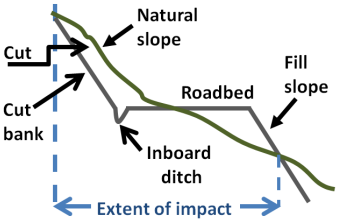
Understanding Napa County Watersheds

Watershed-friendly Roads

Roads and their associated ditches, cutbanks, fill slopes, and stream crossings impact the way water is absorbed and drains off the landscape. In hilly areas, impacts on drainage, including streams, can be severe. When roads cross streams and lengths of road drain directly into streams, the amount of streamflow and the flashiness of the stream in storms may increase. More water in the channel can lead to bank erosion and channel incision. Further, any erosion along road lengths may result in sediment delivery to the stream and degradation of aquatic habitat. In the Napa River, road-related erosion is thought to be the largest sediment source associated with development. Improving roads may be the least costly way to reduce sediment input.

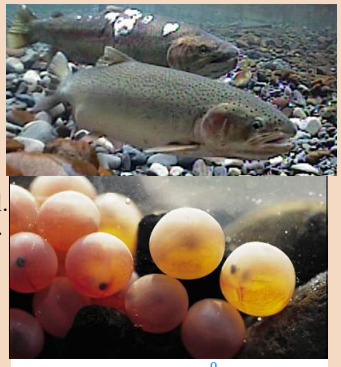
Road Anatomy

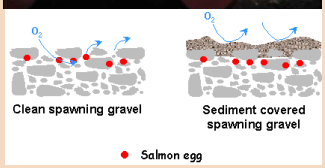


Roads and Fish

Excess sediment degrdes aquatic habitat.

Habitat areas and food sources are destoryed when fine silts cover the sand and gravel streambed. Decreased clarity of water prevents sunlinght 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.





The Napa River is on the state's life of Impaired Waterbodies.

The Napa River was listed in response to concerns that excess sediment was damaging habitat for steelhead trout, Chinook salmon, and other threatened species whose populations have declined substantiallly in recent decades. Local agencies, landowners, and groups are working together to reduce sediment inputs so that the River may be removed from the list.

Roads Impact Creeks

Chronic sediment delivery

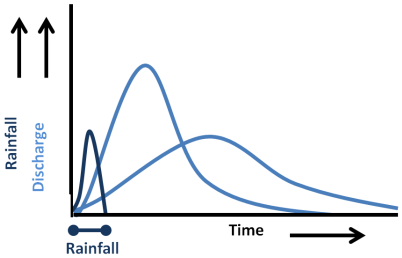
As roads are driven in the dry season, fine sediments accumulate on the road surface. With every rainfall that produces runoff, the road surface erodes and is carried away by runoff. When the road surface is hydrologically connected (runoff drains directly or via ditches) to a creek, these road sediments are delivered to the stream system. This sediment delivery is *chronic* because it is likely to occur during all storms that produces runoff.

Episodic sediment delivery

Roads built into hills have associated cutbanks and fillslopes which can fail or slide in response to storms or other triggers. When the road surface is connected to the stream, a large pulse of sediment delivery could occur. Improperly designed stream crossings are also vulnerable to failing in storm events. Slope and stream crossing failures may or may not occur during any single storm, so erosion and sediment delivery are *episoidic.*

Altered hydrology

Roads in hilly areas can concentrate and direct water into streams more discretely and in higher volume than in pre-road conditions. As a result, streams may experience bank erosion and incision, and less water from groundwater seepage during summer months.



Erosion vs. Sedimentation

Erosion is the physical wearing away of the earth's surface by wind, ice, water, or gravity.

Once soil material is broken free, it may be carried away and deposited elsewhere.

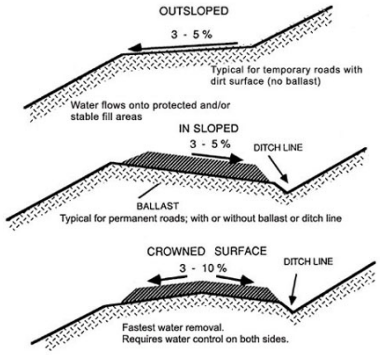
Sedimentation is the process of depositing eroded material. Some indications of sedimentation are mud in the street around storm drains and decreased water holding capacity of a stream, reservoir, or pond.

Take Action to Reduce Sediment in Streams: Improve Road Surface Drainage to Reduce Chronic Sediment Delivery

Road surface drainage is accomplished by **insloping, outsloping or crowning** the roadbed. Roads with springs along the cutbanks are often insloped with an inside ditch. Insloped roads control road surface water well but concentrate water in ditches and require a system of **ditch releif culverts** or other cross drains and extra road width for the ditch. Roads with smaller cutbanks or dry cutslopes may be outsloped. Outsloped roads disperse water, but may require roadway surface and fill slope stabilization. Larger roads are often crowned to drain runoff rapidly.

Look and Learn

Observe your roads during rainy periods to see how water is actually moving and where it is concentrated. Standing water weakens the subgrade and accelerate damage. Water concentrated in ruts or kept on the road surface for long runs can accelerate erosion of the surface material. Steep road grades accelerate erosion unless surfaces are armored or water is dispersed or removed frequently.



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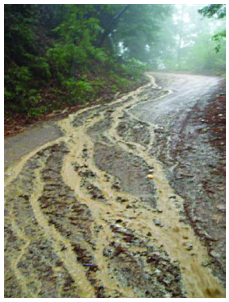
On unpaved roads, these road shapes should be accompanied by **rolling dips or waterbars**. **Rolling dips** are preferred over waterbars because they retain their function even if driven over during saturated conditions, and they require less maintenance. On average, we recommend that no more than 150-200' or unpaved road length be drained by any one rolling dip. Cutbank or inboard ditches should be frequently drained with **ditch relief culverts** or **rolling dips** before erosion can occur. Specific locations should be determined by observing water flow patterns, rainfall intensity, erosion characteristics, and available erosion resistant outlet areas.

Know what's **below.**
Call before you dig.

Common techniques for improving drainage and reducing *chronic* sediment delivery

OUTSLOPING: Sloping roadbed away from hillside



BEFORE
Runoff is uncontrolled and creates rills

AFTER
Rolling dips installed regularly ensure that gullies do not form below road surface

ROLLING DIPS: Sshallow, rounded dip in the road that reverses grade for a short distance, and directs water off the surface of the road to a controlled or protected outlet.

BEFORE
Insloped road with ditch - all drainage from road and ditch goes into stream

AFTER
Outsloped road with rolling dips and no ditch - all drainage from road disperseded across hillside

Treat chronic sediment delivery to get the most bang for your buck

- Less permitting needed (no streambed alteration)
- No dewatering costs
- Reduces materials costs (only supplies are labor and road bed materials)
- Reduces future road surface maintenance costs

RCD and NRCS can provide:
- Resources – maps, literature, videos, site visits
- Assessment of road systems & development of low impact road plans
- Support for implementation – grant $$ and oversight

Take Action to Reduce Sediment in Streams: Protect Stream Crossings from Plugging, Flooding, Diversion, and Washing Out

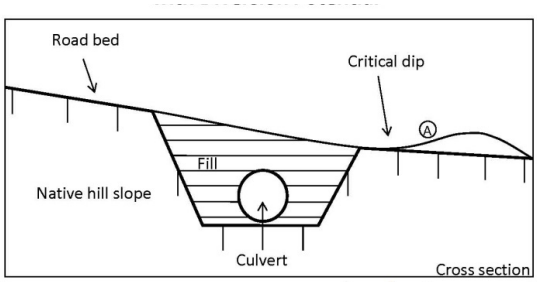
Stream diversion is when flooded stream crossings results in the stream flowing onto the road surface and outside the natural stream valley.

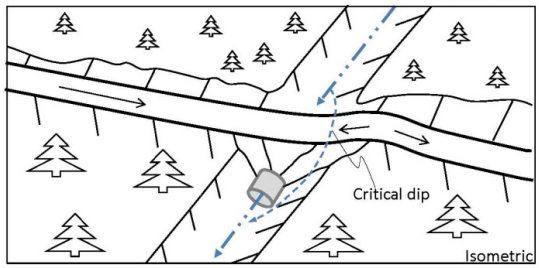
Most **episoidic erosion and sediment delivery** along roadways occurs when stream crossings flood. When crossings flood, streams have potential to flow outside their channel and down the road way if roads are improperly designed. The best way to prevent this type of episodic erosion from occuring is to 1) reduce the potential for the culvert or bridge to become plugged or blocked and 2) shape the roadway so that if flooding occurs, the stream will be directed back into the channel.

Reduce potential for plugging

Most culverted stream crossing flood events occur because woody debris in the channel plugs the culvert inlet. A **single post trash rack** installed above culvert inlets can drastically reduce the potential of these crossing to plug due to woody debris. But remember, an improperly designed debris barrier is worse than none at all. To make a simple and effective trash rack place a T-post in the center of the ditch or channel at a distance two-times the culvert diameter and upstream of the culvert inlet.. In general, the best way to prevent clogging is to remove all floatable debris from in or near the channel for a distance of 100 feet upslope on a routine basis.

Critical dips should be constructed at all stream crossings with diversion potential. A critical dip is a deep rolling dip above or near the culvert that can be used as an emergency spillway adjacent to culvert drains and channel crossings. This allows water to move safely across the road and into the intended ditch or channel in case of culvert failure Critical dips are usually built perpendicular to the road surface to ensure that flood waters are directed into the channel.





Critical Dip Construction:

Culvert Size, Orientation, and Placement Affect Sediment Delivery Too

Undersized culverts and poorly oriented culverts can also lead to significant sediment delivery to streams. Replacing culverts is a more complicated procedure (requiring permitting and engineering assistnace) than other treatments described in this brochure, but sometimes it is necessary for the protection of water quality, property, and longterm maintenance budgets.

When examining your culverts, keep in mind that the capacity of a road drainage culvert should be designed for at least the peak runoff from a 10-year, 24-hour storm and stream crossing culverts should have an opening at least equal to the cross-sectional area of the entering stream during floods. Where natural drainages cross the road, culverts should have the same alignment as the drainage channel and should be placed on the normal stream grade.

How Can You Stop Sediments from Getting into the Creek?

Learn to Identify these Characteristics of Storm-Proofed Roads

Storm-proofing is accomplished by dispersing road surface drainage, preventing road sediments from entering streams, and protecting stream crossings from failure or diversion.

Storm-proofed stream crossings

- All stream crossings have a drainage structure designed for the 100-year peak storm flow (with debris).
- Culverts are set in at base of fill and at channel grade.
- Culvert inlet, outlet, and bottom are open and in good condition.
- Stream crossings have no diversion potential (critical dips in place).
- Stream crossing inlets have low plug potential (trash barriers installed).
- Stream crossing outlets are protected from erosion (extended beyond the base of fill and/or flow is dissipated with rock armor).
- Bridges have stable, non-eroding abutments and do not restrict 100-year flood flow.
- Stream crossings on fish bearing streams meet CDFW and NMFS fish passage criteria.
- Decommissioned stream crossings are excavated to original grade and side slopes are laid back to 2:1


Trash racks lessen plugging potential of culverts

Storm-proofed fills

- Unstable stream crossing and road fills are excavated or structurally stabilized.
- Excavated spoil is placed in locations where it will not enter a stream.
- Excavated spoil is placed where it will not cause a slope failure or landslide.

Road surface drainage

- Year round use roads are either paved or rocked so that none of the native surface is visible and raindrop impact is absorbed by the surface. Un-surfaced roads are closed during rainy periods or are not used when the road surface is wet.
- All road surfaces are disconnected from streams by drainage techniques including berm removal, road surface shape (outsloping, insloping, or crowning) rolling dips, ditch relief culverts, and waterbars.
- Ditches and cutbanks are disconnected from streams because they are frequently drained with rolling dips &/or ditch relief culverts.
- Rolling dip and ditch relief culvert outflow does not discharge to streams or active or potential landslides.
- Gullies (including those below ditch relief culverts) are dewatered.
- Decommissioned roads have been de-compacted (ripped) and have frequently installed permanent drainage structures (cross road drain) to prevent runoff contribution to streams.

Helpful Resources

- Central Coast Private Roads Maintenance Guide - www.rcdsantacruz.org
- Handbook for Rural Roads - www.mcrcd.org
- Video: Addressing Road Sedimentation - www.5counties.org
- LandSmart™ - Assistance for land managers in Napa, Sonoma, Mendocino Cos - www.landsmart.org
- Call 811 before you dig to determine location of underground lines
- Typical construction drawings for road treatments - www.naparcd.org
- California Salmonid Stream Habitat Restoration Manual Chapters IX & X - www.wildlife.ca.gov


Critical dip keeps stream in channel when culvert plugs

This fact sheet was prepared by the Napa County Resource Conservation District
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