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Hydrological and hydraulic processes and definitions

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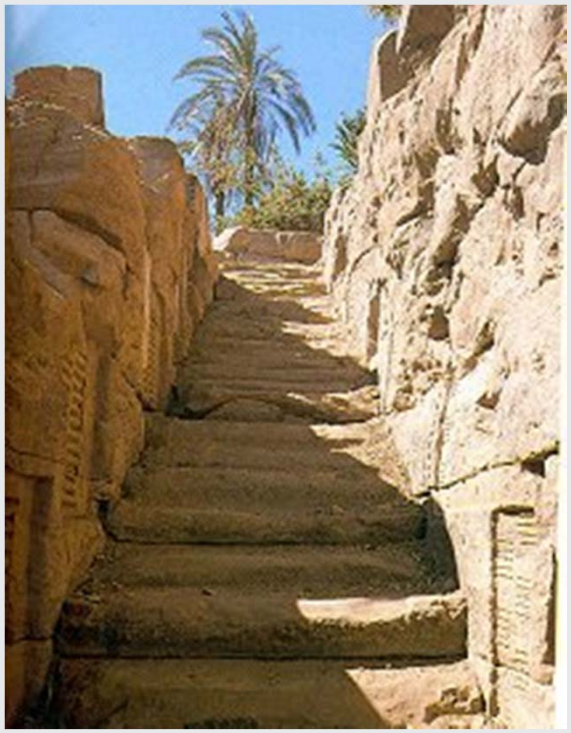
Runoff

- Flow that enters the river system following precipitation (rainfall)
- A key area of study in hydrology
- Can be separated into different components
  - Fast/Direct
  - Slow
- Sometimes expressed as a percentage

Stage

- Stage is the water level measured above datum, symbol “h”
- Measured in metres above a datum



Discharge

- Discharge is the rate of volume of water flowing through a river section, symbol “Q”
- Measured in
  - cubic metres per second or
  - cumec or
  - m^3/s

Mean flow velocity

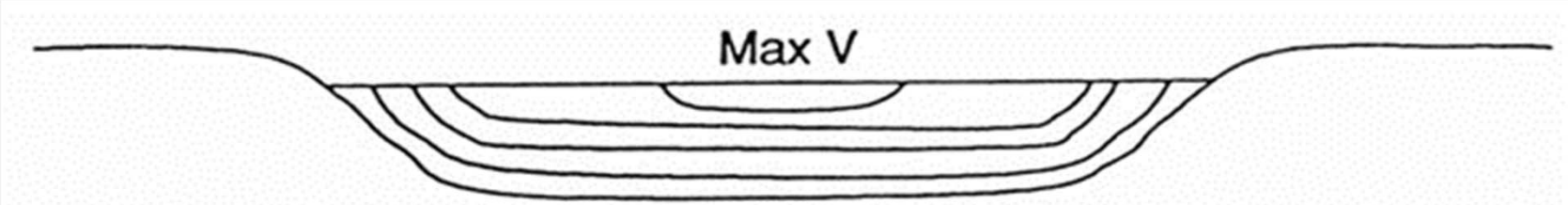
- Discharge divided by flow area

$$V = Q / A$$

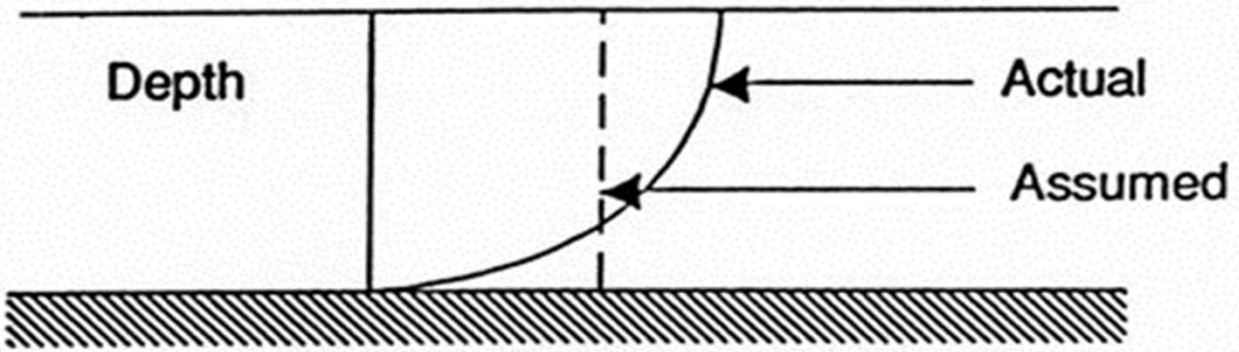
- The velocity is at right angles to the cross-section, units m/s
- It is a typical value for the section
- In flood conditions we may calculate average velocities in the channel and for the flood plains

Velocity distribution

Variation across a section

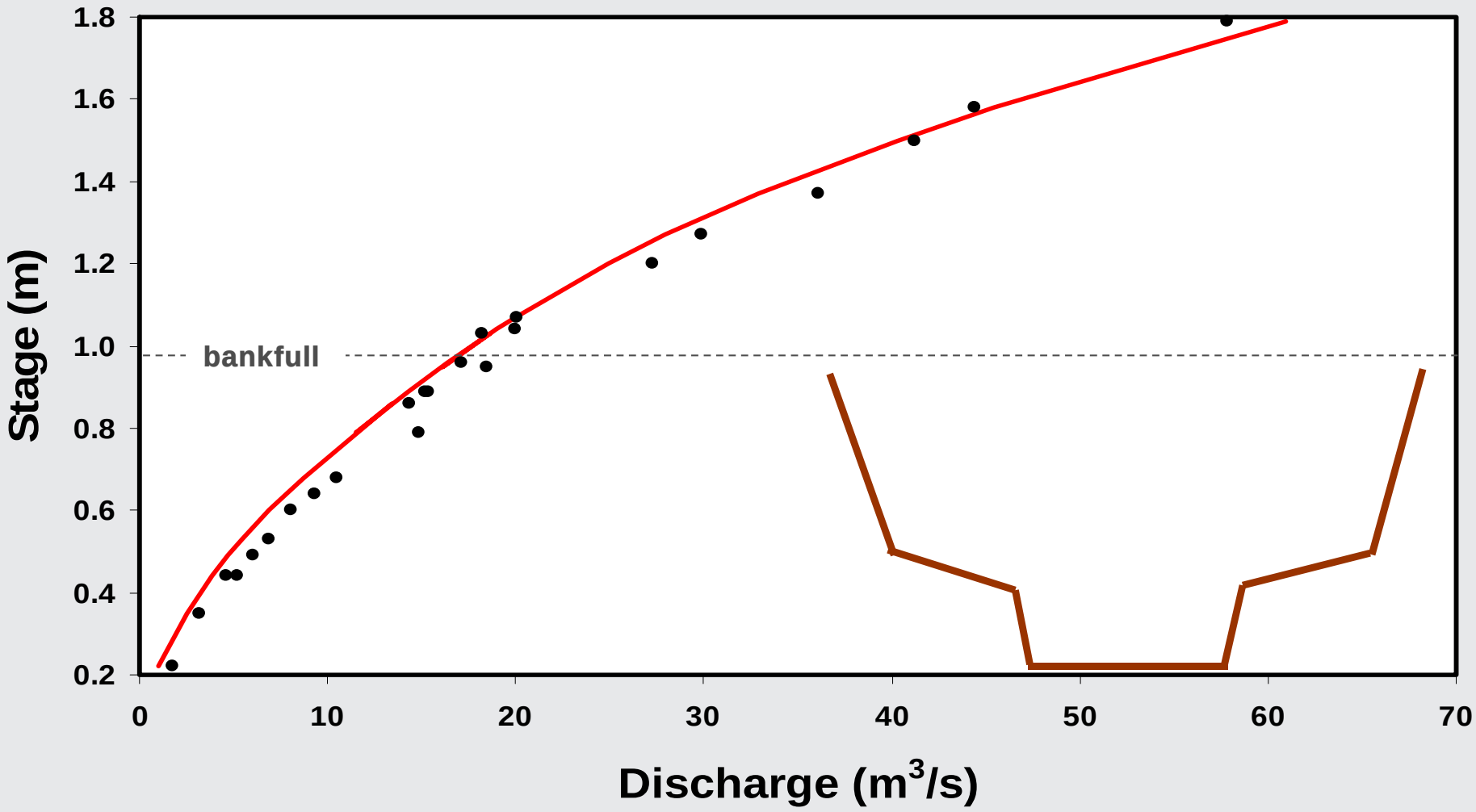


Variation with depth



A rating curve

Plot of stage against discharge

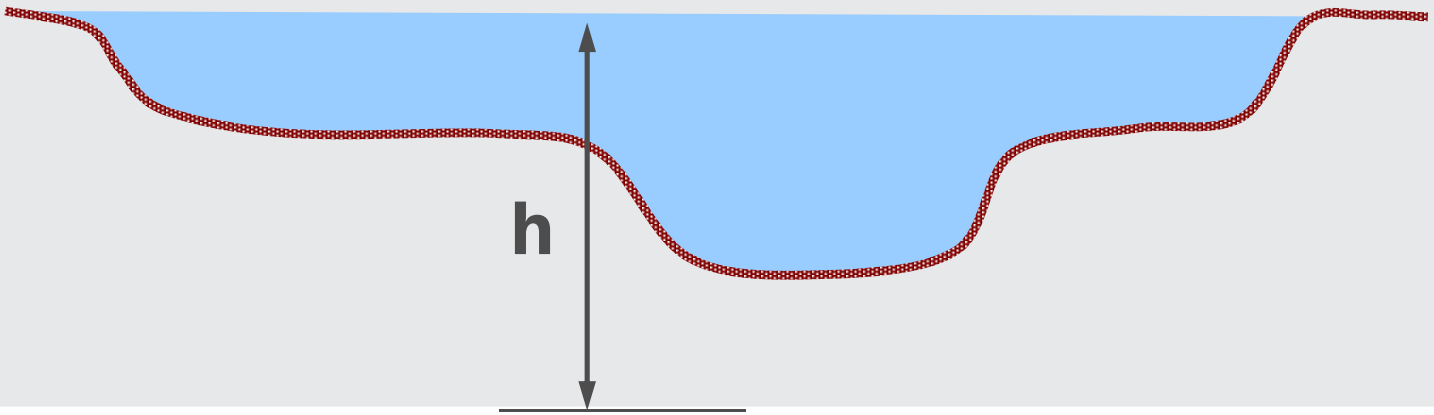


Conveyance “K”

- A measure of the capacity of a river, Conveyance “K” depends on stage, h

$$Q = K(h)\, s^{1/2}$$

- Q is discharge,
- s is water surface gradient

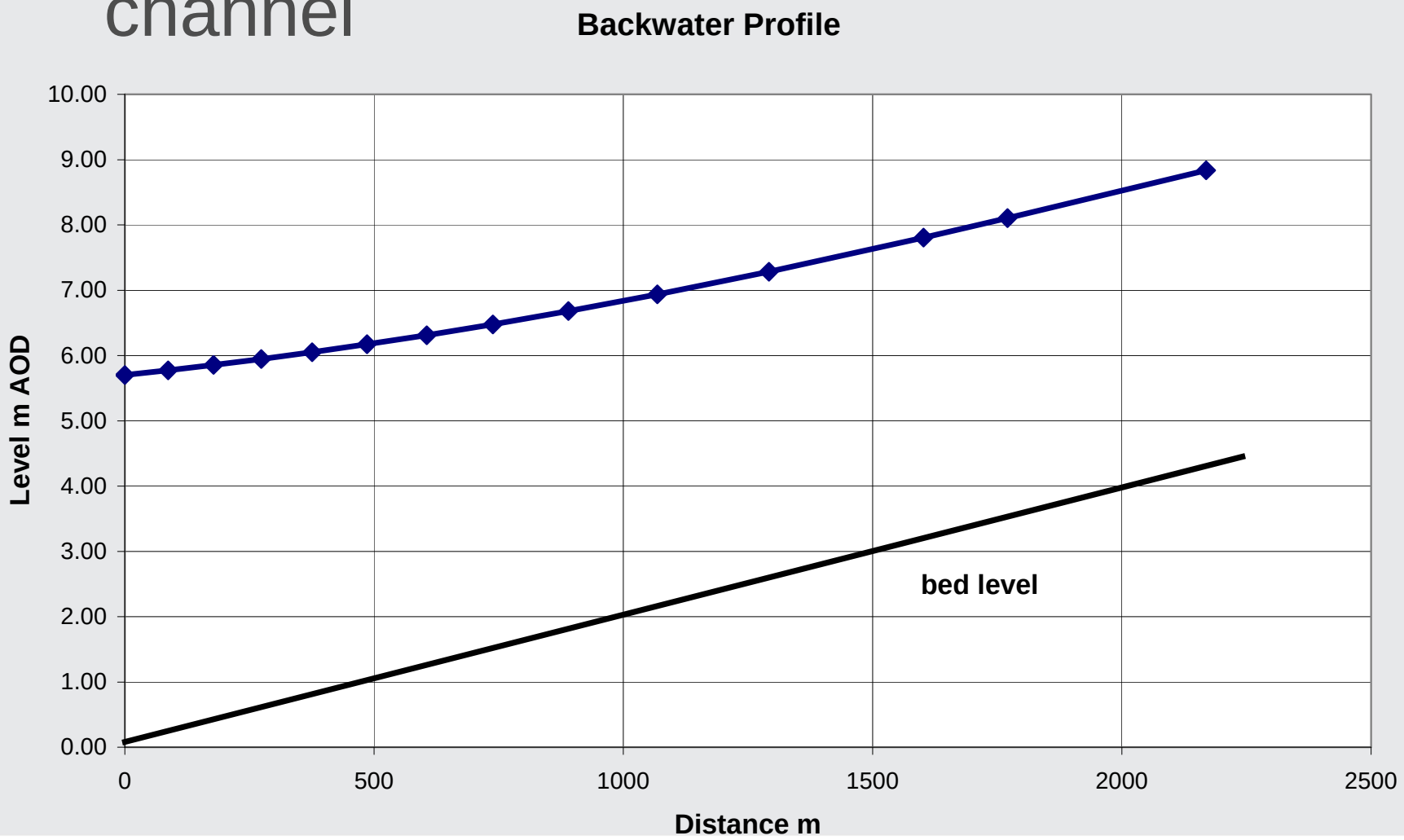


Backwater influence

- The upstream effects of a “control” on water level e.g.
  - ponding behind a weir
  - raised water level from constricting the flood plain

Water surface profile

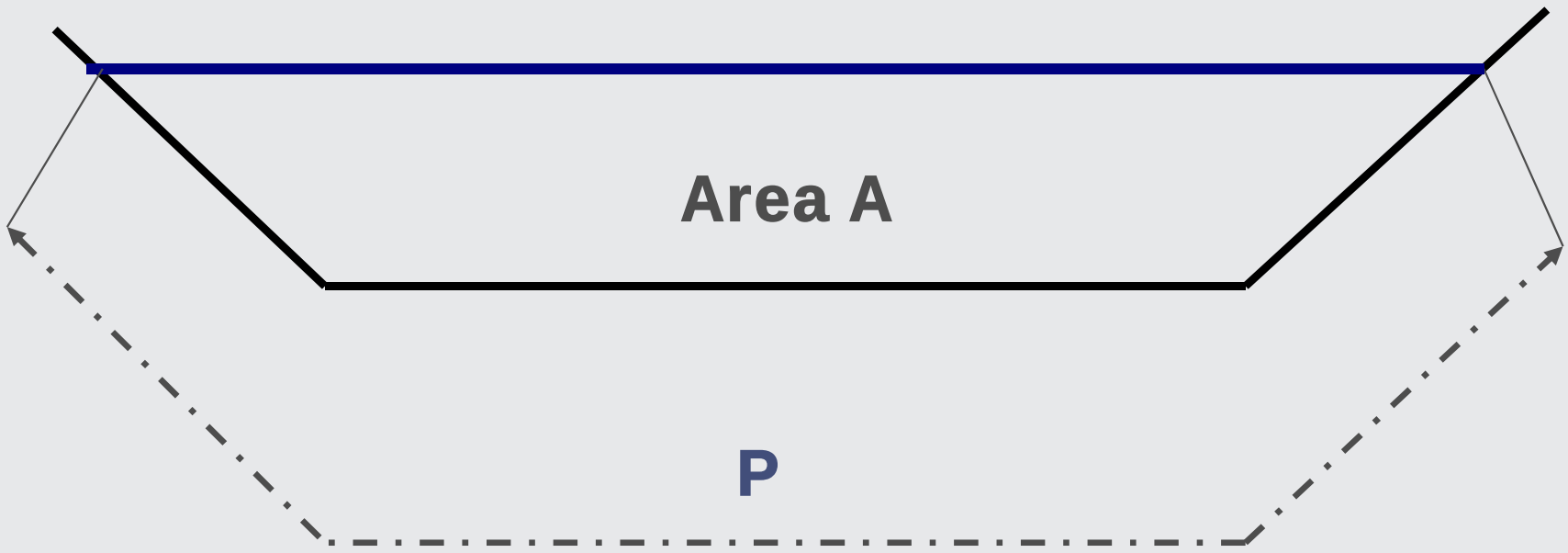
- Plot of stage against distance along the channel



Hydraulic radius

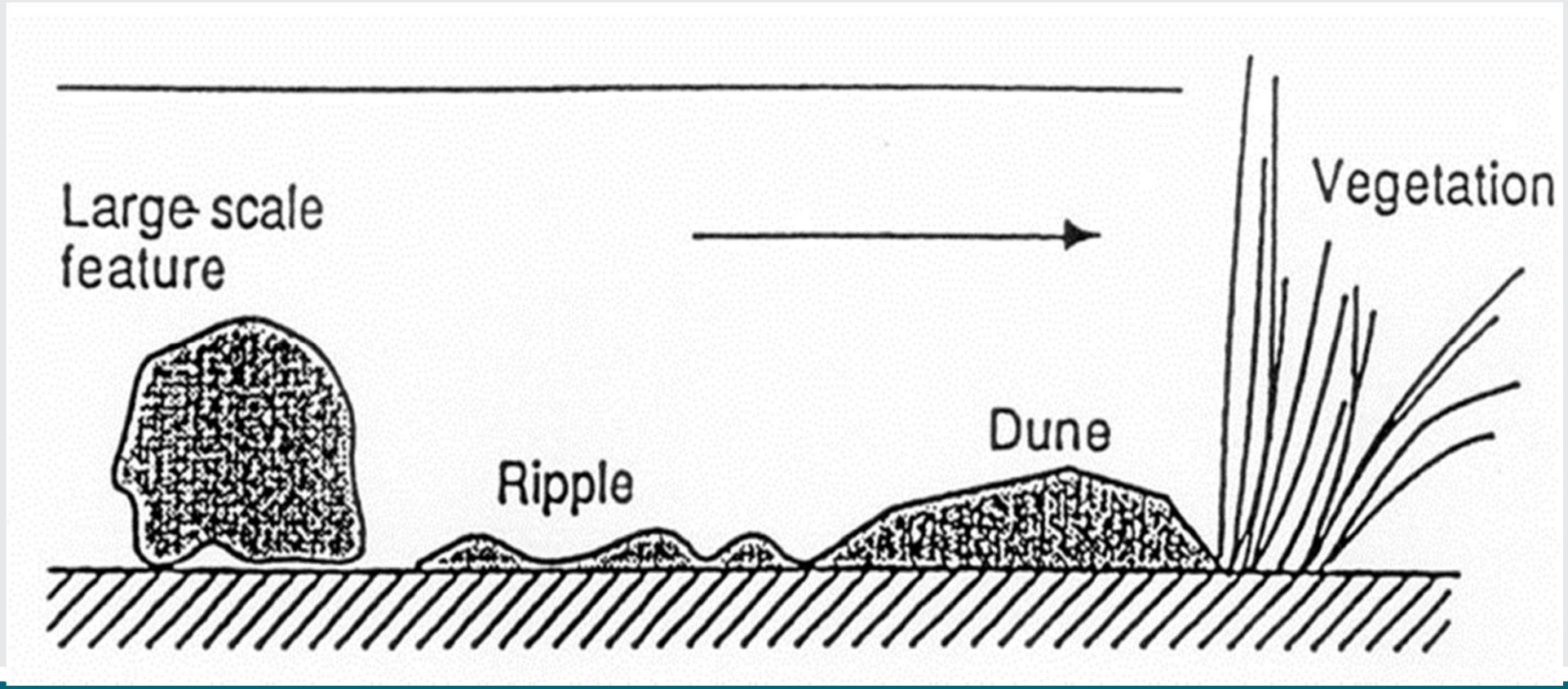
- Represents the shape of the cross section
- Ratio of Area, A to Wetted Perimeter, P

$$R = A / P$$



Flow resistance

- The effect of the river bed and banks to slow down the water flow
- Causes:

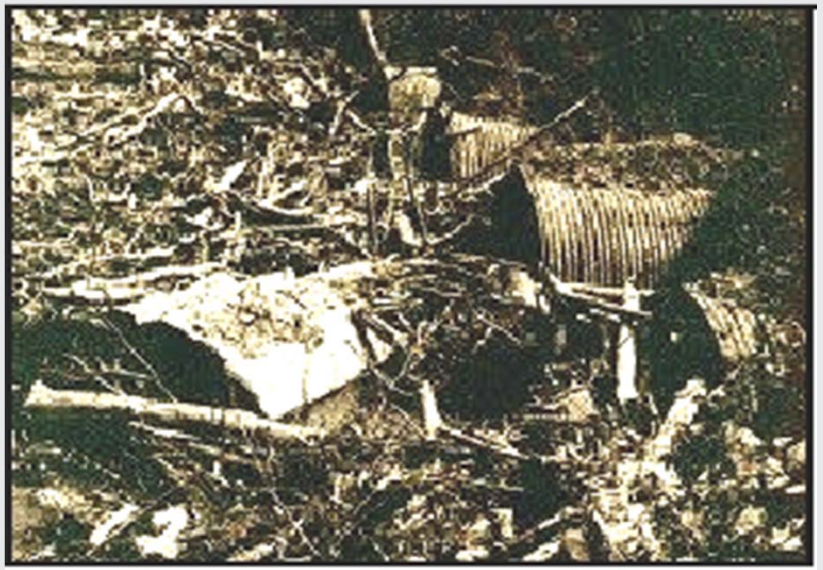


Sediment

> Solid material transported by the flow

Trash

> Floating debris carried by the flow



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Trash

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Compound channel

Functions of floodplains

Washland (water storage)

Floodway (water movement)

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Washland

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Floodway

Probability and frequency

- Probability
  - The chance that some event (e.g. a flood this year) might happen
- Frequency
  - The rate of incidence of an event - especially from observations
- Often data on frequency is used to estimate probability

Flood probability

- Annual Probability, P
  - The chance that the condition will be equalled or exceeded in any year
  - Sometimes expressed as a percentage
- Return Period, T
  - The average interval in years between occurrences of the condition
- Relationship
  - T = 1/P

Probability and frequency

- Probability
  - The chance that some event (e.g. a flood this year) might happen
- Frequency
  - The rate of incidence of an event - especially from observations. Often data on frequency is used to estimate probability
- Design life
  - The service life of an asset intended by the designer. This assumes some rate of deterioration up to a point where the asset requires replacement/refurbishment

Probability of an event occurring or being exceeded during the design life of an asset structure

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> $P = 1 - \left[1 - \frac{1}{T}\right]^{DL}$

> DL is the design life of the asset in years

> T is the return period of the event for which the asset is designed

Return period T (years)	Design life (years)			
	30	60	100	120
10				
25				
50				
75				
100				
200				
500				
1000				

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Solution

Return period T (years)	Design life (years)			
	30	60	100	120
10				
25				
50				
75				
100				
200				
500				
1000				

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Any questions?

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