

# From Flow to Force: The Fluid Mechanics of Sediment Transport

## THE CORE PRINCIPLE: BED SHEAR STRESS

### Shear Stress, Not Velocity, Is the Primary Driver

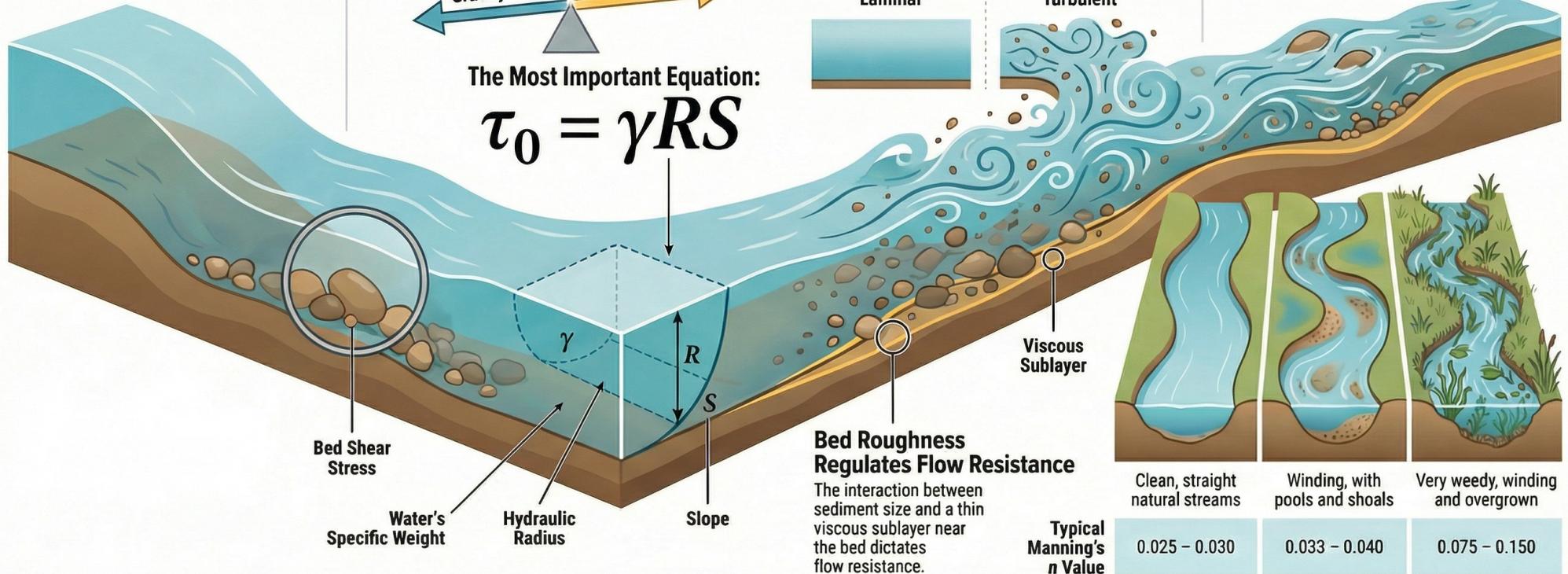
This force initiates motion, controls transport rates, and forms riverbed features.

**A Balance of Forces in Uniform Flow**  
The downslope driving force of gravity is balanced by the resisting frictional force.



The Most Important Equation:

$$\tau_0 = \gamma R S$$



Bed Shear Stress

Water's Specific Weight

Hydraulic Radius

Slope

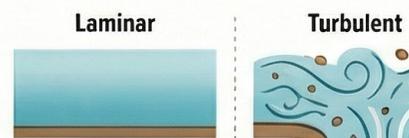
### Bed Roughness Regulates Flow Resistance

The interaction between sediment size and a thin viscous sublayer near the bed dictates flow resistance.

## CHARACTERIZING FLOW & RESISTANCE

### Laminar vs. Turbulent Flow

Natural sediment-transporting flows are almost always turbulent, with chaotic mixing that helps move sediment.



### Manning's 'n': A Practical Measure of Resistance

This empirical coefficient aggregates resistance from bed material, vegetation, and channel shape.



Typical Manning's n Value	Clean, straight natural streams	Winding, with pools and shoals	Very weedy, winding and overgrown
	0.025 – 0.030	0.033 – 0.040	0.075 – 0.150