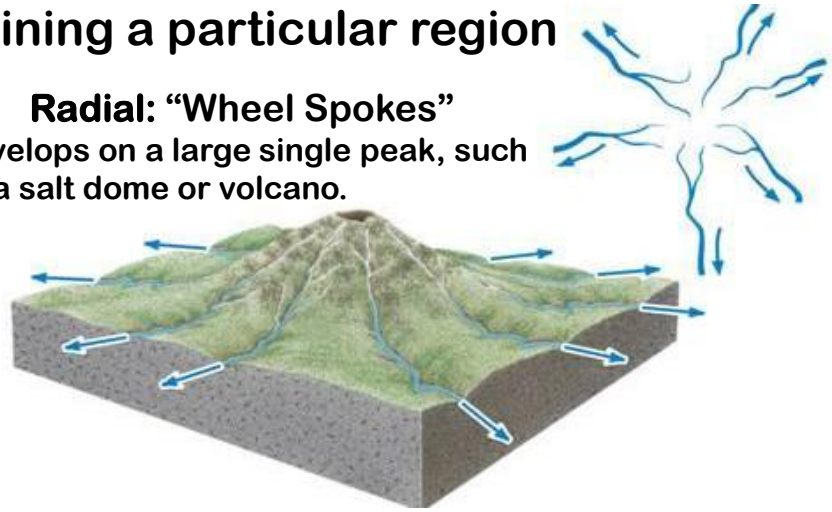
Most common drainage pattern resulting from flow of water over gently inclined flat-lying rock formations.

Example: Springfield Plateau Ozark Region



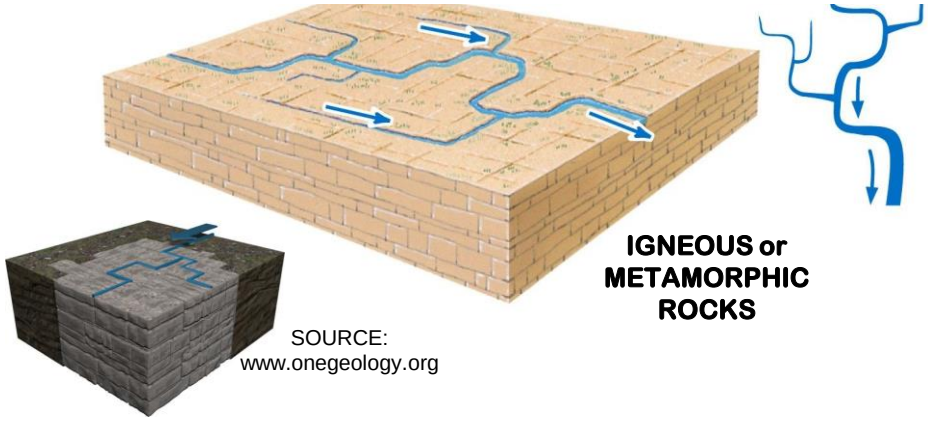
Radial: "Wheel Spokes"

Develops on a large single peak, such as a salt dome or volcano.



Example: Hawaiian Islands, Mt. Shasta/CA

SOURCE: www.studyblue.com

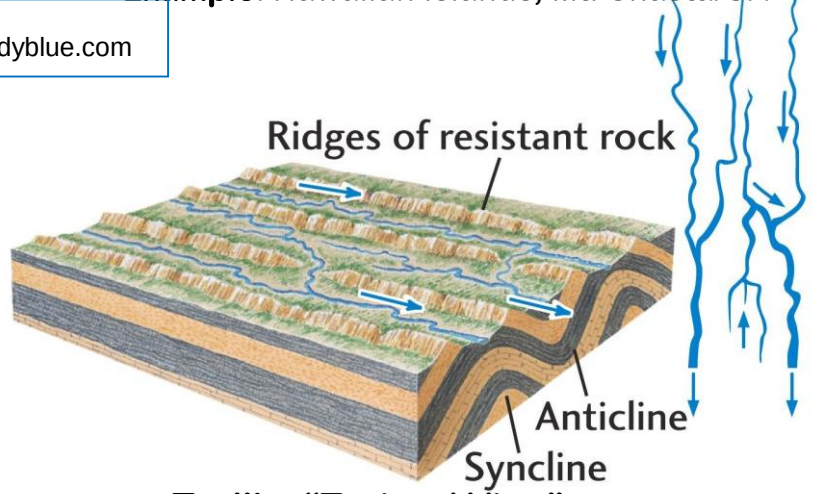


SOURCE: www.onegeology.org

Rectangular: "Square-Corners"

Forms on rocks with well-developed joint system

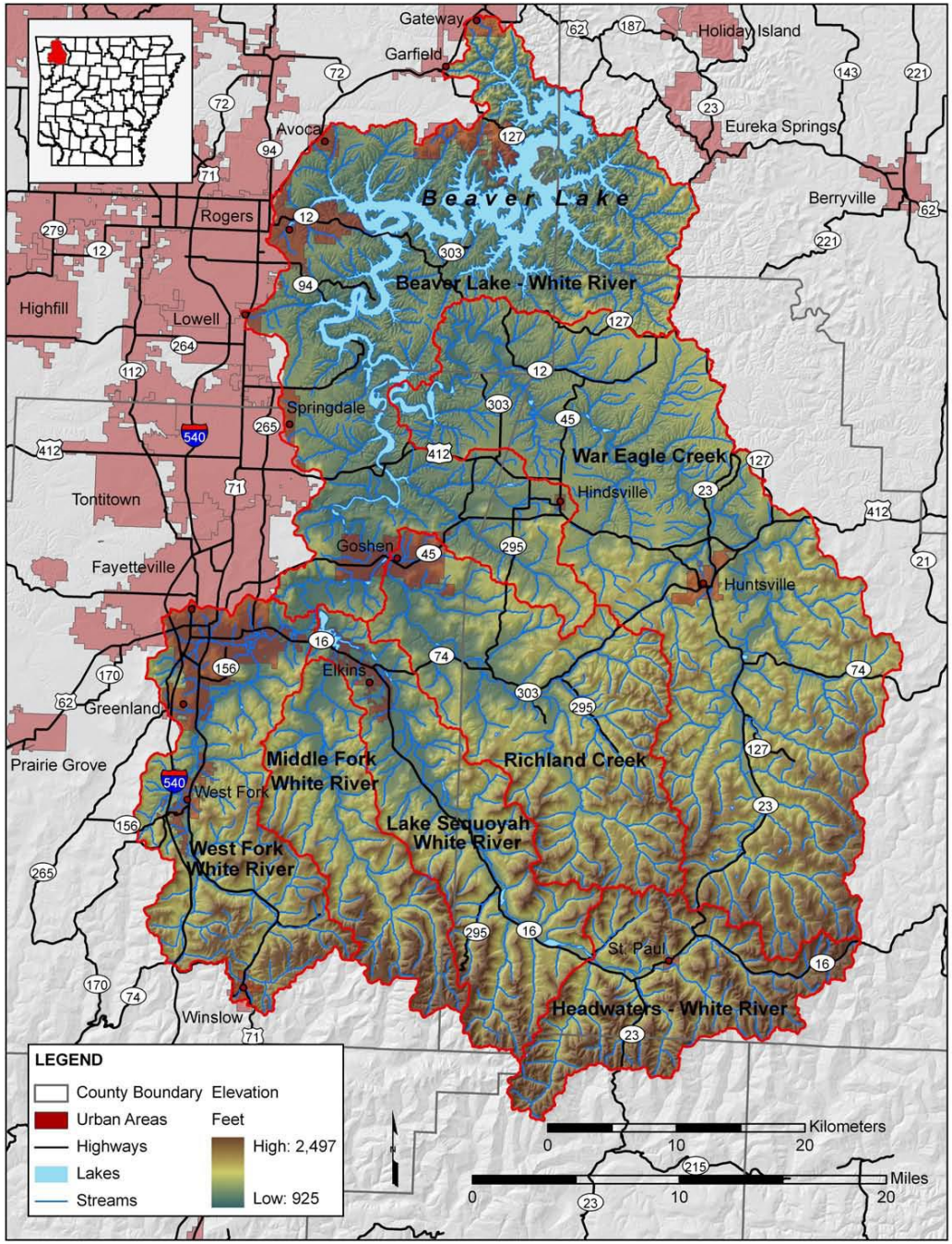
Example: Canadian Shield



Trellis: "Trained Vine"

Streams flowing on "folded" SEDIMENTARY rock units follow valleys bounded by ridges of erosion resistant rock.

Example: Appalachian Mountains Virginia & Pennsylvania



The DENDRITIC drainage pattern is characteristic of the Ozark Plateau Province and the Beaver Lake Watershed.

Source:
http://www.bwdh2o.org/files/45/2010_FINAL_Beaver_Lake_Watershed_Report.pdf

CLIMATE:

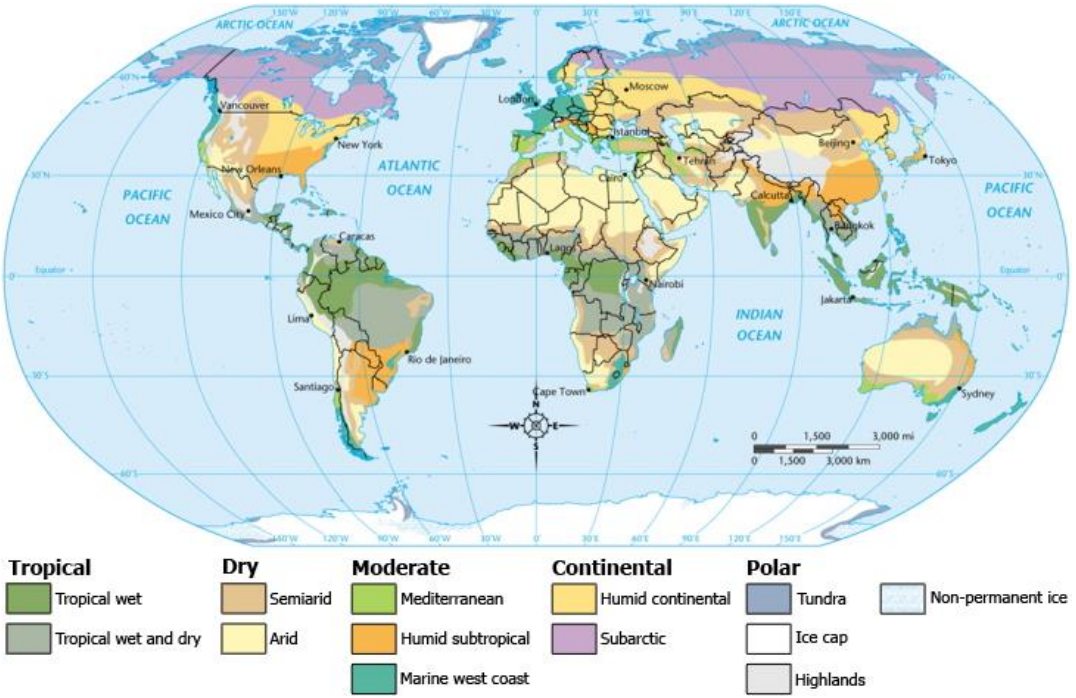
THE AVERAGE WEATHER (INCLUDING RAINFALL, TEMPERATURE, WIND) OVER A LONG TIME PERIOD THAT IS CHARACTERISTIC OF A REGION

DESERTS: Rainfall Negligible

Arid: <0-10 centimeters = <0-4 inches per year
Semi-Arid: <10-30 centimeters = <4-12 inches

Source: www.weaselinthebarley.com/scenic_wallpapers/desert.htm

Source: www.airphotona.com/image.asp?imageid=1742



Source: http://commons.wikimedia.org/wiki/File:ClimateMapWorld.png

GRASSLANDS: Rainfall Minimal

Temperate: <25-75 centimeters = <10-30 inches per year
Tropical: <64-150 centimeters = <25-60 inches per year

http://www.americansouthwest.net/wyoming/yellowstone/pelican-grasslands.html

http://www.kidcyber.com.au/topics/biomegrass.htm

WOODLANDS: Rainfall Moderate

<75-150 centimeters = <30-60 inches per year

Source: http://www.kansasforests.org/newindex.shtml

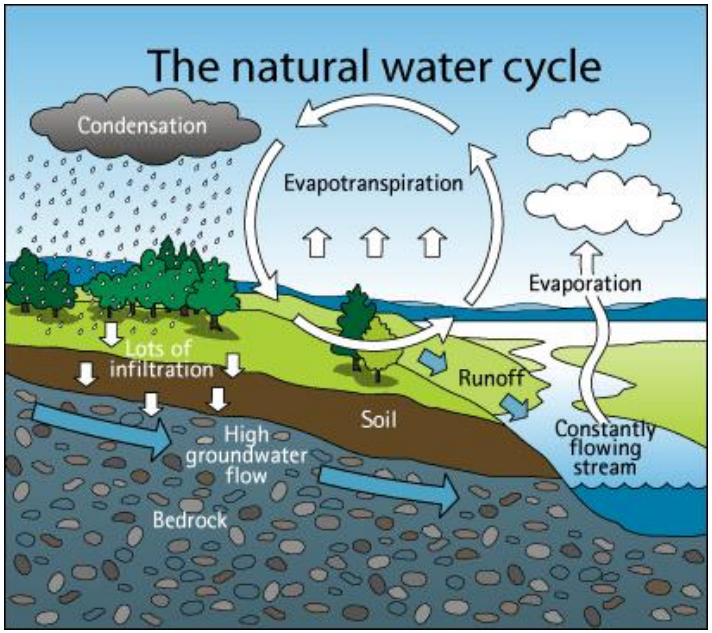
Source: http://www.geograph.org.uk/photo/2427529

RAINFORESTS: Rainfall Maximum

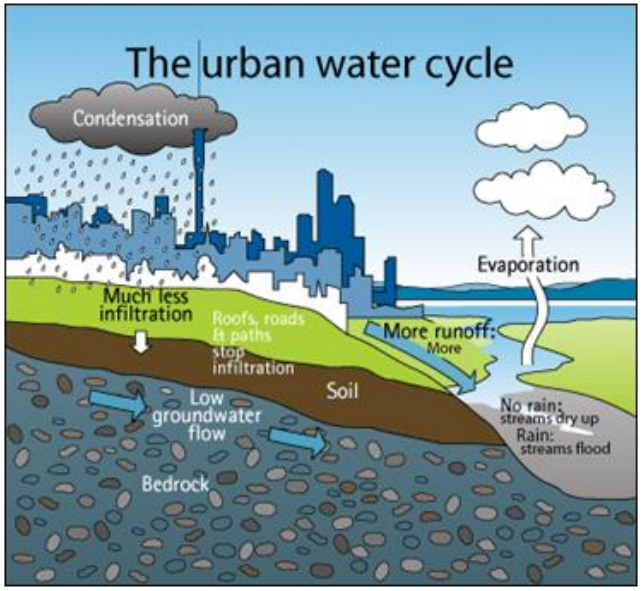
<175-200 centimeters = <69-79 inches per year

Source: http://burns1.wikispaces.com/Southeast+Asian+Rainforest

Source: http://photos.igougo.com/pictures-photos-p211084-rain_forest.html



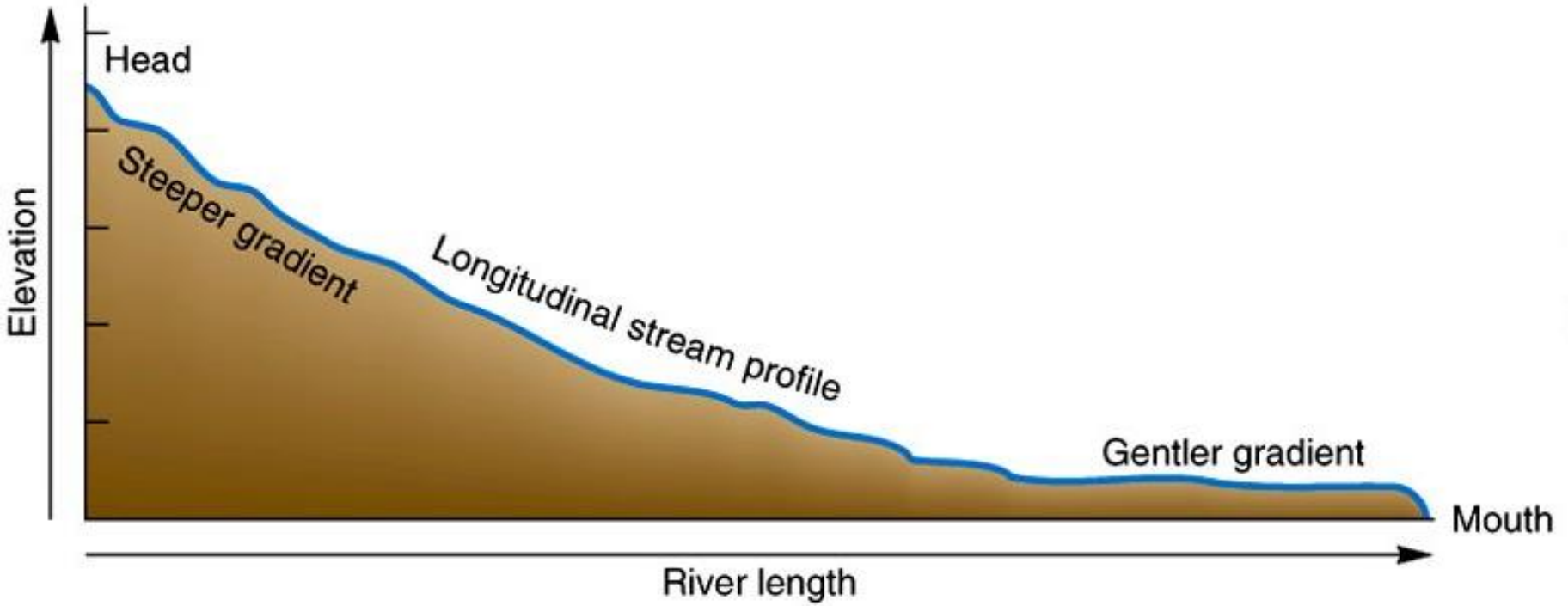
(Source: http://www.sswm.info/category/concept/water-cycle)



(Source: http://www.sswm.info/category/concept/water-cycle)

(Source: http://www.aucklandcity.govt.nz/council/services/stormwater/about.asp)

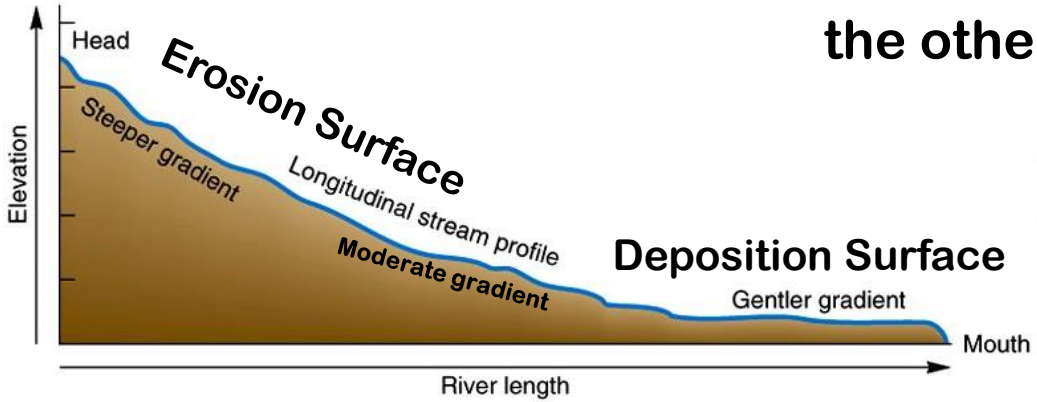
SLOPE or GRADIENT



Source:
http://www.sci.uidaho.edu/scripter/geog100/lect/11-rivers/11-rivers.htm

SLOPE

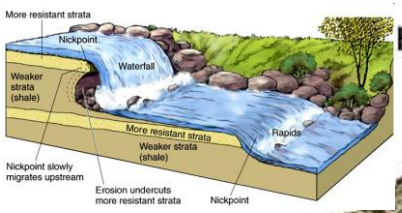
An inclined surface of which one end or side is at a higher level than the other



Source: www.sci.uidaho.edu/scripter/geog100/lect/11-rivers/11-rivers.htm

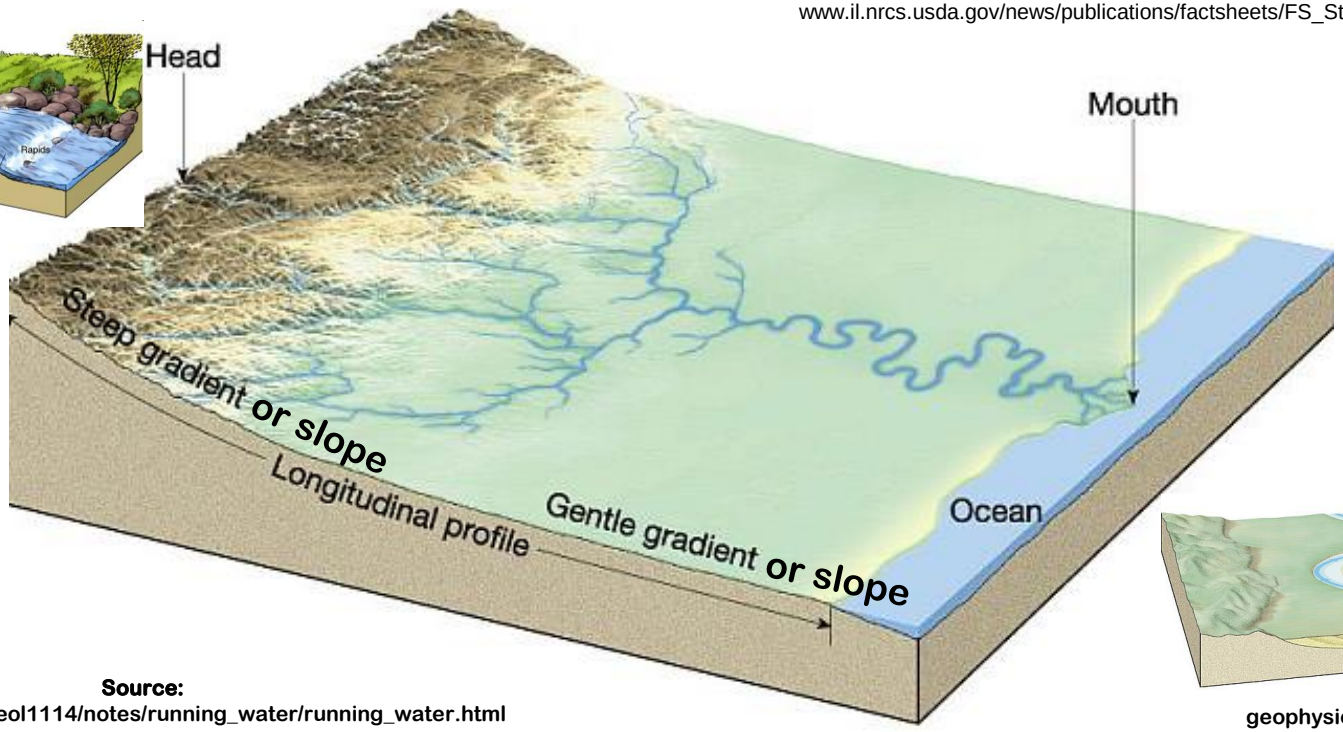
Over many years, streams develop their patterns and characteristics of transporting water and sediment from upland areas, through floodplains, and on to larger streams and rivers, and eventually, oceans.

Source:
www.il.nrcs.usda.gov/news/publications/factsheets/FS_StreamDynamics.html



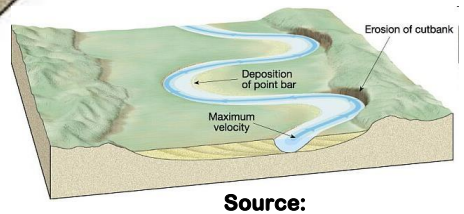
Headwater stream on steep slope

Source:
www.sci.uidaho.edu/scripter/geog100/lect/11-rivers/11-rivers.htm



Source:
geophysics.ou.edu/geol1114/notes/running_water/running_water.html

Meandering stream on nearly level or flat surface



Source:
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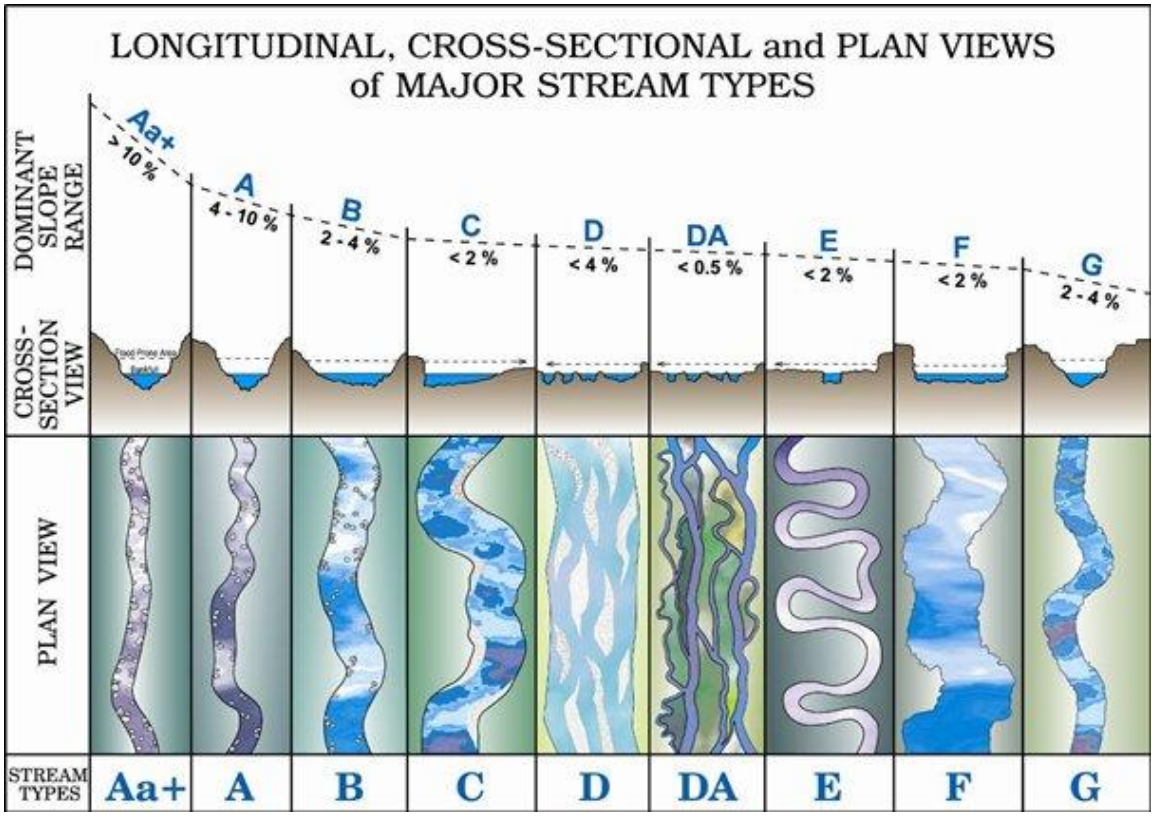


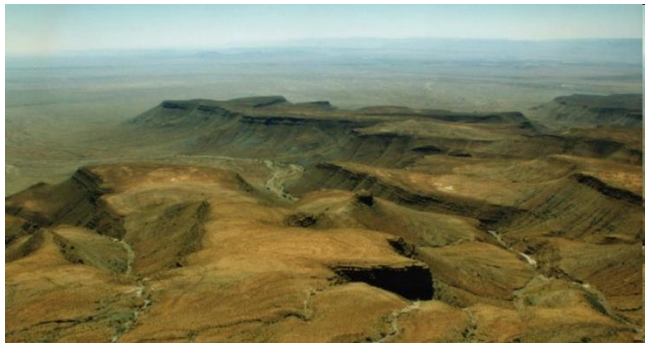
(Rosgen, 1996, reprinted with permission from Wildland Hydrology)

Aa	Very steep, deeply entrenched, low width/depth ratio and laterally contained
A	Steep, entrenched, cascading with step/pool streams
B	Moderately entrenched, moderate gradient, riffle-dominated channel
C	Low gradient, meandering, point-bar, riffle/pool with broad floodplains
D	Braided channel with longitudinal and *transverse bars* – very wide with eroding banks
DA	Multiple channels, narrow and deep, with extensive well-vegetated floodplains and *wetlands*
E	Low gradient, meandering riffle/pool stream with low width/depth ratio, high meander width ratio
F	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio
G	Entrenched 'gully' step/pool and low width/depth ratio on moderate gradients

http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter4.aspx

DYNAMIC EQUILIBRIUM

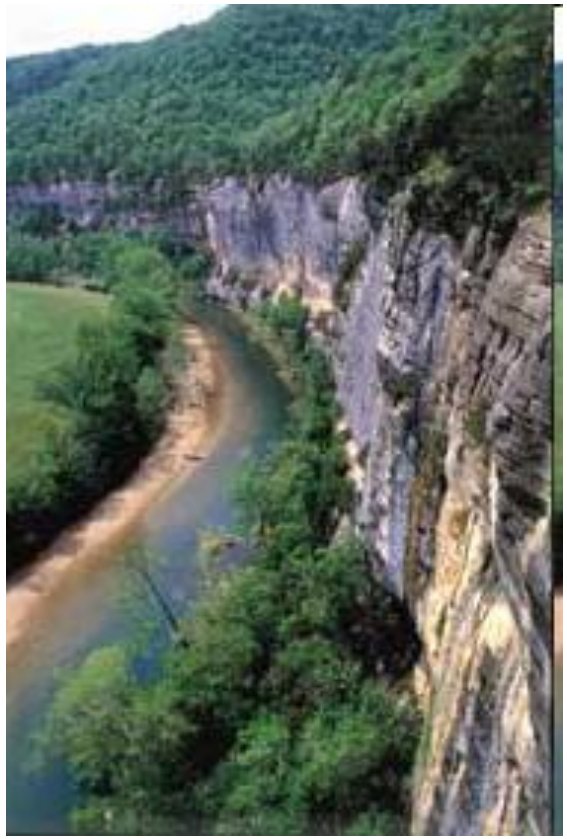
For hundreds of years, where climatic conditions stabilized, only minor changes were made to the landscape, and stream systems developed a balance of size and shape capable of carrying the water and sediment generated within each watershed.



http://throughthesandglass.typepad.com/through_the_sandglass/2009/08/index.html

http://forecaster.deltares.nl/index.php?title=Widen_water_courses

http://littlerock.about.com/od/outdoorrecreation/ig/Cossatot-River-State-Park/Cossatot-River-State-Park.-2qT.htm



http://www.ouraaa.com/traveler/images/mag0105/ST16A.jpg

This balance is known as a state of DYNAMIC EQUILIBRIUM in which stream channels, in a stable climatological setting, continue to shift and change slowly while maintaining their overall shape and size.

HUMAN ACTIVITIES DRAMATICALLY AFFECT THE WATER CYCLE, IMPACT THE LANDSCAPE, ALTER DRAINAGE PATTERNS, & INCREASE RUNOFF

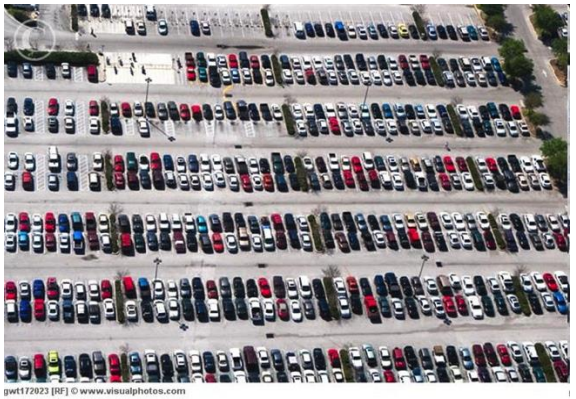
PLOWING

http://kids.britannica.com/comptons/art-56029/An-aerial-view-of-farmland-in-Minnesota-shows-the-unique

CLEAR CUTTING FORESTS

http://fightingfazz.blogspot.com/

PAVING



http://www.visualphotos.com/image/2x3869618/aerial_view_of_cars_parked_in_a_parking_lot

CHANNELIZATION

http://www.portadam.com/cp-projects/channelization/

BUILDING

http://paulin8.blogspot.com/2011/06/sprawl-repair-manual.html

MINING

http://esl-radmila.blogspot.com/2010/10/mountain-top-removals-in-west-virginia.html

The landscape has been altered dramatically by human activity since the beginning of European settlement over 200 years ago. These alterations are causing our stream systems to change dramatically in an attempt to restore equilibrium.

http://www.il.nrcs.usda.gov/news/publications/factsheets/FS_StreamDynamics.html

Climate Patterns Are Changing, Bringing More Frequent Intense Storms with Heavy Downpours on Ever Expanding Areas Covered By Hard Surfaces. This Greatly Increases Stormwater Runoff and Flash Flooding.

2012 Isaac Prompts Flash Flood Watch for Arkansas (katv.com)

April 25, 2011 Flash Flood (ulocal.4029tv.com)

(ulocal.4029tv.com)

April 25, 2011 Fvl/College Ave. (nwaonline.com)

FLASH FLOODING CAUSES EXTREME EROSION

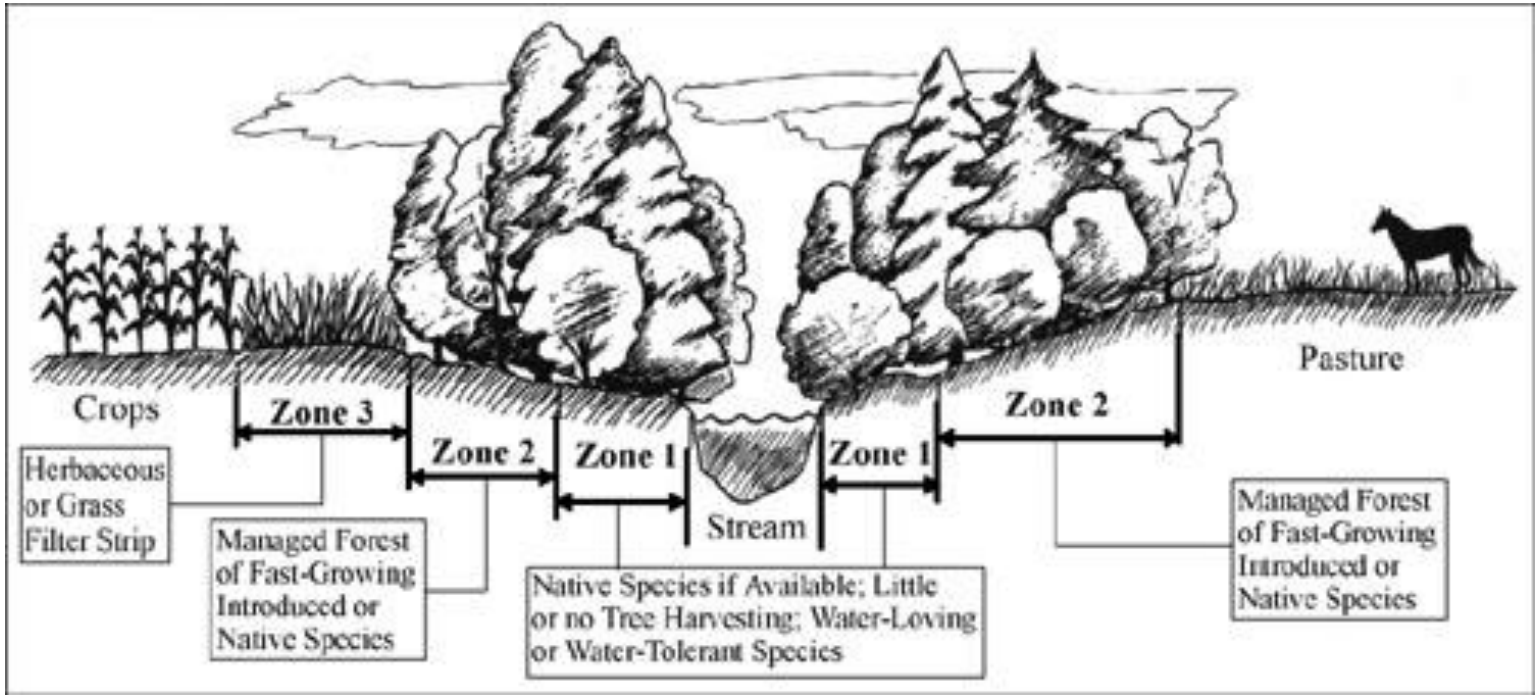
http://www.wrfalp.com/several-north-county-communities-hit-hard-by-heavy-rain-flash-flooding/

Kansas Water Office Photo (kwo.org)

Watershed Conservation Photo (watershedconservation.org)

Austin, TX Photo (crwr.utexas.edu)

WELL ESTABLISED VEGETATIONS HELPS HOLD SOIL IN PLACE



RIPARIAN BUFFER ZONES (aftaweb.org)

OZARKS WATER WATCH NEWSLETTER June 11, 2012
Vol VI Issue 24
WHITE RIVER BANK STABILIZATION PROJECT SPRING 2012

http://archive.constantcontact.com/fs075/1102224436468/archive/1110191050621.html

LOW IMPACT DEVELOPOMENT METHODS AND PRACTICES:

1. **MIMIC &/or WORK WITH NATURE**
2. **UTILIZE STORMWATER RUNOFF AS A RESOURCE**
3. **ALLOW STORMWATER TO SLOW DOWN SPREAD OUT, & SOAK IN REDUCING RUNOFF THAT CAUSES FLASH FLOODING & EROSION**

Learn More: https://www.epa.gov/nps/urban-runoff-low-impact-development
https://www.usgbc.org/education/sessions/sustainable-stormwater-management-11532332

GRASS-COVERED SWALES or DITCHES

GRASS PAVERS

FLAT CURB or NO CURB PAVEMENT

RAIN GARDENS & BIO-RETENTION BASINS LANDSCAPED WITH NATIVE PLANTS

LANDSCAPED BIOSWALES

PERMEABLE Or PERVIOUS CONCRETE

LOW IMPACT DEVELOPOMENT METHODS AND PRACTICES:

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Learn More:

ARKANSAS STORMWATER EDUCATION PROGRAM - https://www.uaex.edu/environment-nature/water/stormwater/default.aspx

GREEN INFRASTRUCTURE - https://www.americanrivers.org/threats-solutions/clean-water/green-infrastructure/what-is-green-infrastructure/

US EPA GREEN INFRASTRUCTURE - https://www.epa.gov/green-infrastructure

US EPA URBAN RUNOFF – LOW IMPACT DEVELOPMENT - https://www.epa.gov/nps/urban-runoff-low-impact-development

WHY IS STORMWATER AN ISSUE? - https://www.uaex.edu/environment-nature/water/stormwater/nwastormwater/why_is_stormwater_an_issue.aspx

Know the Flow

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System

NWArkansas stormwater education