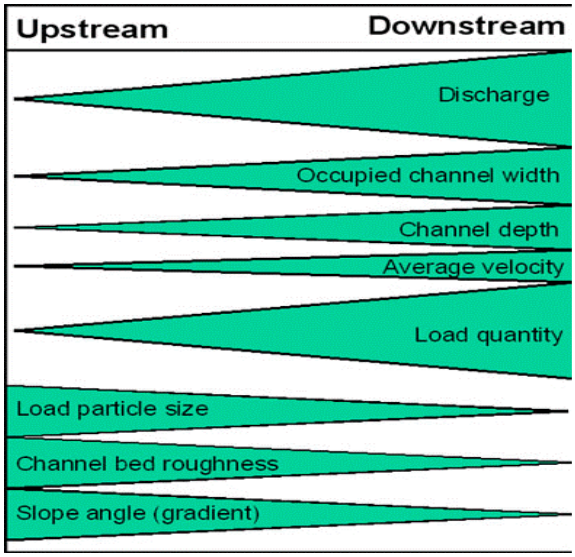
AIMS / THEORIES / CONCEPTS / HYPOTHESES

EXTRA

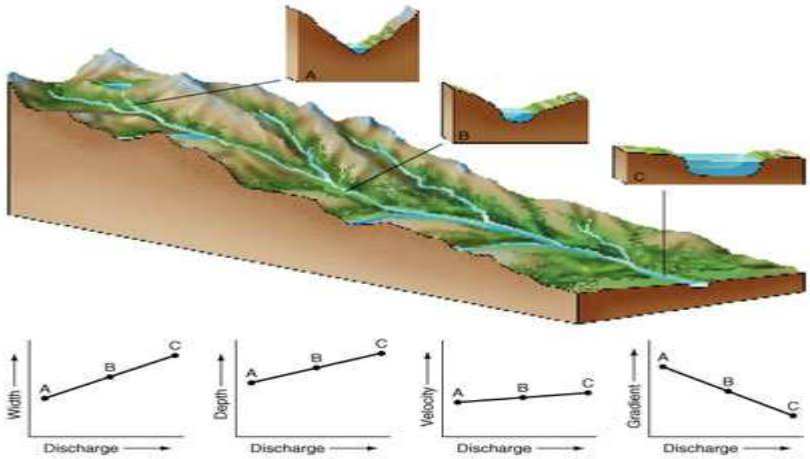
Both the Bradshaw model and the earlier Schumm model upon which it is based are conceptual models. The models are based on fieldwork undertaken on real rivers but they are qualitative rather than quantitative.
They show how a rivers channel, the flow and the load change in a downstream direction but they generally do not put numbers to the changes and accept that variations between river makes quantifying the changes difficult.
It is possible, however, to study Bradshaw model diagrams where the size of the triangle showing the downstream changes gives and indication of relative size.



Here discharge and the size of the load increase the most in a downstream direction.

Channel depth and width come next and it is velocity that shows that smallest increase from source to mouth.

Load size, channel bed roughness and gradient appear to decrease at the same rate



The graphs above show the rate of change of various parameters against discharge which corresponds to downstream changes. On the graphs width and depth appear to increase at the same rate, but velocity increases more slowly.

Manning's Equation

$$V = \frac{R^{2/3} S^{1/2}}{n}$$

V is average velocity (m/s)
R = hydraulic radius (m)
S = energy slope (m/m)
n = Manning's roughness coefficient

Streambed Characteristics	Roughness Coefficient
Mountain streams with rocky beds	0.04-0.05
Winding natural streams with weeds	0.035
Natural streams with little vegetation	0.025
Straight, unlined earth canals	0.020
Smoothed concrete	0.012

The Manning equation tries to quantify the factors affecting the velocity of a river. As you can see the Hydraulic radius (R) based on the channel size and shape is x by 2/3 and is therefore more important than gradient / slope (S) which is halved. He added a roughness coefficient (n) since large bedload will increase friction, but as bedload decreases in size friction will reduce and velocity will increase. This is why average velocity increases downstream even though gradient /slope reduces.