

Soil Erosion and Sedimentation

Soil erosion and sedimentation are naturally occurring processes. In fact, a certain amount of erosion is healthy for ecosystems, but too much erosion can cause problems. The watersheds in Napa County naturally produce relatively high amounts of sediment owing to climate, topography, geology and soil conditions. However, this natural production has been accelerated by human activities over the past 150 years. Soil erosion and sedimentation are among the most serious threats to the long term health of Napa County's watersheds.



Why Should We Be Concerned About Erosion?

■ **Erosion removes topsoil and reduces soil fertility**

A loss of topsoil, which often has important minerals, nutrient-rich soil organic matter, and high amounts of biological activity, creates a less favorable environment for plant growth. In the Napa Valley, where the rich topsoil is the source of its fame, erosion is a major concern.

■ **Soil removed by erosion often ends up in waterways**

Excess sediment in streams, rivers, ditches, and reservoirs, reduces their capacity to store water resulting in more frequent and severe flooding and increased property damage. Sediment accumulations also damage storm drain systems.

■ **Excess sediment degrades water quality and aquatic habitat**

Habitat areas and food sources are destroyed when fine silts cover the sand and gravel streambed. Decreased clarity of the water prevents sunlight from reaching plants resulting in a loss of aquatic plant communities. The result is a reduction in the number and variety of fish and other aquatic life.

■ **Too much sediment threatens the Napa River system**

In 1990 the San Francisco Bay Regional Water Quality Control Board placed the Napa River and its tributaries on the state's "List of Impaired Waterbodies." The listing was made in response to concerns that excess sediment was damaging habitat for steelhead trout, Chinook salmon, and other threatened species whose populations have declined substantially in recent decades. The list, which is a requirement of the federal Clean Water Act, identifies waterbodies that do not meet water quality standards and are not supporting their beneficial uses. Local agencies, landowners, and citizen groups are working together to examine the problem, identify solutions, and ultimately get the Napa River and its tributaries delisted.

What is Erosion?

Erosion is the physical wearing away of the earth's surface by the agents of wind, ice, water, or movement in response to gravity. Surface soil material is removed in the process.

The severity of erosion depends on a combination of many factors, including the amount and intensity of precipitation, the texture of the soil, the steepness of the slope, and the amount of ground cover.

Erosion is often quantified in terms of tons of soil loss per acre per year. A ton of soil may be visualized as the thickness of a sheet of paper spread over an acre.

What is Sedimentation?

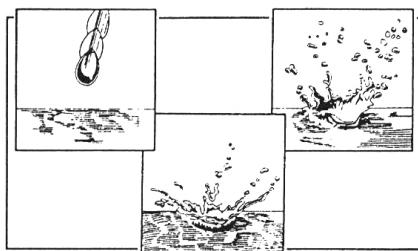
Once soil material is broken free, it may be carried away and deposited elsewhere. **Sediment** is solid material that is or has been transported from its site of origin by air, water, gravity, or ice.

The process of depositing eroded material is known as **sedimentation**. Some indications of sedimentation are mud in the street around storm drains and decreased water holding capacity of a stream, reservoir, or pond.

Types of Soil Erosion

Splash and Sheet Erosion

The Most Serious Form of Erosion in Napa County



Splash erosion occurs on the surface of the soil, when particles are displaced by the force of falling raindrops.

Sheet erosion occurs when rain is falling faster than soil can absorb it, causing water to collect and flow over the ground. Particles that were detached by splash erosion can then be carried away by the surface water.

Splash and sheet erosion are nearly imperceptible to the untrained eye. Left untreated, it slowly and insidiously wears away topsoil, also known as the “A” horizon. In Napa County hillsides the “A” horizon is only 6 to 8 inches thick. A hillside without an adequate ground cover, for instance, is subject to an entire loss of precious topsoil within 30 to 40 years. Most soil scientists agree that it takes at least 200 years to regenerate a mere inch of lost topsoil. Bare, newly disturbed soils may suffer sheet erosion at rates of up to 15 tons per acre per year without visual effects. Displaced particles can move long distances from a site or re-deposit nearby, depending on rainfall intensity and duration, topography, and the density of the particles.

The best defense against excessive sheet erosion is good vegetative cover. On vineyards, cover crops are effective for preventing sheet erosion. Cover crop establishment is frequently enhanced by applications of straw mulch, erosion control blankets, and/or irrigation to germinate seeds prior to the onset of heavy winter rains.

Rill and Gully Erosion

Rill and gully erosion occurs when sheet flows build velocity over unprotected soil and begin to establish paths. This type of erosion is more visually noticeable than sheet erosion.

Rill erosion results when surface runoff concentrates and forms small, yet well-defined channels, called **rills**. Rills usually become apparent when the rate of soil loss exceeds 20 tons per acre per year.



Rill erosion

Gullies are formed when rills become deeper channels. Soil is rapidly removed by water gushing over the “**headcut**,” or uphill end of the gully. This rush of water scours the gully’s bottom, and removes soil material that has



Gully erosion

slumped from the gully’s sidewalls. The slope at the headcut is nearly vertical, causing the runoff flowing over it to be highly erosive so that the gully advances upslope. Gully erosion may lead to soil loss in excess of 300 tons per acre per year.

Rill and gully erosion are best prevented by minimizing sheet flows with good vegetative cover. Where topography and slope make concentration of sheet flow inevitable, flows can be diverted to gently sloping earthen, grass- or rock-lined ditches or protected outfalls with underground pipes. Suitable outfalls may include well-vegetated natural waterways or filter strips, rock energy dissipators, level spreaders, and detention basins. Repair of existing gullies can be accomplished with either hard armor, grade control structures, or bio-engineered installations such as willow revetments and brush wattles. Restoration of native plant communities will frequently help prevent recurring problems in critical or badly-damaged areas.

Mass Wasting



Gravity is a constant force, always pulling towards the center of the Earth. This tireless force moves material downhill in a process known as **mass wasting**. Any downslope movement of rock and sediment is often referred to in general terms as a **landslide**. However, mass wasting covers many different phenomena, some of which are quite slow. These include **falls**, **slumps**, **slides**, and **flows**.

Mass wasting occurs when certain factors cause a change in normal conditions. A natural slope will try to reach a balanced equilibrium. If the conditions change, then this balance may be upset, and a sudden mass movement may take place. The factors which most influence stability are:

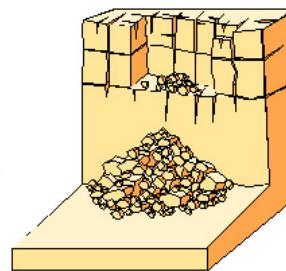
- **gravity**
- the shape and steepness of the **slope**.
- **water**, which weakens the cohesive strength of certain saturated soils.
- **sensitive soils**, or materials which are particularly susceptible to sliding. Soils most commonly affected are those formed in sandstones, shales and serpentine rock.
- **triggering events**, or natural events like earthquakes and storms.

In Napa County, mass wasting is common in the southern hills (Jameson Canyon, Carneros), eastern hills surrounding Wooden and Gordon Valleys, and Mayacamas Mountains (Mt. Veeder, Spring Mountain, Bear Creek Canyon) due to the inherent geologic instability of soils. This susceptibility to mass wasting is sometimes exacerbated by tree removal, overgrazing and grading. A common, very expensive mistake is to grade away the base of a temporarily stable slide with a road cut, destabilizing a large mass uphill. Once activated, a slide can be very difficult to repair and stabilize.

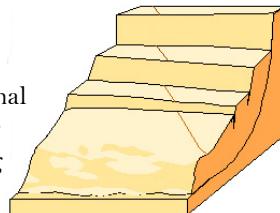
An active slide is not only problematic for property owners, but, as a source of excess sediment in waterways, it is also frequently a serious water quality threat. Thus, it is very important to be able to recognize ancient, dormant, and active slides, and to avoid them when possible. The County of Napa maintains geologic hazard maps which are helpful in identifying specific significant landforms that may be unstable. Consultation with a geotechnical specialist or soils engineer is highly recommended when contemplating any potentially invasive land use or development in an area subject to mass wasting.

Types of Mass Wasting

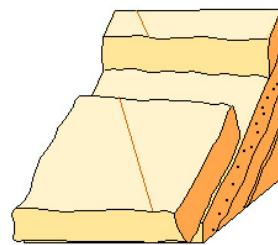
A **fall** is a sudden, nearly vertical movement of rock or soil. For example from an overhanging cliff.



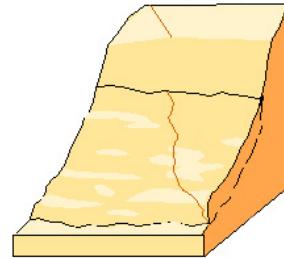
A **slump**, the most common type of mass wasting in Napa County, involves the rotational movement of soil or other material along a curved surface.



A **slide** is similar to a slump except the material does not rotate. Block slides are coherent blocks moving down the hill side, while a debris slide is a jumble of material.



A **flow** is the movement of well-mixed, water saturated soil and rock.



Diagrams created by Dr. Bruce Railsback, Geology Dept., University of Georgia

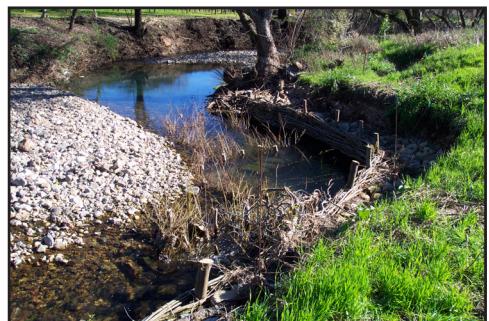
Streambank Erosion

Streambank erosion is a natural phenomenon. Creeks and rivers in equilibrium are dynamic systems: moving and depositing predictable amounts of sediment and shifting, eroding, and meandering within definable, usually well-vegetated riparian belts. A river's equilibrium is upset when changing land uses, such as road construction and urban and agricultural development, modify the hydrology of the watershed by reducing infiltration rates and increasing runoff rates and peak storm flows. These increased flow velocities in turn increase the erosive and destabilizing forces on streambanks.



Incursion of intensive land uses onto floodplains and other portions of the riparian belt, combined with increased flow velocity, frequently lead to property damage. However, confining the river with levees to protect property within the flood plain or riparian belt, thus isolating the river from its floodplain, can exacerbate flooding, bank failures, and excess sedimentation downstream. Bank failures can be, and frequently are, addressed on a piecemeal, site-by-site basis with riprap emplacement or other hard-armor structures. These

measures are frequently ineffective or short-lived, and nearly always have unintended side effects—both upstream and downstream. Revegetation of the streambanks using bio-engineered installations such as willow revetments are often more effective.



Willow revetment wall along the bank of Selby Creek.

Long-term solutions to streambank instability must focus on re-establishing the river's equilibrium, by modifying land use practices within the watershed to more closely emulate the natural hydrology, and by allowing the river a sufficient riparian belt-width in which to resume normal fluvial function.

Sources

Franklin Soil and Water Conservation District and USDA Natural Resources Conservation Service. 2004. *Erosion & Sedimentation Fact Sheet*. www.franklin.swcd.org.

Mount, Jeffery F. 1995. *California Rivers and Streams: The Conflict Between Fluvial Process and Land Use*. Berkeley, CA: University of California Press.

Napa County Resource Conservation District. 1994. *Napa River Watershed Owner's Manual: An Integrated Resource Management Plan*. This manual is a collection of natural resource management recommendations developed by the RCD with assistance from private citizens, local interest groups, and federal, state, and local government agencies. It can be purchased at the RCD/NRCS office. You can also view sections of it on the RCD's website at napared.org/ownermanual.htm.

USDA Natural Resources Conservation Service. 1996. *Soil Quality Information Sheet: Soil Erosion*. soils.usda.gov/sqi.

For more information about erosion, practices to minimize erosion, and techniques used to restore sites that are eroding, call or visit the:

Natural Resources Conservation Service (NRCS)

or

Napa County Resource Conservation District (RCD)

1303 Jefferson St, Suite 500B, Napa, CA
707/252-4188

A great deal of the NRCS and RCD energy is devoted to recognizing and mitigating accelerated, human-induced soil erosion and sedimentation. Technical and financial assistance may be available.

This fact sheet was prepared by the Napa County Resource Conservation District with assistance from the Natural Resources Conservation Service. Funded through Napa County's Watershed Education Program coordinated by the Conservation Division of the Napa County Conservation, Development and Planning Department.