GLY1000 Final Review

Mass Wasting

- Mass wasting is the down slope (hill) movement of rock, soil, or sediment under the influence of gravity. Mass wasting events occur in different ways and at different rates, depending on the types of materials involved (such as rock, soil or earth, mud, debris) and the motion involved (fall, slide, flow).

Factors that affect mass wasting

- ***Nature of materials involved*** (rocks, sediments, soil, etc.)
- ***Steepness of slope***: generally the steeper the slope the more likely it is to fail.
- ***Water***: Water speeds up ordinarily slow, mass wasting processes and greatly increases the chances that faster moving processes will occur. Water in pores and cracks lowers the internal cohesion of most regolithic materials; and, since the gravitational force is always acting, moist or wet material is more likely to move than dry material. Water in pores and cracks displaces air, so water adds to the mass of soil and broken rock on a slope. If pores and cracks are saturated (filled with water), the pore pressure tends to push the material particles apart, further promoting failure and downslope movements.
- ***Vegetation***: plants roots hold unconsolidated material together; plants remove water from the ground.
- ***Heights***:
- ***Climate*** (such as freeze-thaw cycles): Areas with a moist temperate climate are subjected to frequent freeze and thaw cycles. Freeze-thaw cycles affect rocks because when water seeps into cracks in a rock and then freezes it expands putting tremendous pressure (24 tons per ft2) on the rock, forcing the cracks to expand. Climate controls the type and rate of weathering/ mass wasting. Basically the warmer the climate the higher the rate of bedrock erosion and many other erosion. For the most part as the temperature rises the more moisture there is in the air and moisture is one of the main culprits of mass wasting.
- ***presence and orientation of planes of weakness*** (such as joints, bedding, foliations)
- ***Some human activities*** (think of examples): **Drainage diversion and irrigation projects** may destabilize slopes and increase the probability of mass wasting by increasing the moisture in vulnerable areas. **Mining or construction activities**, can result in vibrations and air blasts which may trigger mass wasting events. Other human activities which could potentially impact mass wasting include **transportation vibration, increasing the load that the ground must bear (especially on slopes,) changing vegetative cover, and pumping.**

Some natural processes that over steepen slopes include:

- stream erosion
- wave erosion
- tectonic uplift
- volcanic activity

Mass wasting events are manifested in different ways and at different rates depending on the types of materials involved (such as rock, earth, mud, debris) and the type of motion involved (such as fall, slide, flow).

Creep: very slow mass movement that goes on for years or even centuries. You can't see creep happening but leaning fences and poles and broken retaining walls show where it has taken place.

Slump: Earth material that has moved as a unit along a curved surface is called slump. A slumped mass of sediment is typically clay rich. Slump usually results when the geometrical stability of a slope is compromised by the undercutting of its base, such as by wave action, a meandering river, or construction.

Avalanche: An avalanche, also called a debris avalanche, is a mass of falling rock, but also includes soil and other debris. Like a rock fall, an avalanche moves quickly but because of the presence of soil and debris, they are sometimes moister than a rock fall.

"Landslide" is a general term referring to all slides, flows (even falls) that occur at a moderately fast rate.

Preventing Mass Wasting: Proper design during construction projects can eliminate the potential for increased mass wasting. Human activities such as undercutting the base of the slope, adding weight to the upper part of the slope by building large structures, removing vegetation, and saturating the ground with water increase the risks of mass wasting. Engineering solutions include barriers and retaining walls, drainage pipes, terracing the slope to reduce the steepness of the cuts, and immediate revegetation. Rock falls can be controlled or eliminated by the use of rock bolts, cables, and screens and by cutting back slopes to lesser gradients.

How can you recognize evidence of past mass wasting events?

- The evidence of mass wasting can be observed on aerial photographs, thus frequency and magnitude of the slides can be observed over time sequential aerial photos. Sediment delivery is often accomplished by measuring the concave slope remnant minus that portion of the slide mass that has been removed by fluvial entrainment.

Streams

Recall that precipitation that does not evaporate either infiltrates the ground or runs off the surface.

Some of the factors that influence the infiltration versus runoff include

- the permeability of the surficial material
- the slope of the land
- amount and type of vegetation
- recent amounts of precipitation (degree of saturation of the land)

Runoff is either in the form of sheet flow (such as during floods) or it is confined to channels. Channelized runoff is stream flow.

Things that reduce the infiltration capacity of the ground results in more runoff and greater flooding potential.

Streams erode the surface of the Earth (picking up sediments), they transport sediments, and they deposit sediments.

There are erosional landforms produced by streams, and there are depositional landforms produced by streams.

What factors affect the velocity of streams?

- stream gradient (slope of surface over which it flows)
- The size and shape of the channel: The shape of the channel cross-section affects the amount of water that would come in contact with the riverbed. This in turn affect the friction between the two bodies and thus also the speed of the river. The more the water is in contact with the riverbed, the more friction there is and the speed of the river would be slower. The total length of the riversides and bed is called the wetted perimeter. The speed of the river is not constant in a river channel. The speed of the river is much slower near the riverbed and sides than the speed of the water in the mid-stream. The water over the deeper side of the channel flows faster than the shallow sides.
- Channel roughness: The rougher the river the slower the speed of the river. The amount of friction between a rough surface and the water in the river would be huge. Hence, the river would be slowed down.
- Discharge: The larger the discharge, the faster the river will flow. This is due to the fact that when there is more material in the river, more amount of gravity would be acting on it. Therefore, they would flow faster down the river.

It is a common misconception that the velocities of streams with steep gradients are faster than velocities with lesser gradients, or that the velocity of upstream reaches of a river, where its gradient is steep (think of the "long profile") is greater than its velocity downstream, near its mouth. However, the other velocity controlling factors are important. Downstream, a river generally has a wider, deeper, smoother channel, and a greater discharge. It is carrying the waters supplied by tributaries. It is true, however, that along a given segment or reach of a stream, if its gradient is increased (such as by construction of a meander cutoff of comparable