

Best Management Practices

For Road Rehabilitation

Road-Stream Crossing Removal



Prepared by: Brian R. Merrill, C.E.G. and Ethan Casaday, C.P.E.S.C.
Roads Trails and Resources Maintenance Section
North Coast Redwoods District
California State Parks



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Road - Stream Crossing Removal

Definition

Excavation of road and landing fill from road - stream channel crossings and stabilization of excavated materials. Stream channel bed, banks, and adjacent slopes are restored to their pre-crossing configuration. Longitudinal stream gradient is reestablished through the crossing site.

Synonymous Terms

Road-stream crossing removal, Humboldt crossing removal

Purpose

To prevent erosion of road crossing fill and to prevent diversion of stream flow onto adjacent road surfaces. Erosion of stream crossing fill causes direct sedimentation to the drainage network. Runoff diversion at stream crossings can cause severe gulying on roads and slopes or cause mass movements if flow is directed onto interfluvial areas. Runoff diversions create a direct linkage between streams and roads, which increases sediment delivery to the drainage network. Stream crossings can divert runoff to adjacent subwatersheds causing increased flow, bank erosion, channel migration, and inner-gorge mass wasting.

Planning Considerations

- General Plan compliance
- Anticipated future road use
- Access to nearby rehabilitation sites
- Access for future fire protection, resource management, and backcountry patrol
- Accessibility to site with heavy equipment and service vehicles
- Offsite disturbance caused by accessing site
- Channel response upstream and downstream
- Design and construction of diversion structures or sediment retention structures in affected channels that are flowing year-around
- Availability of suitable locations for crossing fill, either nearby or offsite
- Removal of large woody debris and boulders from crossing fill
- Disposal of culverts
- Stockpiling of woody debris for post-treatment mulching
- Potential for road to trail conversion

Construction Specifications

- The excavator shall prepare the site by first removing all trees and brush growing on the cutbank, roadbed, and embankment fillslope of the adjacent road sections. Trees and brush growing on the crossing fill are also removed. Mulch shall be stockpiled on the top of the adjacent road cutbanks or elsewhere in the crossing excavation area. Mulch may be stockpiled in piles but shall be left accessible to the excavator when earthmoving tasks are complete. Trees growing in undisturbed soil that were partially buried by fill may be left standing, however all fill shall be excavated away from around the base. Care should be taken not to damage roots. An excavator mounted vegetation masticator may be used to remove trees and brush. Tree boles shall be left a minimum of 24" high for later extraction with the excavator or dozer. If a masticator is used, a dozer may be employed to accumulate and pile ground mulch for use on finished surfaces.
- If the stream is flowing, water is diverted away from excavation areas to reduce turbidity. Where channel widths are wide enough a berm is constructed to divert water away from the work area. Where channels are narrow, a small diversion dam is built upstream and stream flow is piped around the worksite and discharged into the stream below the worksite. If flow travels subsurface through the site and cannot be captured and diverted, a filter fabric silt dam will be constructed immediately downstream of the construction footprint.
- At failed crossings, a small road bench is reconstructed along the upstream end of the crossing to allow access to both sides of the crossing. A minimal amount of fill is used and streamflow (if present) is piped around the site or a culvert is installed to convey streamflow under the temporary road.
- Following clearing and access operations, a dozer equipped with rippers shall decompact the inboard ditch and the cutbench portion of the adjacent road sections to a minimum depth of 12 inches. The cutbank shall be stripped of all organic accumulations using the dozer or the excavator or a combination of the two. Small, dispersed organic material shall be mixed and incorporated into the fill material and used to recontour the cutbench. Larger accumulations of organic debris shall be gathered by the excavator and stockpiled with trees and brush removed from the crossing and adjacent roadway.
- If stable areas exist along the adjacent road cutbench, the dozer begins pushing the crossing fill into the cutbank in maximum 6-inch lifts. The dozer pushes the material to the most distant sections of road first and moves back toward the crossing to avoid becoming overwhelmed by large accumulations of excavated fill at the crossing site. The dozer continues to push material out of the crossing compacting it in lifts until the recontoured material becomes too steep on which to operate, the dozer reaches the local Ordinary High Water elevation, or no more fill is available in the crossing. As the dozer cuts crossing fill it leaves a berm on the downstream edge to prevent material from being sidecast downslope toward the stream.
- Cutbanks exposing seeps or springs, or those along the axes of topographic swales adjacent to crossing sites shall not be recontoured. Instead, the crossing fill and embankment fill from the wet road reach shall be exported to dry section of the road farther from the crossing. An outsloped cutbench shall be left adjacent to the stream crossing if wet areas are present.

- As the dozer begins the crossing excavation, the excavator positions itself at the downstream edge of crossing and begins removing fill and placing it where the bulldozer can push it to the storage area. In crossing excavations where stream flow is present, the excavator always works from downstream extent of excavation to the upstream extent to prevent pooling and uncontrolled release of water and sediment in the event of a failure of the bypass piping.
- Usually dozer pushes in excess of 300 feet require exportation with dump trucks. If the adjoining road is not suitable for material storage, the excavator removes the crossing fill and it is loaded directly into a dump truck, and material is end-hauled to stable road reaches near the crossing excavation. Whenever possible exported fill will be distributed widely across nearby, stable road reaches to distribute the surplus material rather than surcharging one specific area. When space is limited along nearby stable road reaches, other roads in the project area may be identified to store fill. Roads with gentle and stable sideslopes or through-cuts with low gradients will be used to deposit exported material. Sites with springs or other adverse hydrologic conditions shall not be used to store exported fill. Exported fill shall not be deposited in natural stream channels or wetland areas. As exported fill is deposited, the material shall be spread and compacted in 6-inch lifts by the dozer. Exported fill shall be deposited as close to the source area as possible to reduce the potential for spread of exotic plants and soil-borne plant pathogens. Mulch stockpiled adjacent to fill sites shall be spread evenly over the surface.
- The dozer and excavator continue to work in tandem until all crossing fill within the stream channel and on the adjacent slopes has been removed. In addition to the crossing fill, any material deposited in an upstream colluvial/alluvial wedge is removed whenever practicable. The extent/distance to which the upstream material is removed shall be weighed against the expected collateral damage to the riparian corridor. Extensive riparian disturbance is warranted only in situations where large amounts of sediment are determined to be unstable. The excavation should be designed to match the slopes and banks upstream and downstream from the crossing. In cases where the failed crossing includes a large inner-gorge gully or has incised below pre-disturbance stream grade, it may be necessary to leave the channel configuration in its unnatural condition.
- The excavator makes final adjustments to the excavated stream crossing. The final surface is smoothed by back dragging with the dozer or with the excavator bucket. Excavator buckets equipped with a blade attachment shall be used to smooth the recontoured slope.
- Trees and brush removed prior to excavation are then spread over the surface of the side slopes as mulch. Mulch shall be preferentially applied to stream crossing sites to reduce the delivery of sediment from surface erosion on crossing sideslopes. Within 50 feet of stream crossing excavations mulch shall be applied to sideslopes to provide 70% to 90% surface coverage. Between 50 feet and 100 feet mulch shall be applied to sideslopes to provide 50% to 70% surface coverage. Road approaches with less than a 50 foot natural buffer to stream channels shall be treated with mulch applied to provide 50% to 70% surface coverage. Where the quantity of mulch material is insufficient to meet these requirements, locally derived material will be imported to the crossing sites

from nearby interfluvial road sections. Mulch applied at crossings should be pressed onto the ground surface wherever possible using either the excavator or the dozer.

- Logs and rocks should not be placed in the excavated portion of the channel because this often causes lateral migration resulting in bank erosion and slope undercutting. Slope undercutting may destabilize the crossing sideslopes and deposit large volumes of sediment directly into the stream channel. Logs should be placed on the channel margins or can span the channel to provide for future LWD recruitment. In situations where the gradient of the channel will remain unstable following excavation, check dams may be constructed to retain sediment within or adjacent to the treated reach. The check dams shall be designed by a licensed geologist experienced in fluvial geomorphology and open-channel hydraulics. The materials used in the construction of the check dams shall be obtained near the site and be composed of natural materials (i.e., large logs, rootwads, and boulders). Saw-cut ends, cable, bolts, rebar, and other hardware shall be concealed to the maximum extent possible.
- Where stream crossing excavations extend upstream to disturbed portions of the natural channel and no apparent natural top of the crossing is obvious, the channel grade at the top of the excavation should be anchored to some grade control such as a rock outcrop, a large tree root, or large woody debris firmly embedded in the channel. In the absence of any hard-point, the upstream end of the crossing should be tapered to the unnatural channel grade as far upstream as is practical to minimize headcutting of the stream as it adjusts to the newly established local gradient.
- Road sections immediately adjacent to stream crossings should not be fully recontoured. Instead, the fill is tapered toward the crossing and some cutbank is left exposed. This reduces the slope on each side of the crossing and reduces the chance for a post-treatment slope failure that will deliver sediment directly to the drainage network. In crossings with gentle sideslopes, cutbanks can be fully recontoured if post-treatment failure is not considered a significant hazard.

Environmental Considerations:

Aesthetics

Eliminating stream crossings and restoring the topography to the natural conditions that existed prior to the road construction will improve aesthetic values within the park. Short-term effects to local forest and prairie settings will occur as vegetation is disturbed for rehabilitation work. Exposed earth and dried vegetation may be visible for several years following treatment. Typically, prairie settings are more widely visible, but recover within several months. Grass reoccupies the disturbed area during the first growing season following construction. Forest settings take longer to recover but have a limited visibility and typically do not affect park viewsheds.

For safety reasons, work areas are closed to the public during construction. Therefore, the general public will not view temporary visual effects at construction sites. Closure orders shall be posted with information about the project at the nearest public use area and at all access points. After the closures are lifted, the public will be able to view the work locations, however, the final project condition closely matches the pre-disturbance landform and quickly blends into the surrounding area as duff and herbaceous plants cover the

exposed soil. Interpretive panels may also help the public visualize the final appearance of the recontoured road.

Trees are removed and scattered on exposed soil as mulch during road recontouring work. This can present a negative aesthetic effect, particularly in a park setting. The effect is transitory, however, as vegetation recovery is generally rapid in the north coast region. Because of the thick understory vegetation and dense stands of trees growing adjacent to work sites, work will not be visible from most public use areas.

Air Quality

Diesel exhaust and dust will be produced as part of the heavy equipment work. Air quality in the vicinity of the work is generally high, unless wildfires or prescribed burns are occurring, and the products of the heavy equipment will be rapidly dispersed. The equipment will be moving through the project sites so that any individual site will not receive prolonged exhaust.

Heavy equipment operations may expose workers in the project area and vicinity to exhaust fumes and dust. Heavy equipment operators shall be cautioned to avoid prolonged exposure to exhaust and dust. The cabs of heavy equipment shall be kept in good serviceable condition to provide protection from exhaust and dust. Seals, windows and doors should be kept in good condition to provide protection when necessary. Detected exhaust leaks shall be repaired immediately to protect workers from exhaust exposure and reduce fire hazard. Project inspectors can position themselves upwind of heavy equipment operations to reduce exposure to exhaust and dust. In extreme dust situations a respirator may be worn. Respirator use shall be in compliance with the Department's Respirator Policy and Respirator Handbook.

Heavy equipment engines and hydraulics generate heat during the work. However, sources of high heat are shielded by equipment covers and do not expose nearby object to high heat. The effects of residual heat diminish rapidly within a short distance of the equipment. Heat shields shall be maintained in good serviceable condition to prevent high heat exposure. The removal of some trees and brush from the roads prior to removal will allow increased sun into the sites and may increase daily temperatures on the soil surface. However, rapid natural revegetation is expected due to fertile soils, summer fog, and high winter rainfall in this area. Heat generated during road recontouring work will not affect local air temperatures, or regional or global climate.

Biological Resources

A primary goal of stream crossing removal is the improvement of habitat for, and protection of threatened, endangered, and rare species. Short-term adverse effects may be less than significant or shall be mitigated to reduce the adverse effects to a less than significant level. All appropriate mitigation measures shall be incorporated into project planning. Projects shall be conducted in compliance with all applicable State and Federal threatened and endangered species protection laws and regulations.

The U.S. Fish and Wildlife Service (USFWS) shall be requested in writing to provide Technical Assistance under Section 10 of the Endangered Species Act (ESA) in cases when there is a question about whether a specific project has the potential to effect the habitat of threatened & endangered (T&E) species. Under Section 10, and USFWS can provide

assistance in project planning and design to avoid effects to T&E species. At the State level, the California Department of Fish and Game (CDFG) may also provide informal consultation on projects that may effect T&E species.

When effects to T&E species cannot be avoided by design and mitigation an Incidental Take Permit shall be requested under Section 7 of the ESA. A Federal nexus must exist as a requirement for an Incidental Take Permit from a Federal agency under Section 7. If no Federal nexus exists, consideration shall be given to the development of a habitat conservation plan (HCP).

All projects shall be reviewed by the District's Senior State Park Resource Ecologist (SSPRE) to ensure protection of natural, cultural and historical resources. Site visits including the project manager and SSPRE may be necessary to review a specific site and its effects on State Park resources.

The SSPRE shall work closely with the project manager to implement the following practices to protect biological resources:

Plants: Qualified technicians shall conduct rare plant surveys at all crossings planned for removal prior to project implementation. If any rare plants are located, they shall be avoided to the maximum extent practicable. If rare plants cannot be avoided, appropriate mitigation measures shall be developed in consultation with the SSPRE and CDFG. The mitigation measures shall be incorporated into construction specifications. Final reports shall be required on all plant surveys conducted by consultants or contractors. Consultants shall be requested to list any locally designated species or species of concern, should they exist in the project area.

Trees: All trees, regardless of DBH (diameter breast height), growing in crossing fill will be removed as part of the crossing removal process. Trees greater than 24 inches DBH buried by crossing fill that predate construction may be retained. Limbs of these trees may be removed if required for access. Small trees, less than 24 inches DBH, buried in crossing fill that predate construction shall be left whenever practical. Equipment operators shall be required to avoid striking retained trees to minimize damage to the tree structure or bark. Tree roots shall be avoided, as the excavations will not be deeper than original ground surface. Some advantageous roots may be damaged that have grown into embankment fill.

Fish: Stream crossing removal projects shall be designed to limit negative effects to water quality and fish habitat by incorporating practices that reduce turbidity in streams during construction and reduce erosion of crossing slopes following treatment.

Where channel widths are wide enough, a berm shall be constructed to divert flow away from the work area. The berm shall be maintained during the excavation to ensure its effectiveness. Upon completion of the site, all berms shall be removed and flow shall be restored to the natural channel. Where channels are narrow streamflow will be captured in an intake gallery and piped around the worksite. Discharge of the diverted flow shall be at the downstream end of the construction footprint to eliminate the possibility of stranding aquatic species in the dry crossing excavation area. If flow is subsurface and cannot be diverted around the site, a sediment filter shall be installed immediately downstream of the construction footprint.

Construction activities after October 15th shall proceed on a day-by-day basis in consultation with CDFG and according to the 24-hour National Weather Service forecast. Work in the rainy season shall occur during dry spells with materials for erosion control on-site at all times. Work shall be conducted so that no more than one-half day's work is active at one time and all work shall be completed by the end of each day. When winterization of access roads is required, all access road shall be winterized prior to any additional earth moving tasks.

Any soil disturbance adjacent to stream channels shall receive evenly distributed mulch coverage with masticated brush and trees to reduce sheet erosion. Mulch generated during the clearing phase of the rehabilitation work shall be used to the maximum extent practicable along roads near crossing sites. Refer to construction specifications for details regarding mulch coverage adjacent to stream channels.

Birds: Potential habitat for the State and Federally listed marbled murrelet exists in various locations throughout North Coast Redwoods District. To avoid noise disturbances, any work within ¼ mile of the suitable habitat for murrelets shall take place after September 15th. Potential habitat for the Northern Spotted Owl exists in various locations throughout North Coast Redwoods District. To avoid noise disturbances, work within 1000 feet of suitable roosting and nesting habitat for Spotted Owl shall take place after July 10. In most cases, habitat trees will not be affected by stream crossing removal, however, if trees need to be removed that are potential Owl habitat, protocol surveys shall be conducted prior to construction. No habitat disturbances shall occur within 1000 feet of a nesting site.

The Senior State Park Resource Ecologist shall assess each project for the presence of "fully protected" bird species listed under the California Fish and Game Codes. If the potential exists for the presence of these species, USFWS and CDFG consultation shall occur to develop avoidance measures.

Operations shall occur prior to these dates only if approved surveys indicate the absence of protected species or, incidental take permits are obtained from USFWS. The ¼ mile distance rule shall be reduced if geographic features such as a ridge separate the site from suitable habitat (See Technical Assistance Report, April 2001). On sites where background noise is greater than the noise caused by road recontouring equipment, such as adjacent to a major highway, construction may occur prior to the above dates because noise disturbance is no longer an issue.

Amphibians: Field technicians shall document the presence of suitable habitat for sensitive amphibians at stream crossing removal locations. Amphibian habitat shall be avoided wherever practicable. Once crossing fill is removed and drainage is restored, habitat quality both at the site and in the watershed overall will be improved. If species of concern are located the project work shall avoid individuals and their habitat to the maximum extent practicable. If listed species are located and avoidance is not possible, incidental take authorization shall be obtained from CDFG and/or USFWS.

Exotic Plants: All exotic species growing within the stream crossing footprint will be removed and disposed of as directed by the SSPRE. Disposal may include burial, piling, or burning, or a combination thereof. Heavy equipment may also introduce exotic plant seeds or spread existing seed into the landscape. To minimize potential effects, all heavy equip-

ment shall be pressure washed prior to entering the park or moving from a known infested area within the park to a non-infested area. Anti-fungal wash agents may be specified if the equipment has been exposed to any pathogen that could affect park resources. All heavy equipment contracts shall specify pressure washing of the machines prior to entering the park. Park equipment operators are required to pressure wash equipment before transporting to different units within the District.

Freshly disturbed ground created by heavy equipment during crossing treatments may provide habitat for exotic plant species. In areas where exotic species may exploit disturbed soils and dominate the revegetation, treatments using mulch, seeding, herbicide applications or combinations thereof may be used to reduce the invasion of exotic species.

Wetlands: Natural wetland habitat such as marsh, riparian, and vernal pools shall not be filled by stream crossing removal projects. However, equipment will be working within existing road alignments at crossings and will only treat previously affected areas. Equipment shall remain on existing road alignments to the maximum extent practicable. Equipment may travel off road only when no other alternative is available and after the project inspector and SSPRE have reviewed the route. When appropriate, the U.S. Army Corps of Engineers shall be consulted for permitting work in wetlands.

Wildlife Corridors: Wildlife dispersal or migration corridors may be temporarily altered from the natural migration routes during the heavy equipment work because of daytime noise effects. However, there may be alternative routes adjacent to the work areas suitable for their use. Stabilizing the landform will reduce future potential landslides and large gullies that can inhibit wildlife movement.

Cultural Resources

Stream crossing removal projects require the movement of earth that could have adverse effects on significant cultural resources. Therefore, review under Public Resources Code 5024 is required to identify any significant cultural resources within the area of potential effect for a proposed project. Field surveys shall be conducted by qualified archeologist and reviewed by Departmental Archeologists/Historian. In the event that avoidance of a cultural resource is not practicable, mitigation measures to decrease the effects of a recontouring project to less than significant shall be proposed. Construction monitoring shall take place to decrease the potential for negative effects to cultural resources in areas of moderate to high sensitivity during construction.

In the event that previously undocumented cultural resources are encountered during project construction (including but not limited to dark soil containing shellfish, bone, flaked stone, or groundstone, or deposits of historic trash), work at the site shall stop until a State qualified archeologist has evaluated the area. If any human bones or remains are uncovered, work shall stop until the County Coroner, State qualified archeologist, and appropriate Native American representatives have evaluated the find. Effects to sacred or religious sites shall be avoided to the maximum extent practicable. If a sacred or religious site exists in a project area, formal State Historic Preservation Office consultation shall occur as well as review by the Native American Heritage Commission.

Abandoned logging and ranch roads have potential cultural or historical significance, either individually or collectively. Therefore, all roads, road crossings, and road networks sched-

uled for treatment shall be reviewed to determine their historical significance. Individual ranch and logging roads that are eligible for listing with the OHP shall be preserved and protected to the maximum extent practicable. Road networks that may represent a historical district shall be evaluated within the scope of the project to determine if treatment of roads within the network will negatively affect the network as a whole. All abandoned roads that are proposed for recontouring have already shown evidence of deterioration or have failed in part. Over the long term these roads will fail of their own accord. Roads identified as erosive that are also identified as having cultural significance can be treated with partial recontouring or decommissioning to preserve the road bench and provide improved drainage while preserving the original alignment of the road. Roads with historical significance that do not pose an erosion threat or other threats to natural resources will not be treated and will be avoided by vehicles or heavy equipment.

Geology /Soils

Stream crossing removal reduces mass wasting and surface erosion by eliminating the anthropogenic cause of these problems such as roads, landings, and stream crossings. Treatments are designed to restore natural fluvial and riparian topography and surface hydrology thereby increasing the stability of the rehabilitation sites. Inspectors trained in landform rehabilitation conduct direct oversight of the work to ensure that the treatment designs are complete, have a stable geometry, and blend well into the surrounding natural topography.

Minor slope adjustments and surface erosion may occur after treatment, as soil is re-exposed during the stream crossing removal. Bare ground shall be mulched with vegetation removed during the work to the maximum extent practicable to minimize surface erosion. Refer to construction specifications for details regarding mulch coverage adjacent to stream channels. Stream crossing removal will significantly improve the stability of the work sites and reduce surface erosion from the existing condition.

Heavy equipment operators shall be cautioned to minimize their exposure to unstable slopes that may occur naturally or result from the earthmoving process. Inspectors shall continually observe slope and fill areas and caution operators if unstable conditions appear to be present. A qualified geologist shall review stream crossing sites during project construction to determine if any geologic conditions exist requiring additional caution or alteration of treatment. If unique features do exist, a licensed geologist shall instruct inspectors on specific treatments to maximize safety and stability of the site.

The NCRD lies within a highly active seismic region. Portions of the Northern Coast Ranges Fault System (San Andreas Fault Zone), the Mendocino Triple Junction, and the Cascadia Subduction Zone lie within or near the NCRD. Exposure to strong ground shaking is possible throughout the District. Seismic events will expose workers to direct effects from ground shaking, and possible secondary effects from ground rupture, seismically induced mass wasting, and seismically induced tree failure. However, rehabilitation workers are not exposed to a higher level of hazard than those in other settings. The time-weighted-average exposure to seismic hazards is less at rehabilitation site than it would be in an urban or suburban setting. Due to the remote location of most rehabilitation projects, seismic effects are unlikely to affect park visitors or staff.

Seismic effects may have significant effect on stream crossing fills. Steeply perched fills are susceptible to ground shaking and may fail especially when partially or completely saturated. Seismicity will also affect recontoured sites following treatment. Strong shaking may induce mass wasting of recontoured fills. Methods of compaction presented earlier in this BMP reduce the potential for co-seismic mass wasting, however intense and prolonged shaking may still produce post-treatment adjustments to recently recontoured fills. Surface rupture may displace recontoured fills along with surrounding topography but are not likely to significantly affect recontoured sites compared to the effects of shaking.

Conditions for tsunami generally do not exist because road recontouring locations are generally inland from water bodies. No volcanic hazards exist in the project vicinity.

Subsidence of land is not anticipated to be a problem at stream crossing removal locations. Soil and geologic conditions that could result in subsidence such as expansive soils and soluble bedrock do not exist in the NCRD. Stream crossing excavations will not affect unique geologic or physical features.

Hydrology / Water Quality

Existing (altered) drainage patterns will be restored to pre-disturbance patterns. In some cases where pre-disturbance patterns cannot be restored, rehabilitation work may require the realignment of a stream segment. To ensure that channel stability will be maintained, project planners will establish new drainage segments only after thorough review by a licensed geologist experienced in fluvial geomorphology. Reconnecting diverted streams to their natural flow pattern will increase discharge in abandoned channels. However, significant geomorphic adjustments are not likely to occur due to the increased discharge because the reoccupied channels had originally formed under the post-treatment flow regime.

Water quality will be improved as watershed rehabilitation is implemented within an impacted watershed. However, following rehabilitation work a short-term increase in suspended sediment and bed load will occur downstream of the rehabilitation sites that are directly adjacent to streams. Sediment is delivered to the stream from ravel along the adjacent slopes and minor amounts of soil lost downslope during excavation. These effects are limited to the first winter following treatment and in most cases are limited to the first runoff-generating event of the winter. The affect on aquatic habitat is observed immediately downstream of the rehabilitation sites but does not typically extend more than several hundred feet downstream. Sediment delivery from road segments not directly adjacent to streams would be limited to highly mobile debris flows or torrents, which have not been observed during post-treatment project reviews.

In larger subwatersheds rehabilitation work is typically spread over a period of several years so that short-term (post-treatment) water quality effects are not experienced simultaneously. Long-term transport rates of suspended load and bed load will be higher without rehabilitation work, and high volume short-term pulses of sediment typically occur during extreme storm events.

The cumulative effect of removing stream crossings on water quality will be a reduction in suspended and bed load transport, improved fluvial-geomorphic functioning, and an improvement in the aquatic habitat throughout the drainage network.

Shallow subsurface flow will be influenced by changes in surface drainage patterns and/or changes in porosity of the soil at rehabilitation sites. Changes in the direction or rate of shallow subsurface flow may be influenced by changes in surface drainage patterns. Stream crossing excavation work may intersect the water table. However, minor amounts of turbidity introduced at the excavation sites are not likely to have a significant effect on groundwater quality. No wells exist that provide direct conduits to the groundwater supply.

Stream crossing removal projects will not have a significant affect on the amount of groundwater available for public water supplies. The water table adjacent to the crossing excavation may be lowered as saturated crossing fill is removed from the stream channel, however this effect will be localized around the crossing site. Project planning shall identify public water supply and Park water systems that may be affected. Persons responsible for the maintenance of these water systems shall be consulted and if negative effects are anticipated, mutually agreeable mitigations shall be developed.

Hazards & Hazardous Materials

Failure of, or leakage from, vehicles or heavy equipment could result in the release of hazardous substances (primarily petroleum based products) to the ground or water. Equipment is required to be leak free throughout rehabilitation projects. Leaks that develop are repaired immediately in the field or work is suspended until repairs can be made. Spill kits are maintained on site in the event of accidental spillage. Appropriate agencies shall be notified in the event of significant spillage.

The NCRD has adopted a general safety protocol for backcountry heavy equipment operations. The general protocol outlines broad safety issues common to all projects and presents guidelines on how to address those issues. The general protocol also directs project managers to develop a project specific safety plan for each rehabilitation project. The plan shall identify any existing emergency response plans. The project shall be designed and implemented to avoid any conflicts with existing plans and to avoid any increase in emergency response time.

Workers spend most of their work hours in remote wildland settings and may be exposed to natural hazards consistent with that environment (e.g., wild animals, insects, noxious plant, lightning, wind, etc.). All employees are issued first aid kits and are trained how to respond to anticipated and unanticipated incidents. Employees are asked to disclose any sensitivity that might affect their employment tasks.

Heavy equipment can get very hot during the warmer part of the work season; this equipment is sometimes in close proximity to flammable vegetation. Equipment that is not properly outfitted can generate sparks from exhaust systems. Friction between metal parts crushing rocks could also generate sparks. Spark arrestors or turbo-charging (which eliminates sparks in exhaust) and fire extinguishers are required for all heavy equipment. Heavy equipment itself can be used for fighting fire in the backcountry. The safety plan developed for each project is reviewed by all project staff and includes job site characteristics to reduce the potential for fire. Park staff is required to have a State Park radio on site, which allows direct contact to California Department of Fire Protection and centralized dispatch center. Construction crews shall be required to park service vehicles away from flammable material such as dry grass and brush. At the end of each workday, heavy equipment shall be parked over mineral soil to reduce the chance of fire.

Land Use / Planning

Project design shall include review of any General Plan that has been developed for a park unit. The General Plan shall be used to guide the general direction and level of rehabilitation efforts. Any reference to a project in a General Plan shall be included in the CEQA document. Projects shall not be implemented if they are in conflict with a General Plan.

All projects shall be in compliance with the Resource Management Directives of California State Parks and all State and Federal environmental laws.

Projects shall be compatible with existing land use in the vicinity of projects. The existing land use on State Park property includes recreation and preservation. Stream crossing removal will not affect agricultural resources. Agricultural resources on adjoining property will benefit from stream crossing removal by improving water quality and quantity. Illegal agricultural activities have been discovered on State Parks during planning and inventory phase of watershed rehabilitation projects. All illegal uses are immediately reported to State Park law enforcement officials. Information signs are placed at all points of entry into project areas prior to implementation, informing the public of the upcoming project to help deter illegal agricultural uses.

In general, established communities do not exist within the boundaries of any North Coast Redwood Parks. Stream crossing removal will not disrupt or divide the physical arrangement of an established community. If a project is identified in an established community, alternative transportation routes shall be developed to mitigate the removal of road stream crossings. Community members shall be notified of projects that may have any effect on the community and agreements shall be developed that are mutually agreeable.

Mineral Resources

Stream crossing removal will not conflict with adopted energy conservation plans. The projects will not involve wasteful and inefficient use of non-renewable resources. Heavy equipment shall be used in as efficient manner as possible and project designers shall continue to research and implement the most energy efficient techniques. Stream crossing removal will not affect availability of a known mineral resource that would be of future value to the region and residents of the state.

Noise

Noise levels will temporarily increase at the work site, although the noise generally diminishes rapidly with distance. Equipment operation at sites close to campgrounds or residences shall be limited to daytime hours between 08:00 to 16:00 Monday through Friday.

Workers in close proximity to the heavy equipment are exposed to high noise levels. Workers shall be advised to wear ear protection when in close proximity to the heavy equipment. Earplugs shall be provided to all workers and extra earplugs shall be stored in all vehicles and equipment. All operations are in compliance with OSHA regulations.

Population / Housing

Stream crossing removal will have no cumulative effect on regional or local population projections. Stream crossing removal will not induce growth of human populations or communities. Stream crossing removal will not displace existing housing or affect affordable housing.

Public Services

Stream crossing removal may affect fire protection abilities because the abandoned roads will require additional heavy equipment time to reopen a road to vehicle traffic. Most stream crossings proposed for removal are already closed due to crossing failures and natural revegetation. A network of service roads shall be maintained throughout the North Coast Redwoods Parks to aid in fire suppression.

If stream crossing removal is planned for a road that is currently open to vehicle traffic, park rangers will be consulted to determine appropriate mitigation measures to maintain law enforcement access. However, stream crossing removal sites are usually along abandoned roads covered with thick vegetation and numerous road failures. Therefore, stream crossing removal will not affect emergency access.

Recreation

Stream crossing removal projects will not directly affect campground facilities within park units. Occasionally if campsites are located close to or downslope of a rehabilitation site, the sites may be temporarily closed for public safety. Backcountry stream crossing removal areas will be closed to the public temporarily during the construction season to protect visitors from worksite hazards. All trails and roads within the Park backcountry that are not within the project area will remain open during the summer work season. Park visitor services and ranger staff shall be informed of any area closures and will affect visitors or other park operations. Area closure signs shall be posted at all access points to projects and at campground and visitor center kiosks. Official closure notices shall be obtained and posted during the project implementation and post-treatment recovery phases.

Transportation/Traffic

Traffic by workers to and from the work sites will be required on County roads and State highways. Given logistical constraints of the amount of heavy equipment work that can occur simultaneously in the project the maximum number of round trips required per day will be less than 10 in any given park, which is insignificant compared to current levels of traffic.

Heavy equipment is generally transported on a lowboy transport and is classified as a wide load on State highways. All equipment transport operations shall be in compliance with State and local laws and all permits shall be obtained as necessary. Pilot trucks shall be assigned to accompany the transport as required by State and local laws. Transportation of heavy equipment is common on roads and highways in this region due to logging and gravel mining industries.

Parking capacity will not be affected by stream crossing removal projects.

Stream crossing removal does not increase traffic hazards to the public. Stream crossing removal eliminates road use and the hazards associated with them.

Stream crossing removal will not result in conflicts with adopted policies supporting alternative transportation. They will not result in effects to rail, waterborne or air traffic.

Glossary for Best Management Practices

aggrade - the filling of a stream channel with sediment. This usually happens when the supply of sediment is greater than the stream is transporting. Compare to “degrade” and “graded stream.”

alignment - the area affected by a road or trail including the fill slopes, road bench, and cut bank. Also a linear representation of features on a map such as a stream channel.

curvilinear - road or trail alignments following the contours of the land and crossing those contours at low angles. The curvilinear layout keeps the alignment perpendicular to the overland sheet flow or runoff.

cutbench - the portion of a roadway that has been cut into bedrock or native soil. Compare with embankment.

decommissioning - the treatment of a road to eliminate diversion potential during periods of nonuse. A road is typically decommissioned when the road will not be used for a period of time but may be used some time in the future. Decommissioning includes the removal of stream crossing fill and partially recontouring or outsloping road segments between crossings.

degrade - refers to the erosion of a stream channel. This usually happens when the supply of sediment is less than the amount the stream is transporting. Compare to “aggrade” and “graded stream.” Also refers to poor water quality or a disturbed watershed function.

ditch memory - subsurface water flow along a former drainage ditch after road removal is completed. This often occurs when ditches have not been ripped. Also see memory.

ditch relief culvert - see road cross drain

diversion potential - the potential for water to divert down a roadway if a stream crossing becomes plugged. Stream crossings with diversion potential have a high likelihood of contributing massive volumes of sediment to streams if the diversion causes gullies or landslides. Diversion potential is reduced by construction of a fail safe crossing (critical dip with rock armor) or by complete stream crossing removal.

drain lens - buried angular rock wrapped in filter fabric used to drain subsurface water from springs or seeps.

duff - partially decayed organic material composed of needles, leaves, and twigs on the forest floor .

embankment - fill excavated from the cutbench and used to construct the outboard road bench. This is often referred to as the fill slope or outboard fill material.

endhauling - the transportation of excavated material to a stable storage location using a dump truck.

energy dissipater - material such as rock riprap or a structure made of logs, metal pipe, or poured concrete that is used to reduce the energy of flowing water below culvert outlets or dips.

Glossary for Best Management Practices

(continued)

erosion control - activities that prevent soil from being detached and moved down slope including, but not limited to, road removal, revegetation, mulching with brush, out sloping, and compaction of unstable fill.

erosion prevention - cost effective techniques used to prevent erosion before it happens.

fail safe crossing - a stream crossing that has been constructed in a way that has no potential for diversion. The ultimate fail safe crossing would include an oversized culvert, road approaches that slope upward in both directions, a critical dip that drains back into the stream, energy dissipaters, brush rack, and a headwall.

fall line - an imaginary line on a sloped surface that follows the steepest angle. You can think of the fall-line as the line that would be made by a ball rolling down the slope.

fill - material used to construct roads and related structures. Fill can include soil, rock, and large organic debris.

full recontouring - the treatment of a road that completely eliminates (obliterates) the road from the landscape. Full recontouring is accomplished by recovering all available fill and burying the cutbank until the surrounding terrain is fully matched. This type of treatment is also referred to as road removal or road obliteration. See obliteration.

geomorphology - the study of the earth's surface and the processes that shape it. Geomorphology is closely related to geology.

geomorphologist - a person who studies geomorphology.

grade - the natural, proposed, or planned ground surface. Usually grade is set to match the surrounding topography.

graded stream - a stream that, over a long period of time can move as much sediment as is supplied to it. Compare to "aggrade" and "degrade."

gradient - the measurement of the angle along the length of a road or a stream. This term is often confused with grade (see grade).

gully - a steeply sided channel caused by concentrated surface runoff erosion. Gullies can usually be identified by their location away from natural stream valleys. Gullies are at least 1 square foot in cross-sectional area. Compare with rill.

Humboldt crossing - a stream crossing constructed with logs set parallel to the stream channel and covered with fill.

hydrology - the science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rock, and in the atmosphere. This term is often confused with hydrogeology, which is the science of groundwater.

Glossary for Best Management Practices

(continued)

inboard - refers to the upslope side of a road, trail or other feature.

inboard ditch - a drainage ditch cut along the inboard side of the roadbed to intercept drainage from the slope above or small streams. Inboard ditches usually direct their water through a culvert that crosses under the road.

large woody debris (LWD) - also known as large organic debris (LOD), refers to logs and stumps found in stream channels, road fills, etc., having a diameter greater than 12 inches and a length greater than 6 feet.

legacy road - a road originally constructed for another purpose that remains in use. Many of today's park roads were originally constructed as logging roads but now serve as back-country access roads.

mass wasting - a general term that includes many types of massive earth movements. These include rock slides, debris slides, debris flows, and earthflows, etc.

meander - a series of gentle curves in a stream, road, or trail.

memory - a subsurface zone where water will preferentially flow due the presence of a gully or inboard ditch buried in recontoured fill. Also see ditch memory.

obliteration - to completely remove the road feature from the landscape. This is accomplished by full recontouring. See full recontouring.

outboard - refers to the downslope side of a road, trail or other feature.

operator - the person operating heavy equipment or other machines.

outsloping - the treatment of a road to eliminate diversion potential along the roadbed during road reengineering. Outsloping includes excavation of some of the road fill along the outboard edge of the road and placing it against the cutbank to eliminate the inboard ditch and provide drainage toward the outside of the road. Outsloped roads are commonly graded and covered with compacted road base to harden the surface.

partial recontouring - similar to outsloping, this term is reserved for roads that are to be removed or decommissioned. The partial recontour often has a steeper cross slope on the former roadbed to ensure proper drainage. Partially recontoured roads are not matched at the top of the cutbank like fully recontoured roads.

permeability - a measure of the rate at which water can pass through soil.

rill - a small erosional feature similar to a gully in morphology but less than 1 square foot in cross-sectional area. Rills often form on soft bare soil or road surfaces. Compare with gully.

ripping - decompaction of the soil by means of rippers mounted on the rear of a dozer.

Glossary for Best Management Practices

(continued)

roadbed - the surface of the road where driving takes place. The roadbed extends from the inboard ditch or cutbank to the outboard slope break or berm.

road cross drain - a drainage structure which utilizes a culvert to direct water from an inside ditch to an area beyond the outer edge of the road fill.

roadway - the corridor including the cutbank, the inboard ditch, the roadbed, and the embankment.

rolling dip – a shallow dip designed to convey water off of the road surface while allowing vehicles to pass at reduced speed. Rolling dips should be located where stable landscape features exist that can carry runoff without causing erosion.

runoff - rainwater flowing on the surface of the ground. Runoff can be generated by rain falling on saturated ground or from heavy rain that cannot soak in fast enough.

sediment - Silt, sand, clay, and gravel that is moved by water and deposited at some location.

sediment control - activities that filter dirt out of water, including silt fence and sediment retention basins.

slope angle - the angle of the hill slope measured in percent along the fall line.

soil - clay, silt, sand, compost, air, water, and weathered rock mixed in various proportions. Soil consists of horizons or layers that display different amounts of weathering and fertility.

spoils – soil and organic material that is excavated from stream crossings or road embankments that is used for recontouring or can be end-hauled to a stable storage location.

stream crossing - a constructed road section across a natural stream. There are many types of crossings such as bridges, culverts, Humboldt (see definition), and fill crossings.

surfacing – rock aggregate or paving that is placed on the road surface to reduce erosion and weather-proof a road for winter use.

through-cut – a portion of a road that has cutbanks on both sides with drainage flowing down the road or inside ditch.

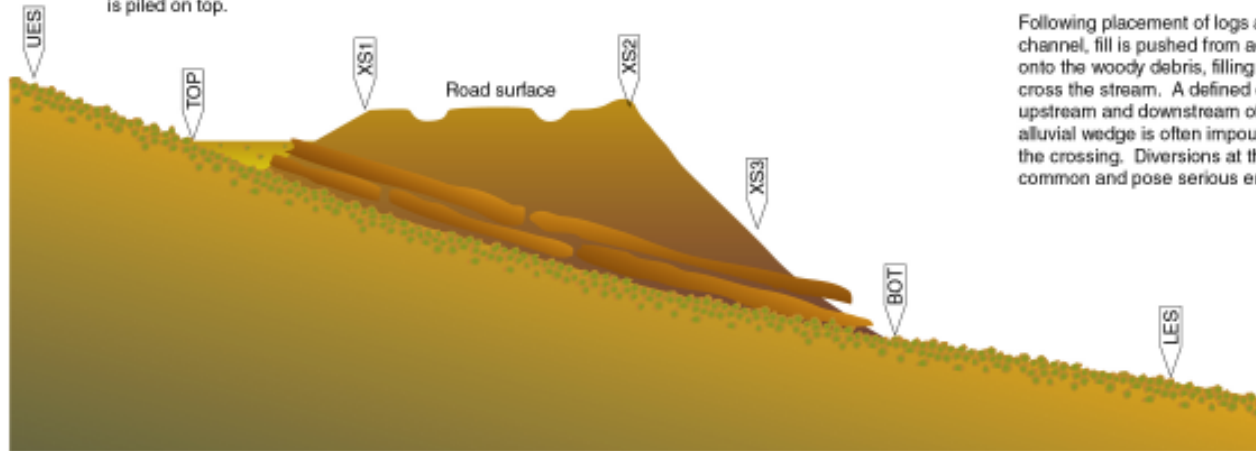
topography - the natural shape of the land's surface.

topsoil - the uppermost layer of decayed organic matter, seeds, soil, and microorganisms.

trash rack – a structure located upstream of a culvert inlet designed to trap floating debris to prevent the culvert from becoming plugged.

Humboldt Stream Crossing Excavation Longitudinal Profile Cutaway

Logs, stumps, and brush are pushed into the channel to provide a conduit for low stream flows. Logs are typically set parallel to the stream channel and brush is piled on top.

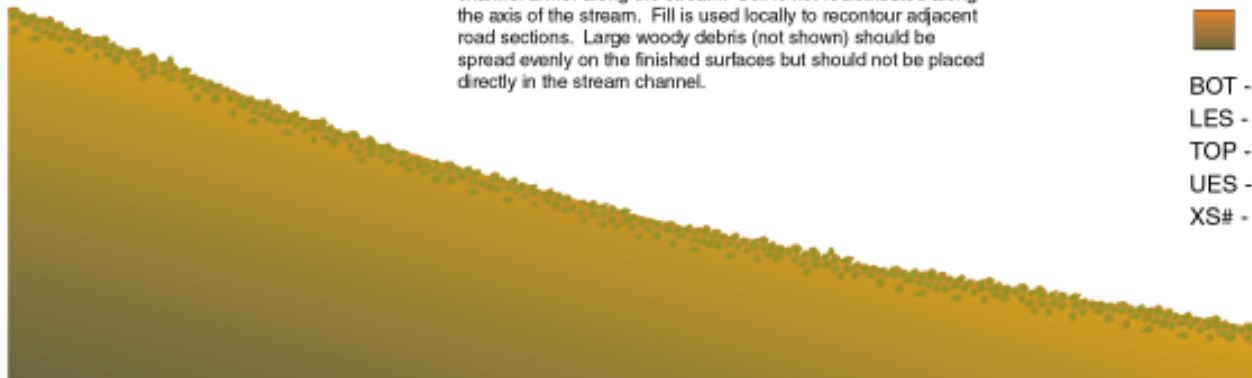


Before treatment

Following placement of logs and debris in the channel, fill is pushed from adjacent road sections onto the woody debris, filling the inner gorge to cross the stream. A defined channel is present upstream and downstream of the crossing. An alluvial wedge is often impounded upstream of the crossing. Diversions at these crossings are common and pose serious erosion threats.

After treatment

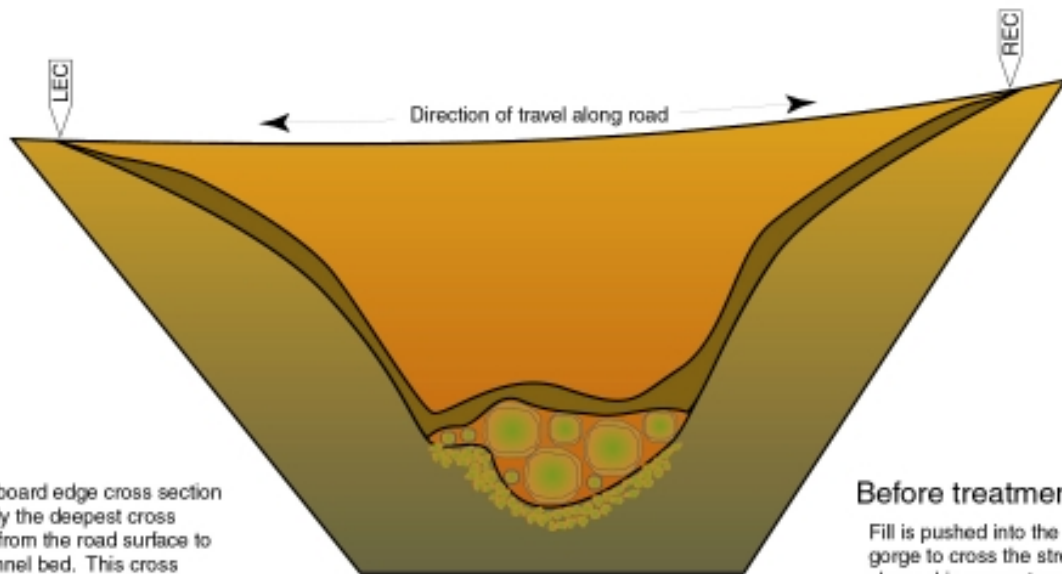
Fill and logs are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the axis of the stream. Fill is used locally to recontour adjacent road sections. Large woody debris (not shown) should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



LEGEND

- Bedrock
- Excavated Fill
- BOT - Bottom of cut
- LES - Lower end stake
- TOP - Top of cut
- UES - Upper end stake
- XS# - Cross section

Humboldt Stream Crossing Excavation Cross Section Cutaway



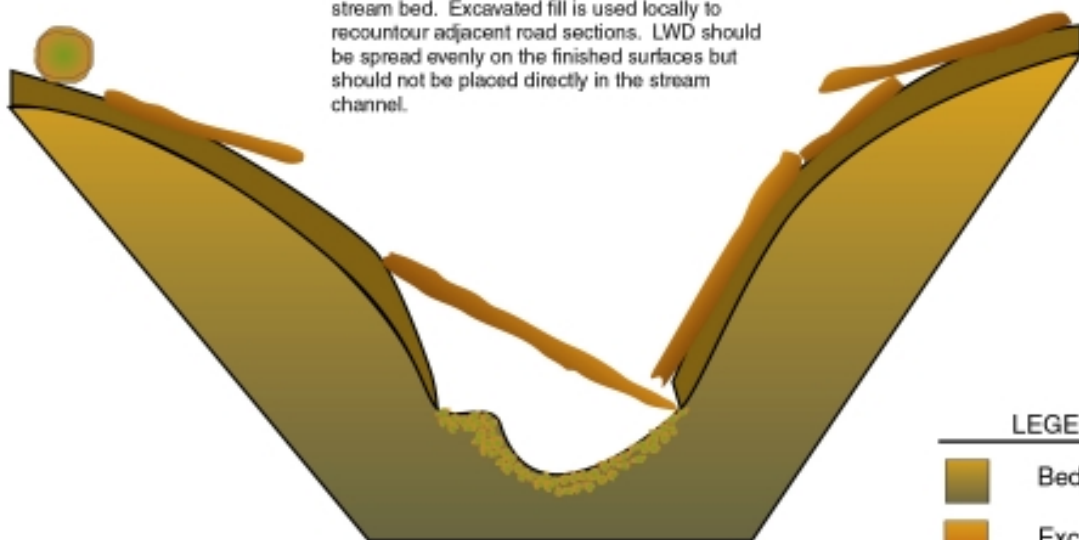
The outboard edge cross section is usually the deepest cross section from the road surface to the channel bed. This cross section would be representative of an outboard edge cross section. This view is looking downstream.

Before treatment

Fill is pushed into the channel and inner gorge to cross the stream channel. A channel is present upstream and downstream of the crossing. Logs and/or culverts are common in these crossings to convey flow under the road. Diversions at these crossings are a serious erosion threat.

After treatment

The fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the stream bed. Excavated fill is used locally to recountour adjacent road sections. LWD should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.



LEGEND

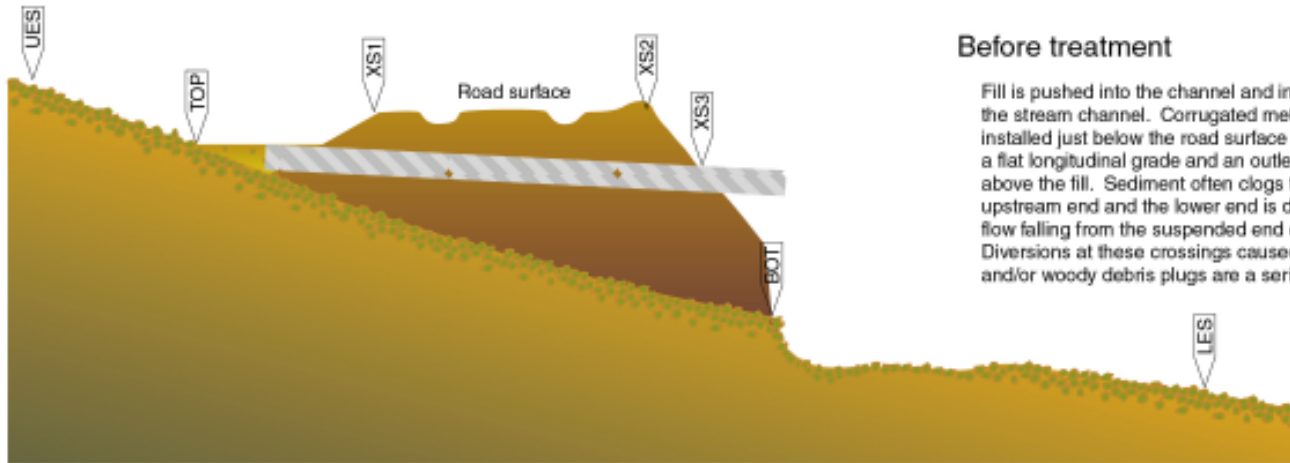
- Bedrock
- Excavated Fill
- Organic soil

LEC - Left edge cut
REC - Right edge cut

Culvert Stream Crossing Excavation

Longitudinal Profile Cutaway

The outboard edge cross section (XS2) is usually the deepest cross section from the road surface to the channel.

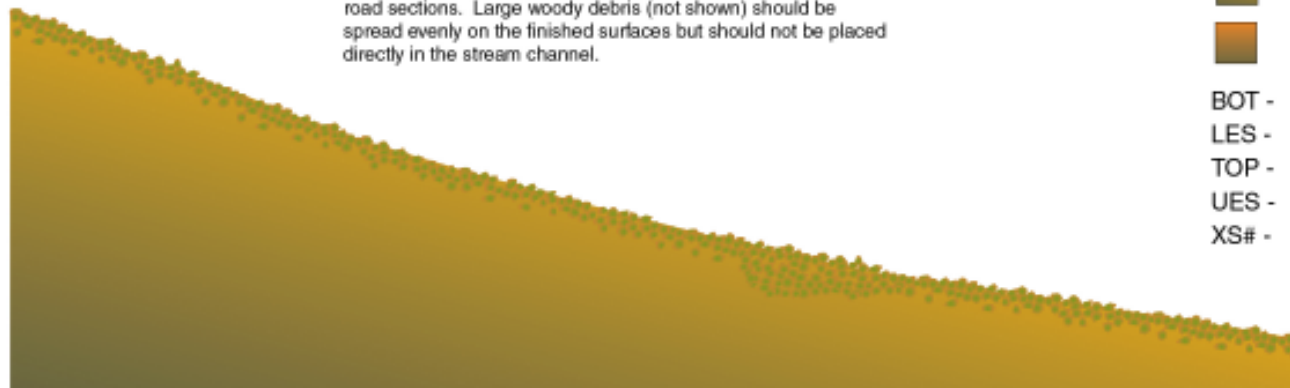


Before treatment

Fill is pushed into the channel and inner gorge to cross the stream channel. Corrugated metal pipe (CMP) installed just below the road surface is typically set with a flat longitudinal grade and an outlet hanging well above the fill. Sediment often clogs the pipe at the upstream end and the lower end is deeply scoured by flow falling from the suspended end of the culvert. Diversions at these crossings caused by sediment and/or woody debris plugs are a serious erosion threats.

After treatment

Fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the axis of the stream. Fill is used locally to recontour adjacent road sections. Large woody debris (not shown) should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.

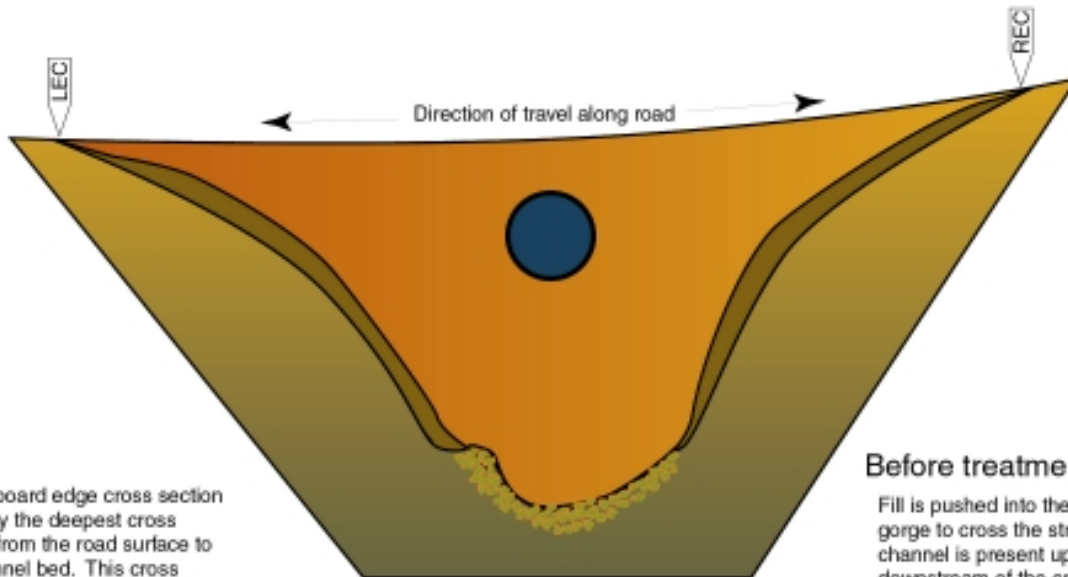


LEGEND

- Bedrock
- Excavated Fill

- BOT - Bottom of cut
- LES - Lower end stake
- TOP - Top of cut
- UES - Upper end stake
- XS# - Cross section

Culvert Stream Crossing Excavation Cross Section Cutaway



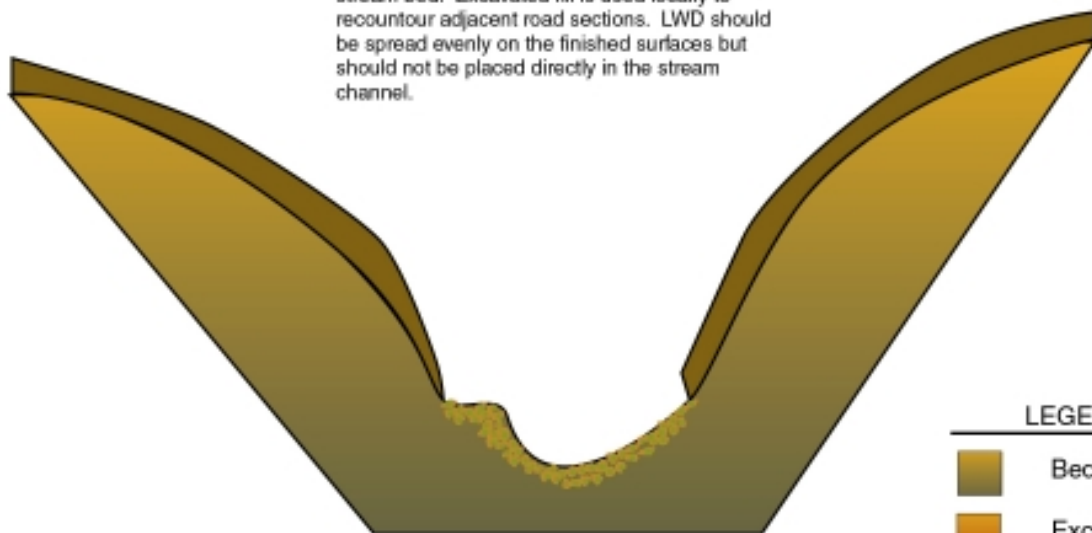
The outboard edge cross section is usually the deepest cross section from the road surface to the channel bed. This cross section would be representative of an outboard edge cross section. This view is looking downstream.

Before treatment

Fill is pushed into the channel and inner gorge to cross the stream channel. A channel is present upstream and downstream of the crossing. Culverts are common in these crossings to convey flow under the road. Usually culverts are set too high and undercut the outboard fill as water "shotguns" from the outlet. Diversions at these crossings are a serious erosion threat.

After treatment

The fill and culverts are excavated from the channel to re-expose the channel armor along the stream. Soil is not redistributed along the stream bed. Excavated fill is used locally to recontour adjacent road sections. LWD should be spread evenly on the finished surfaces but should not be placed directly in the stream channel.

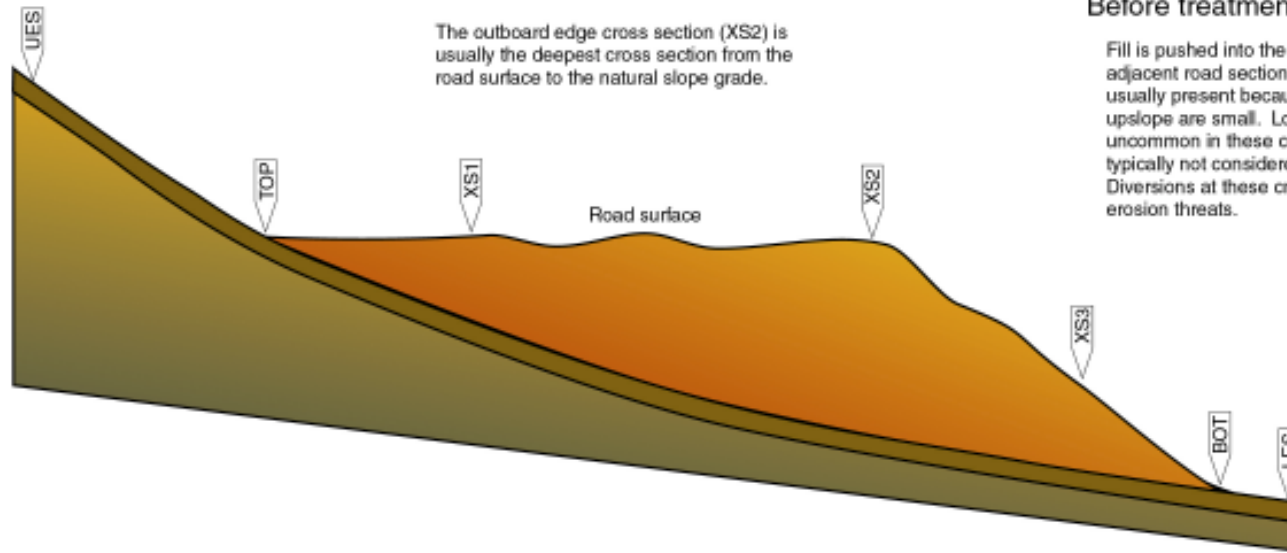


LEGEND

-  Bedrock
-  Excavated Fill
-  Organic soil
- LEC - Left edge cut
- REC - Right edge cut

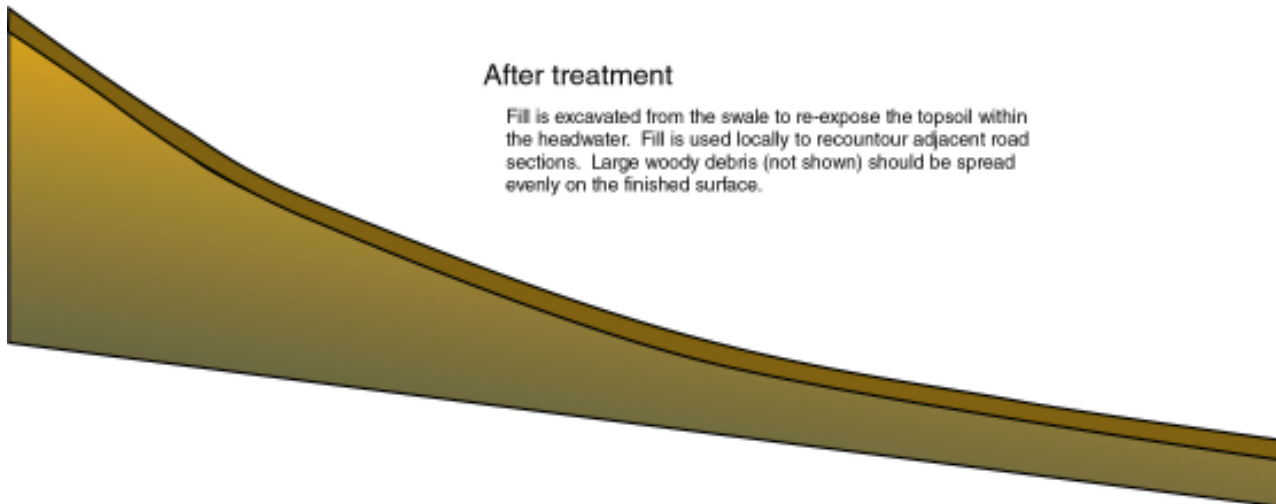
Headwater Swale Export Recontour

Cross Section Cutaway



Before treatment

Fill is pushed into the headwater swale from adjacent road sections. A channel is not usually present because the drainage areas upslope are small. Logs and culverts are uncommon in these crossings since flow was typically not considered in their design. Diversions at these crossings are serious erosion threats.



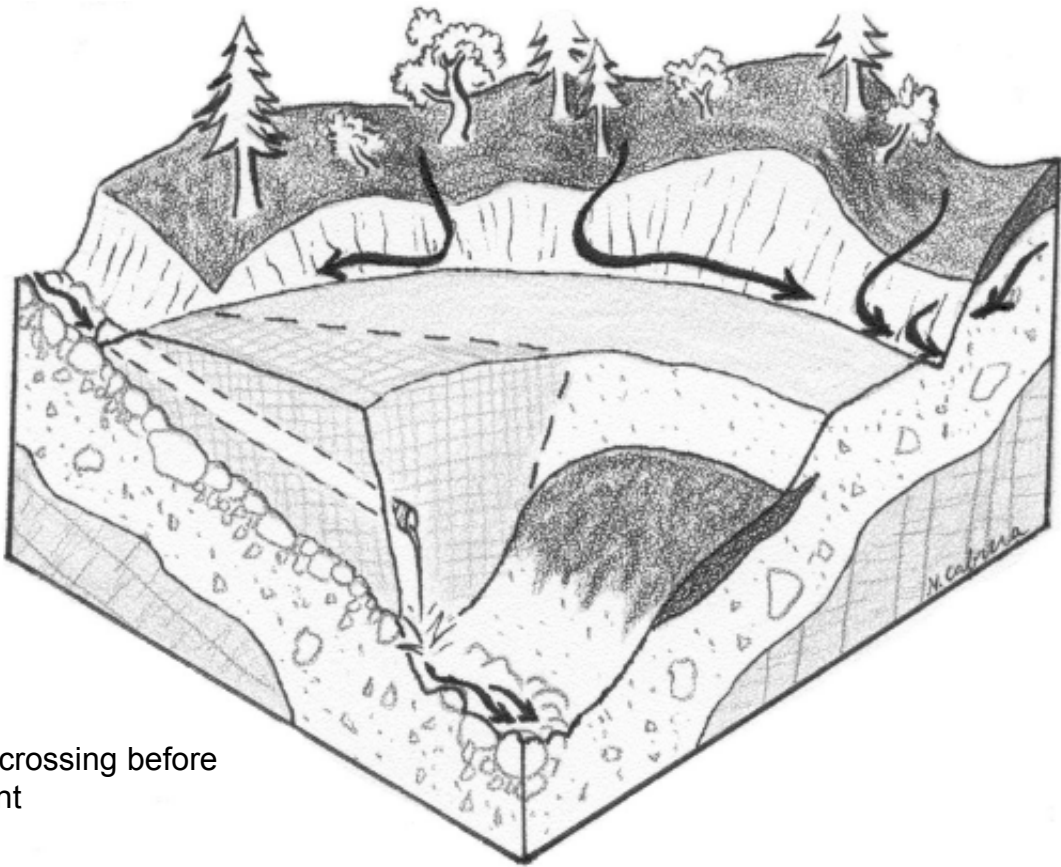
After treatment

Fill is excavated from the swale to re-expose the topsoil within the headwater. Fill is used locally to recontour adjacent road sections. Large woody debris (not shown) should be spread evenly on the finished surface.

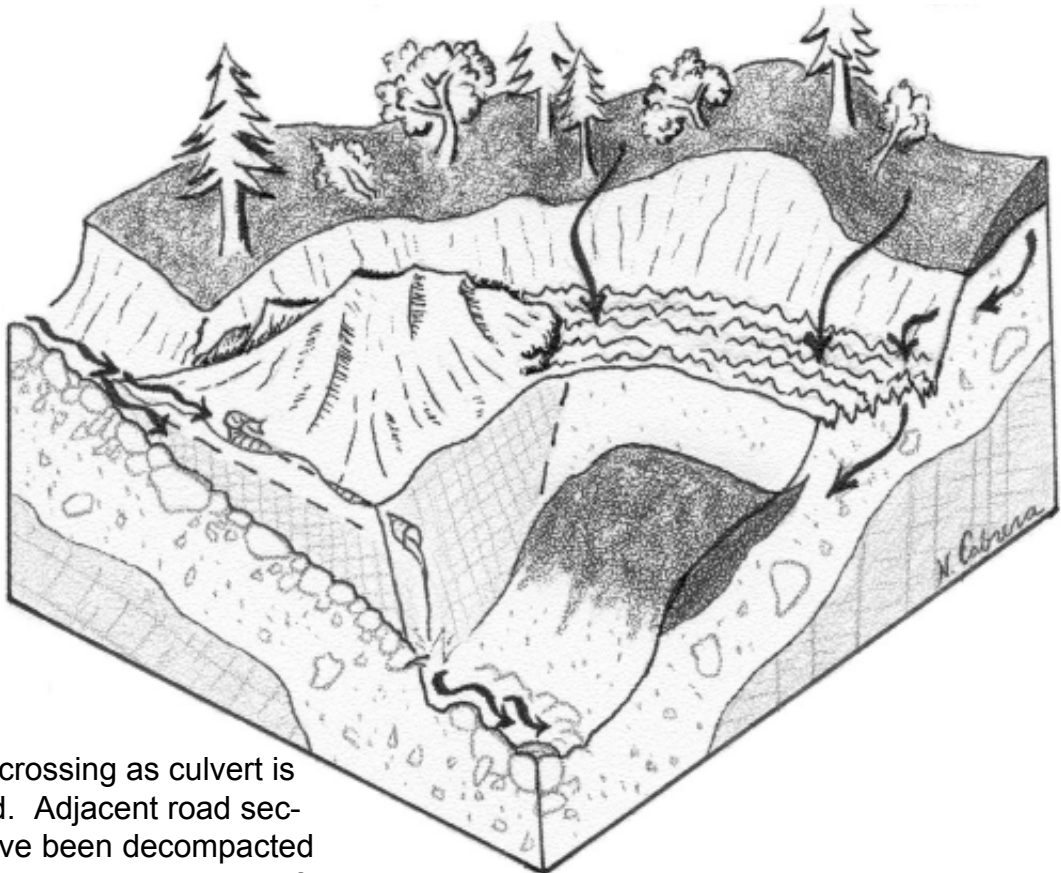
LEGEND

- Bedrock
- Excavated Fill

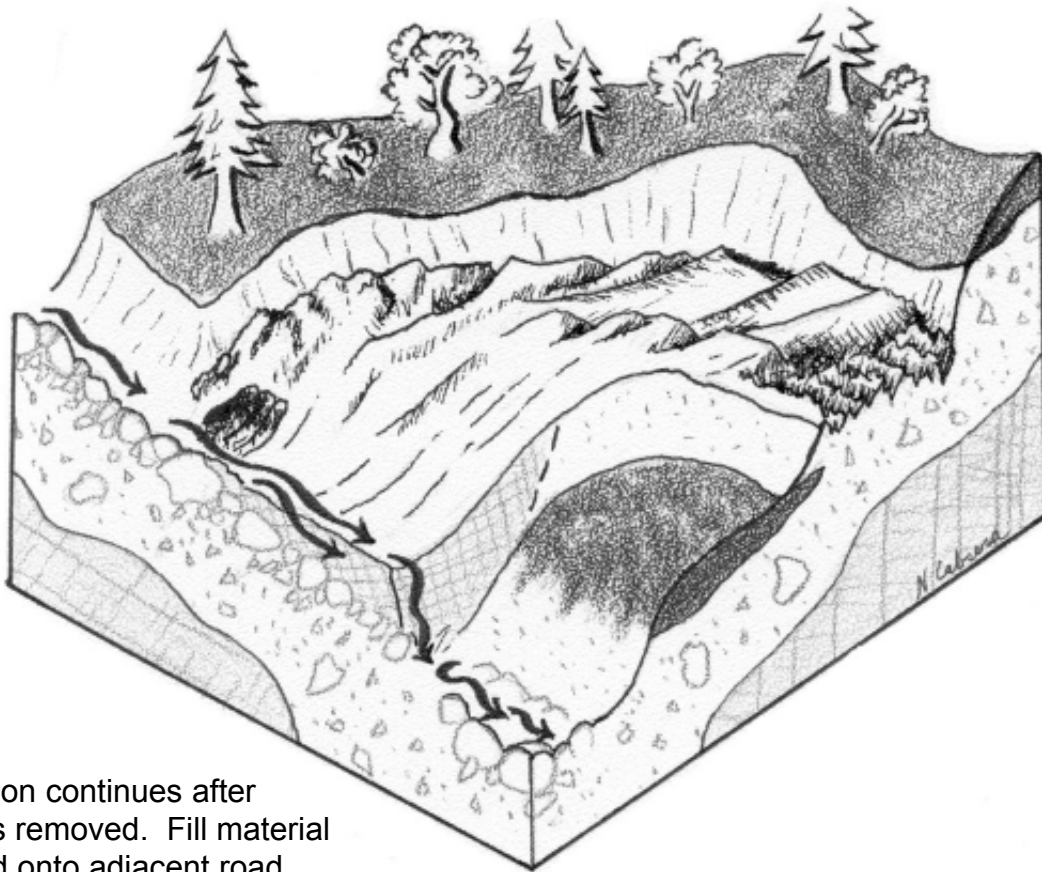
- BOT - Bottom of cut
- LES - Lower end stake
- TOP - Top of cut
- UES - Upper end stake
- XS# - Cross section



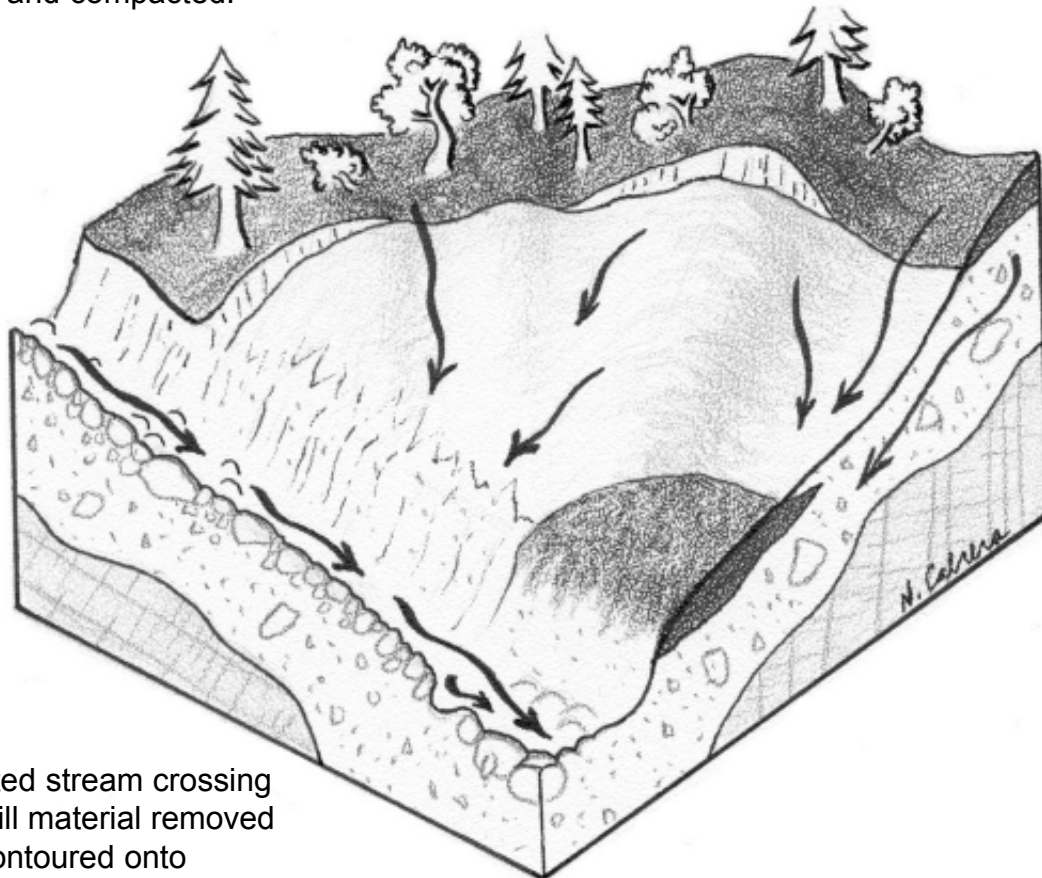
Stream crossing before treatment



Stream crossing as culvert is exposed. Adjacent road sections have been decompacted and fill is being pushed out of the crossing.



Excavation continues after culvert is removed. Fill material is moved onto adjacent road sections and compacted.



Completed stream crossing with all fill material removed and recontoured onto adjacent road sections.