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River Water Quality

Section **2b**: Hydrology & Ecology of Running Waters

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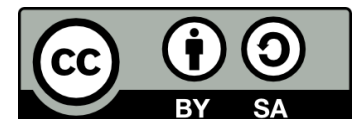


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Hydrology & Ecology of Running Waters

River Hydro-morphology

Section Contents

1. Water flow in a stream
2. Stream Water Discharge
3. Transport of Material
4. Stream Profiles
5. Sinuosity
6. Bars, Riffles & Pools
7. Floodplain



Water flow in a stream

- Rivers represent the excess of rainfall onto land areas [Precipitation – Evaporation (70% Precipitation) – infiltration to groundwater] which flows via channels to the sea.
- 2 types of water flow:
 - ✓ Laminar flow – occurs when water is moving very slowly. All water units flow parallel at the same speed
 - ✓ Turbulent flow – occurs when the velocity is increased. Most usual pattern of flow, characterized by instability, with neighboring units of water moving in different directions & with different velocities
- Velocity affects the nature of substrate & the biota. The current velocity varies within a stream's cross section due to friction, sinuosity & obstructions. Higher velocity is measured near the surface & the center of a stream, & decreases as a function of depth



Stream Water Discharge

- Is the volume of water passing a given point during a given period of time (m^3/sec)
- Depends on channel width, depth & water velocity. Increases when a river receives water from its tributaries
- Discharge controls water chemistry (through dilution) & is related to the transport of suspended sediment
- Long-term monthly discharges characterize the regime of a river. The plot of discharge through time is called “hydrograph”

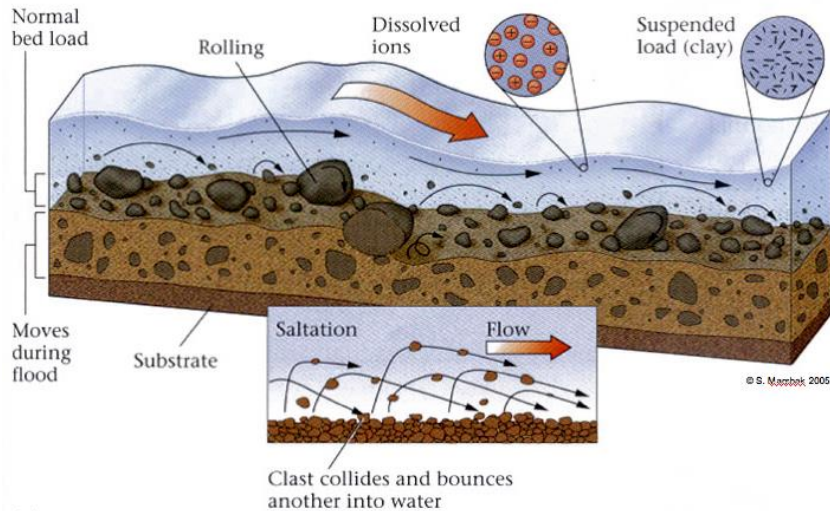


Transport of Material

- Transportation in 3 states:
 - ✓ Dissolved Matter - amount of material transported in dissolved load (subsurface flow). Solutes derive from chemical weathering of bedrock & soil
 - ✓ Suspended Solids - particles (<0.06 mm) in suspension depending on stream velocity. Solids derive from erosion of slopes, stream channel & bank
 - ✓ Bed Load - coarser sized fragments that cannot be in suspension. Particles moving by traction (rolling, sliding & skipping) along the channel bed
- The amount transported as solid or in suspension depends on basin characteristics, lithology & hydrologic pathways
- Stream competence - The size of the particle that can be eroded & transported is a function of current velocity
- Entrainment - the incorporation of particles when stream velocity exceeds the entraining velocity for a particular particle size
- Deposition occurs when stream competence falls below a given velocity for a particular particle size

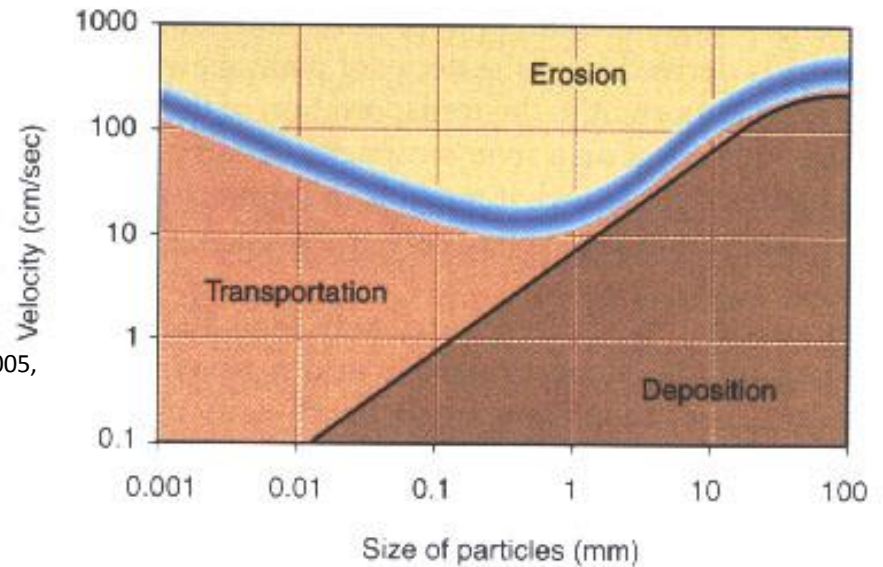


Transport of Material



The way matter is transported by a stream according to size & velocity.

From <http://www.geol.umd.edu/~jmerck/geol342/lectures/04.html> ©S. Marcobok 2005,
© 2013 John W. Merck, Jr.



The effect of velocity in the transport of material relatively to their size.

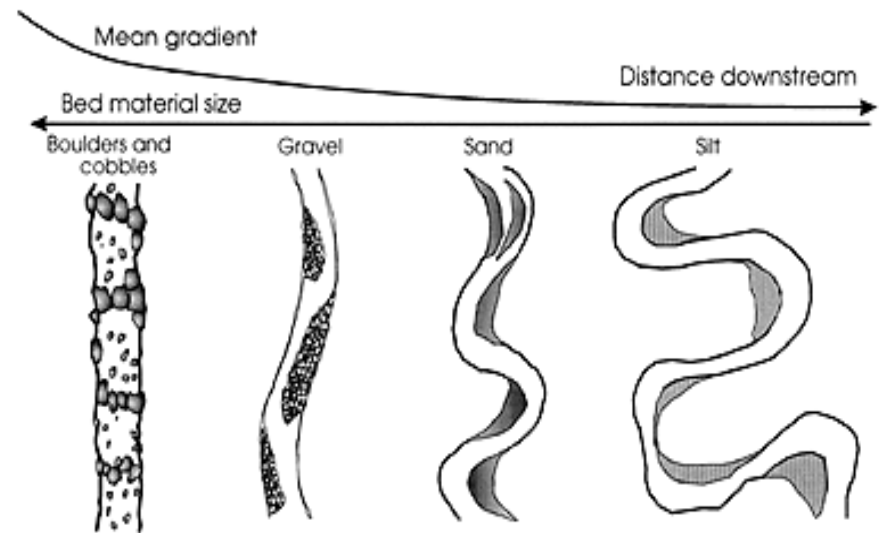
From <http://www.geol.umd.edu/~piccoli/100/CH12.htm>, © 2013 Phil Piccoli



Stream Profiles

- Unlimited variations- Generally a fast-flowing, turbulent mountain stream with the addition of tributaries results in a large & smoothly flowing river that winds through the lowlands to the sea
- Biological variables correlate with stream size & distance downstream
- Substrate also affects the type of fauna:

Group	Preferred Substrate
Lithophilous	Gravel, Cobbles, Boulders
Psammophilous	Sand
Xylophilous	Wood
Phytophilous	Plants



Substrate variability with distance downstream. At the headwaters the gradient is steep resulting downstream in a concave longitudinal profile. From: <http://shorelandmanagement.org/depth/rivers/04.html>
Sediment Transport. Adapted from Church, M. 1992. Channel Morphology and Typology. Chapter 6 in The River Handbook, vol. 1, P. Calow and G.E. Petts, eds. pp. 130, 136.



Sinuosity

- Is the course a flowing water will follow
- It is measured with the Sinuosity Index – SI:
 - ✓ The ratio of channel distance to down valley distance. Values range from 1 (simple, well-defined channels) – 4 (highly meandering channels)
- Stream flow creates distinctive land-forms composed of straight, meandering & braided channels, channel networks, & flood plains
- **Meandering** is the natural tendency for alluvial channels ($SI > 1.5$)

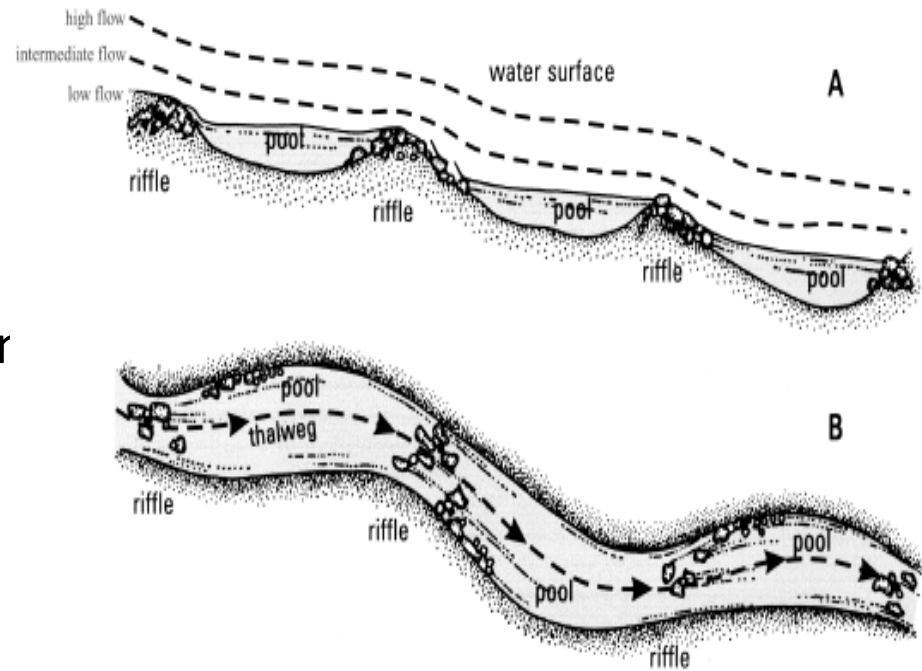


Foto aerial de el Rio Cauto acerca de Guamo Embarcadero, Cuba. From: <http://en.wikipedia.org/wiki/File:Rio-cauto-cuba.JPG>. By Urdangaray, No rights reserved



Bars, Riffles & Pools

- Within a stream channel 3 characteristic areas can be found: riffles, pools & runs
 - ✓ Riffle: shallow channel, with high velocity & turbulent flow. Turbulent surface & coarse substrate
 - ✓ Pool: a deeper channel, with low water velocity & turbulence. Fine substrate & not turbulent surface
 - ✓ Run: Deep channel with fast but not turbulent flow. The substrate lacks fine deposits.



Formation of riffles & pools. From:

<http://www.chesco.org/index.aspx?NID=2118>

Adapted from North Carolina Cooperative Extension Service, 1999



Floodplain

- Stream channels through their course influence the shape of the valley
- Floodplain is the self-adjusted flat area near the stream. Is the valley floor prone to periodic inundation during over-bank discharges
- Flooding is a regular & natural behavior of the stream. It is usually accompanied by disasters in urban areas near river shores.

