6. Road Deactivation

Introduction

This chapter describes the objectives of road deactivation[1] and procedures for developing and reporting deactivation prescriptions. It also presents a number of techniques to address the province-wide range of terrain, soils, climatic conditions, and access. The other aim of this chapter is to provide administrative and process-oriented guidance on how to interpret and meet the requirements of the Act and Forest Road Regulation.

Refer to the Ministry of Forests *Best Management Practices Handbook: Hillslope Restoration in British Columbia* and other suggestions for further reading for more information on the technical and operational aspects of road deactivation. The objectives of this chapter are to:

- discuss deactivation objectives and the three levels of road deactivation
- describe and illustrate some common techniques for water management and road fill pullback used to reduce potential adverse effects on adjacent forest resources, and identify the range of techniques typically employed for each level of deactivation
- discuss the methodology used to conduct deactivation studies and develop prescriptions, and describe the content of these prescriptions
- discuss the involvement of qualified registered professionals in development of deactivation prescriptions, and present the linkage between prescriptions and terrain stability field assessments
- discuss revegetation requirements for deactivated roads, major works implementation, post-deactivation inspections, maintenance, and final approvals of deactivation works.

Objectives of deactivation

Deactivation minimizes the risk to resources—including environmental, social, and economic resources—within and adjacent to the road location from hazards such as landslides, uncontrolled soil erosion, and sediment transport.

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[1] In the Act, **deactivation** of a road is an engineering issue that involves application of techniques to stabilize the road prism, restore or maintain the natural drainage patterns, and minimize sediment transport to protect neighbouring resources at risk from potential landslide and sedimentation events. In the Act, **rehabilitation** of a road is a silvicultural issue that is typically done in accordance with a silviculture prescription or logging plan, and is normally carried out concurrently with (or following) deactivation, to restore the affected area to a productive site for growing crop trees.
Note: Deactivation is not necessarily tied to road closure, though that result may be unavoidable. Any administrative process to remove proponent responsibilities for the future stability of the landbase and any steps to remove legal status would take place after carrying out permanent deactivation.

Prescriptions must meet three important engineering objectives:

- stabilize the road prism and clearing width
- restore or maintain surface drainage patterns, and control subsurface drainage, consistent with natural drainage patterns
- minimize the impact of silt and sediment transport on other forest resources.

In addition, a deactivation prescription and associated works must address the following:

- Consideration must be given to the level of deactivation and the level of access that will be provided to meet the objectives for integrated resource management shown in the forest development plan.
- Deactivation works in community watersheds must not adversely affect water quality.
- Safe fish passage and protection of fish habitat immediately upstream and downstream of the crossing must be provided for or addressed, as must the timing and description of the work to achieve these objectives.
- All works in and around a stream crossing must be in accordance with the timing windows and measures that have been developed and made available by the designated environment official. If the proponent wishes to deviate from these measures, or if measures have not been made available, approval to do so must first be obtained from the district manager. Refer to the *Fish-stream Crossing Guidebook* for information related to crossings of fish streams.
- While vehicle access may be desirable, pullback of unstable fills along segments of a permanently deactivated road may eliminate such access. The focus should be on stabilizing the road prism, restoring or maintaining the natural drainage patterns, and minimizing sediment transport. The benefits of motor vehicle access should be considered, only if it will not adversely affect forest resources. There is no legal requirement for the tenure holder to provide such access if additional expenditures are necessary to do so.

Deactivation levels

A permit holder is required to carry out road maintenance as defined in the Act until a road is deactivated, transferred to another user, or taken over by the district manager. The Forest Road Regulation describes three levels of deactivation that can be used for forest roads: *temporary, semi-permanent*, and *permanent*.

Temporary deactivation

Temporary (or seasonal) deactivation may be used when regular use of the road is to be suspended for up to 3 years. The temporarily deactivated road must be field-inspected at a frequency commensurate with the risk to user safety and forest resources. If inspections indicate inadequate deactivation or damage to deactivation work, repairs must be made to correct the deficiencies.

Semi-permanent deactivation

The intent of semi-permanent deactivation is to place the road in a self-maintaining state that will result in minimal adverse impact on forest resources during the time that regular use of the road is suspended. Similar to temporary deactivation, regular inspections of semi-permanent deactivation works are required. Identification of deficiencies should be followed by any necessary corrective measures within a reasonable timeframe, considering the risk to the road, its users, and the environment.

Temporary deactivation for more than 1 year is not permitted for roads that are located in isolated areas that are accessible only by air or water or are located in areas with a moderate or high likelihood of landslides. The reason is that less frequent inspections are likely to occur for such roads, and it would be difficult to get equipment and crews to the sites for any necessary repairs. Semi-permanent deactivation is required in these areas to provide a lower risk to user safety and adjacent environmental resources.

Semi-permanent deactivation may be used for roads that are to be deactivated beyond 3 years or as described above for roads in isolated areas. In addition to the range of measures commonly deployed in temporary deactivation, for semi-permanent deactivation greater attention should be placed on mitigating the risk to adjacent resources through more aggressive application of water management techniques and possibly road fill pullback.

Permanent deactivation

The intent of permanent deactivation is to place the road in a self-maintaining state that will indefinitely protect adjacent resources at risk. Permanent deactivation commonly involves a range of measures that are similar to semi-permanent deactivation, but are often more aggressively applied where roads traverse areas of steep terrain or erodible soils, especially in geographical areas that receive high levels of precipitation.

Permanent deactivation is done with the expectation that the road will no longer be used by the person required to deactivate it. The road will receive no further inspections or maintenance. Permanent deactivation of mainline and primary branch roads is seldom carried out since these higher-order roads provide access for future harvesting and other needs. Permanent deactivation is thus usually limited to in-block roads and cutblock access roads, and to roads that provide duplicate access to areas.

Permanent deactivation will normally result in the elimination of motor vehicle access along road segments where unstable road fill is pulled back and where stream culverts and bridges are removed. However, for roads that cross flat or gentle terrain with no stream crossings, little or no work may be necessary to permanently deactivate the roads. In this case, motor vehicle access may be both possible and acceptable, unless there is a requirement in a higher-level plan to eliminate such access.

A permanently deactivated road is simply Crown land and no permit is required for use of the land base for motor vehicle access. The road location must be shown on a forest development plan, but can be removed from the plan in the second year following the district manager's acceptance. Retaining the old road location (with expired tenure) on atlas maps does no harm, as the former route may be useful in some emergency.

Water management techniques

Water management is one of two activities in road deactivation. In lieu of maintenance, water control elements that require routine maintenance can frequently be "fail-safed" by adding self-maintaining elements that, if properly installed, are less prone to failure. This is simply a back-up should the other element fail due to irregular or a complete absence of maintenance. Restoring or maintaining surface drainage patterns and control of subsurface drainage, consistent with natural drainage patterns, can be achieved by one or more of the following water management techniques.

Cross-ditch across an intact road

The purpose of a cross-ditch is to intercept road surface and ditchline water and convey it across the road onto stable, non-erodible slopes below the road (Figure 22).

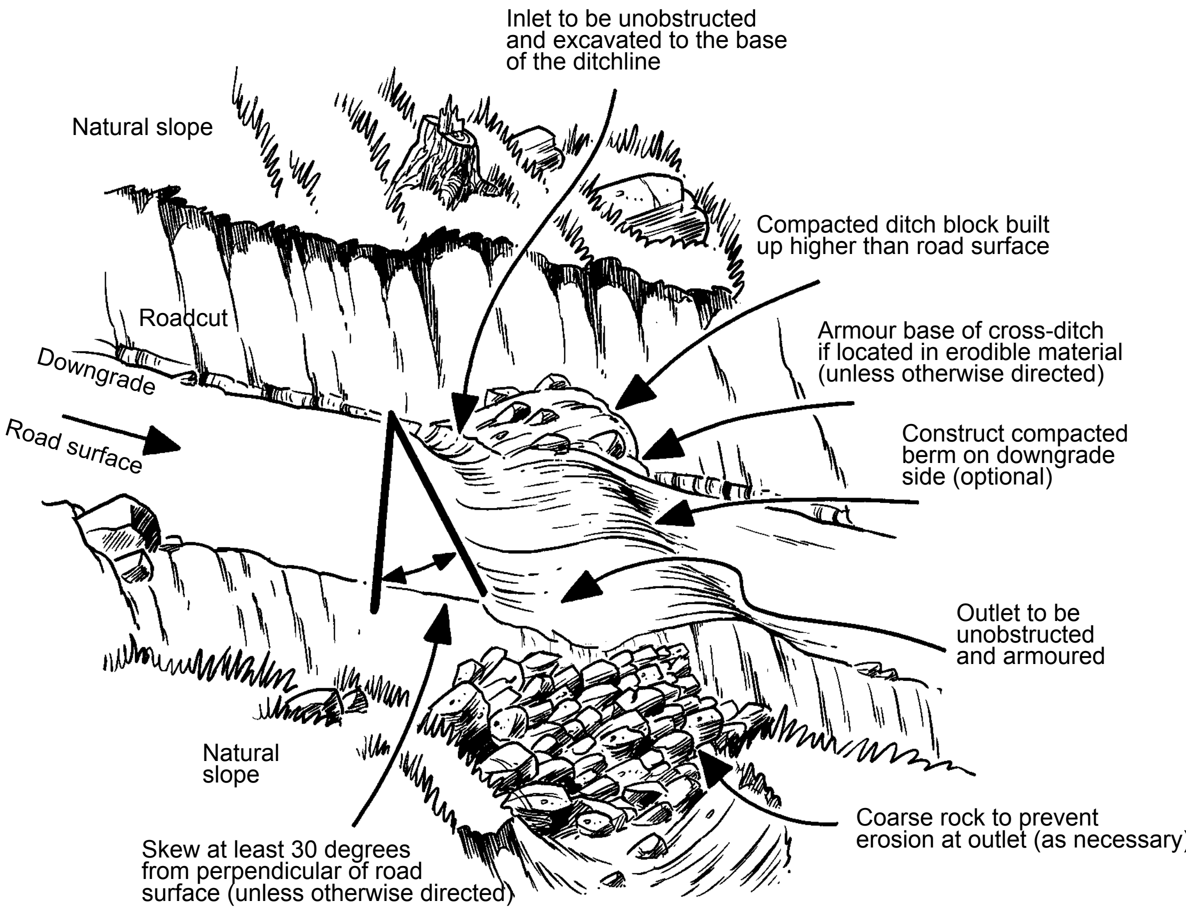

Figure 22. Cross-ditch installation across an intact road.

A well-compacted ditch block should be installed immediately downgrade of the cross-ditch inlet. For permanent or semi-permanent deactivation, the ditch block is usually higher than the road surface. The ditch block should be non-erodible, relatively impermeable, and large enough to divert all expected flows into the cross-ditch. Where ditchwater converges at low points in the road, no ditch block or berm is required, as the cross-ditch should be constructed as a broad gentle swale.

- Armour the base of the cross-ditch if erosion or rutting of the subgrade is expected to cause a problem for future road access. Armour the outlet of the cross-ditch, unless noted in the prescriptions. Size and placement of the armour will depend on the anticipated flows and downstream consequences.
- Use angular rock large enough to protect exposed soil, but small enough so as not to divert or obstruct flows. Where coarse rock is unavailable, other methods of protecting the outlet area may include revegetation, erosion control mats, sandbags, soil bioengineering, or appropriately sized and placed woody debris.

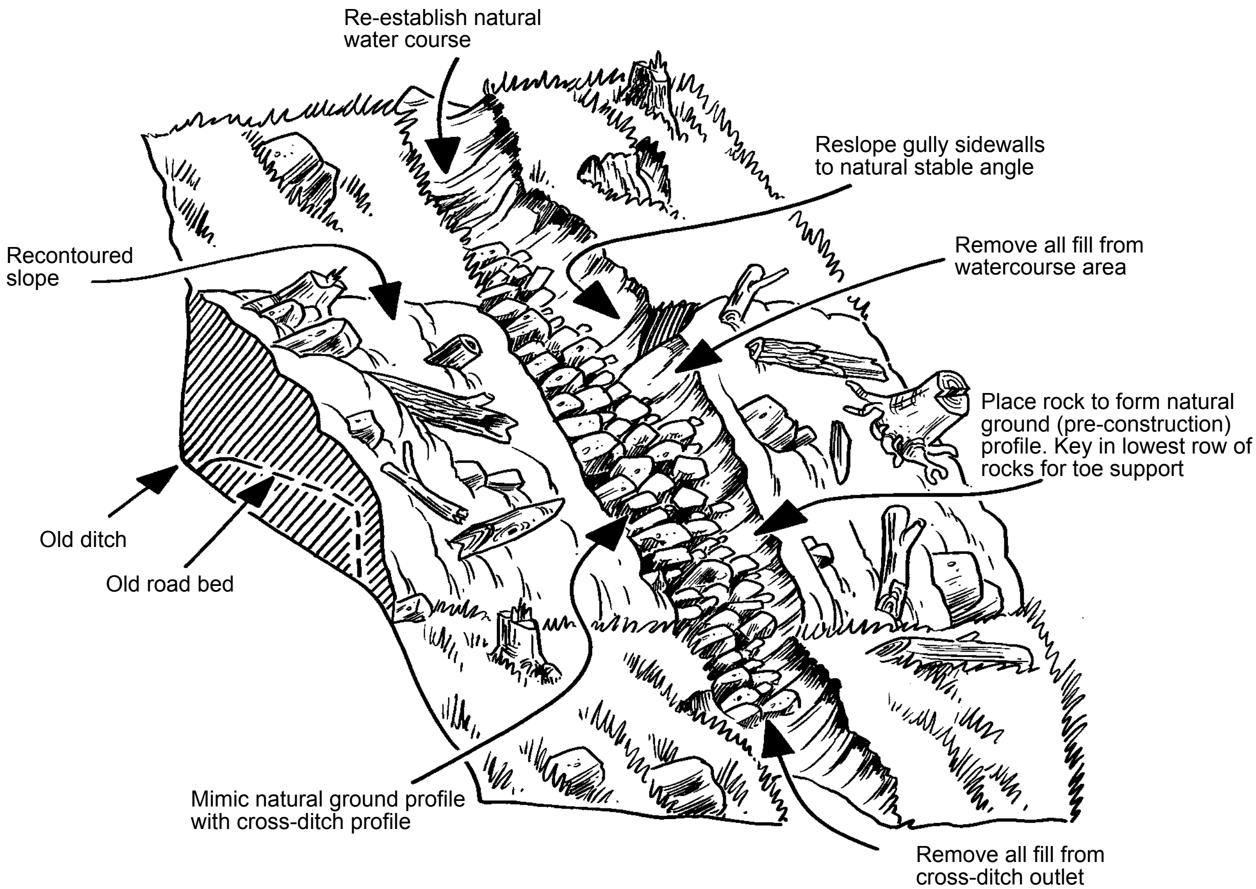

Figure 23. Cross-ditch installation across full road pullback.

Cross-ditch in full pullback

The purpose of a cross-ditch located within segments of full road fill pullback is to restore the natural hillslope drainage paths to pre-construction (historic) locations along the hillslope (Figure 23).

Armouring the base of cross-ditches constructed within fill slope pullback zones may not be needed in cases of very low flows, or where the flows are not hydraulically connected to larger streams in the watershed (fish habitat or water supply areas), or if no sedimentation is expected.

- Where cross-ditches in pullback are located at stream crossings, restore the width and natural gradient of the stream and armour the stream banks (sides of the cross-ditch) and the base of the channel.
- Flatten the sides of the cross-ditch as necessary to prevent slumping of fill into the stream.
- Consider also excavating a stepped channel in non-erodible materials to reduce the flow energy if erodible materials are present downslope.

For sites with no rock where lack of armour is a concern, the potential for erosion can be reduced by widening the base of the cross-ditch or stream channel, flattening the sideslopes to a gentle angle, creating wide flares at the outlet, and ensuring that the outlet grades evenly into the natural ground with no step.

Waterbars

The purpose of a waterbar is to intercept surface water on the road and convey it across the road onto stable slopes below the road. Waterbars can also be used to reduce the flow energy along the grade. Reverse waterbars direct flow off the road into the drainage ditch (Figure 24).

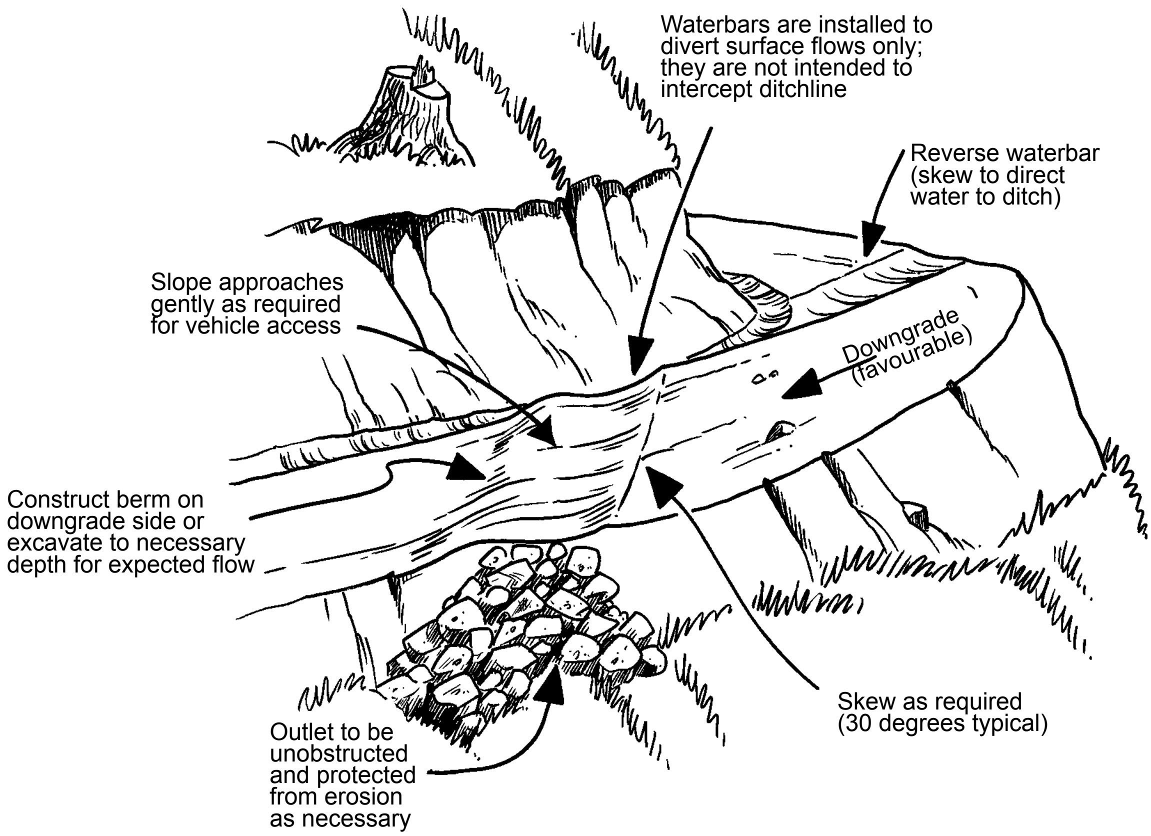

Figure 24. Waterbar installation.

Stream culvert removal

Stream culverts should be pulled and the channel reconstructed where culvert maintenance is impractical or impossible. The objective is to remove an existing metal or plastic pipe, or log culvert, creating the least amount of sedimentation possible and leaving a cross-ditch. This should be done by re-establishing the natural width and gradient of the stream, as well as armouring the stream banks (sides of the cross-ditch) and the base of the channel. The size, depth, and shape of the re-established stream crossing depend on the hillslope and creek/gully contours and expected flows. Figures 25 and 26 show techniques that can be used to remove a pipe or log culvert where running water is present in the channel, and the stream is hydraulically connected to fish habitat or community water supplies.

- At challenging sites, explore the range of practical options with experienced staff or fisheries agencies, to reduce the potential sedimentation to acceptable levels.

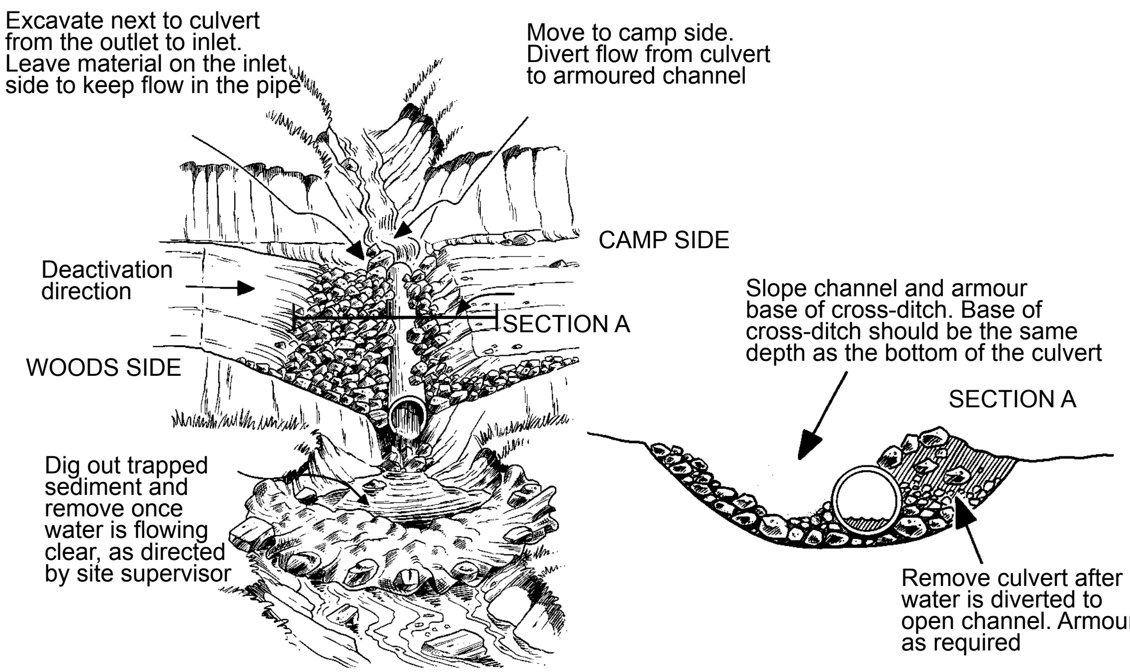

Figure 25. Metal or plastic pipe stream culvert removal (non-fish stream).

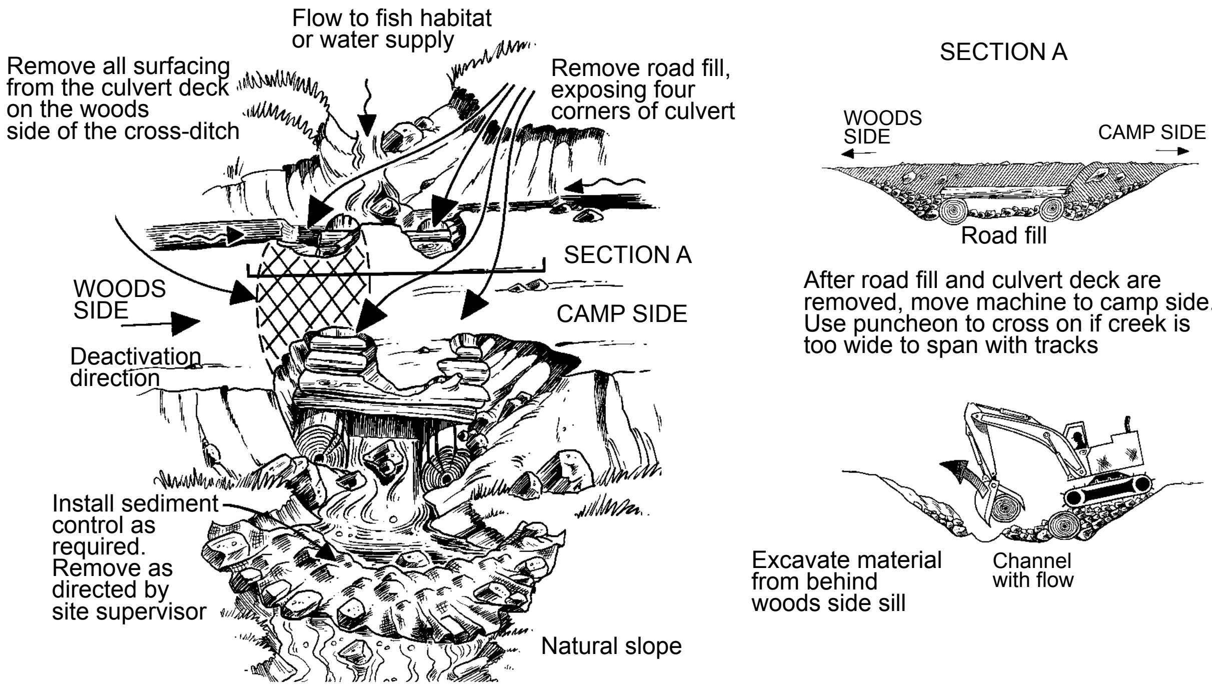

Figure 26. Log stream culvert removal (non-fish stream).

Trench drains

A trench drain is a cross-ditch that has been filled in with coarse rock and built up as the road fill is pulled back against the cut (Figure 27). The purpose of a trench drain is to pass both surface and seepage flow across road fill pullback. Trench drains, which are only prescribed in areas of full (heavy) pullback, are particularly useful where all the space on the road bench must be used for placement of road fill pullback.

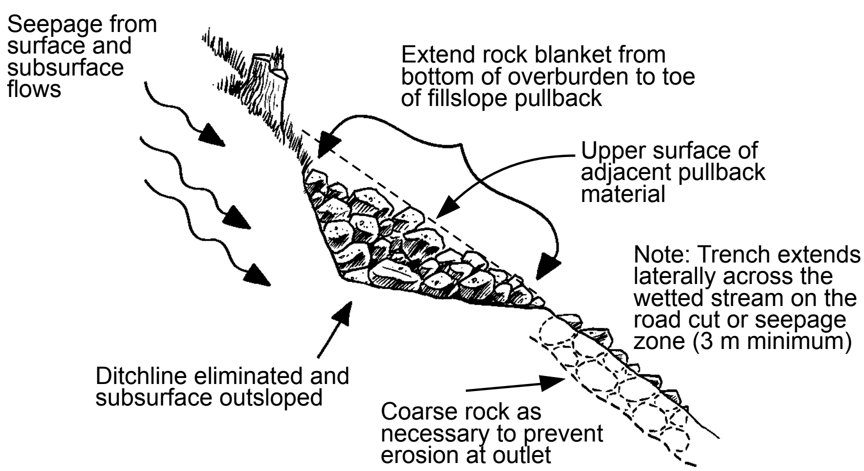

Figure 27. Trench drain.

The installation procedure is as follows. A ditch is dug across the road from the outlet to inlet, exposing native ground along the full length. The ditch should then be infilled with rock as it is excavated. A geosynthetic filter fabric (non-woven cloth) may help to keep soil from clogging the drain.

To carry the same flow (volume), trench drains are wider than a cross-ditch, but can disperse the water over a broader hillslope area.

Blanket drains

The purpose of a blanket drain is to disperse point seepage or subsurface flow under the road fill pullback. It disperses rather than concentrates the flow at a specific hillslope location. Blanket drains are not intended to convey surface flows or replace open cross-ditches in areas of substantial flow.

A blanket drain has a wider "footprint" in plan than a trench drain (it commonly extends a greater lateral distance along the road) to provide increased flow capacity (Figure 28).

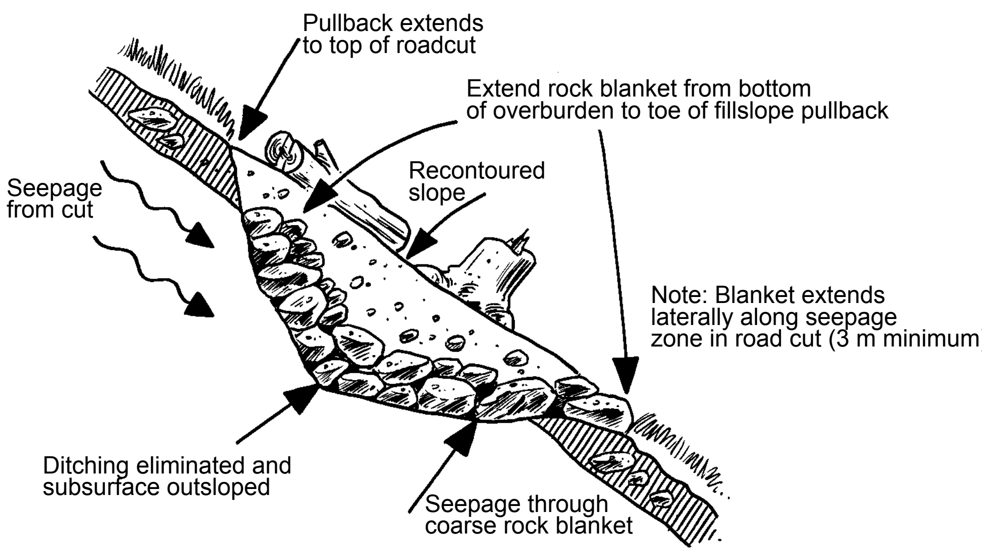

Figure 28. Blanket drain.

French drains

The purpose of a French drain is to divert flow along the base of a cut slope, and to discharge it into a stable location, such as a creek or gully. French drains can be used where road fill pullback or bank sloughing may block the ditch and cause water management problems. They can also provide some degree of water management if the road cannot be decompacted to below ditchline depth. The rock-filled French drain extends down the ditchline until it intersects, and is hydraulically connected with, a cross-ditch or gully.

French drains are normally used in conjunction with road fill pullback, but are sometimes used on active roads with road cut instabilities (Figure 29).

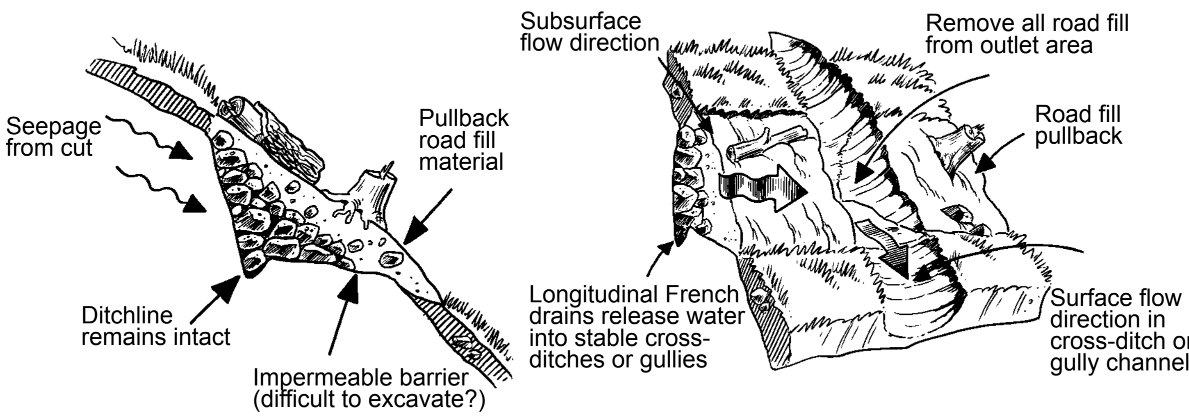

Figure 29. French drain.

Fords and armoured swales

Fords and armoured swales provide erosion-resistant and storm-proof wet crossings for motor vehicles. A ford is used to cross a stream, whereas an armoured swale is constructed where a cross-ditch would normally be used.

Fords

A ford is a dip in a road constructed to cross a perennial or ephemeral stream. It is usually designed and built as a permanent feature during original road construction, or during semi-permanent or permanent road deactivation (Figure 30). Fords are restricted to non-fish streams unless otherwise approved by the fisheries agencies. For deactivation, the running surface of the ford is often protected using rock armour where seasonal or ephemeral flows are expected, and is carefully graded to allow continued motor vehicle access.

Where flows are expected continuously during the time the road is in use, consider constructing a modified ford using low-flow culverts. Further future deactivation of fords is not normally required if they are well constructed. In cases where sediment and small woody debris is transported along the stream and could in-fill the voids in the large rock, a visual inspection of the ford may be necessary from time to time.

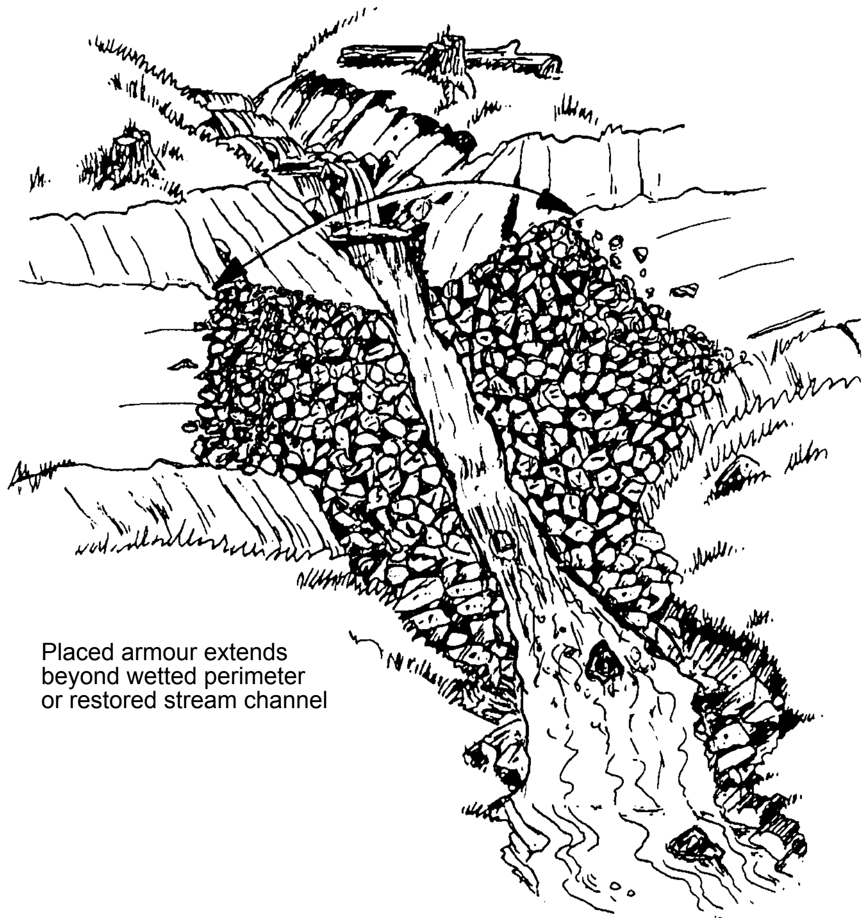

Figure 30. Example of a ford installed on a non–fish-bearing stream.

Armoured swales

An armoured swale is a dip in the road grade installed to convey road surface runoff, ditchwater, or cutbank seepage across a road where short-term vehicle access is required (Figure 31). It may also be used where it is critical to minimize sedimentation during short-term works such as road deactivation.

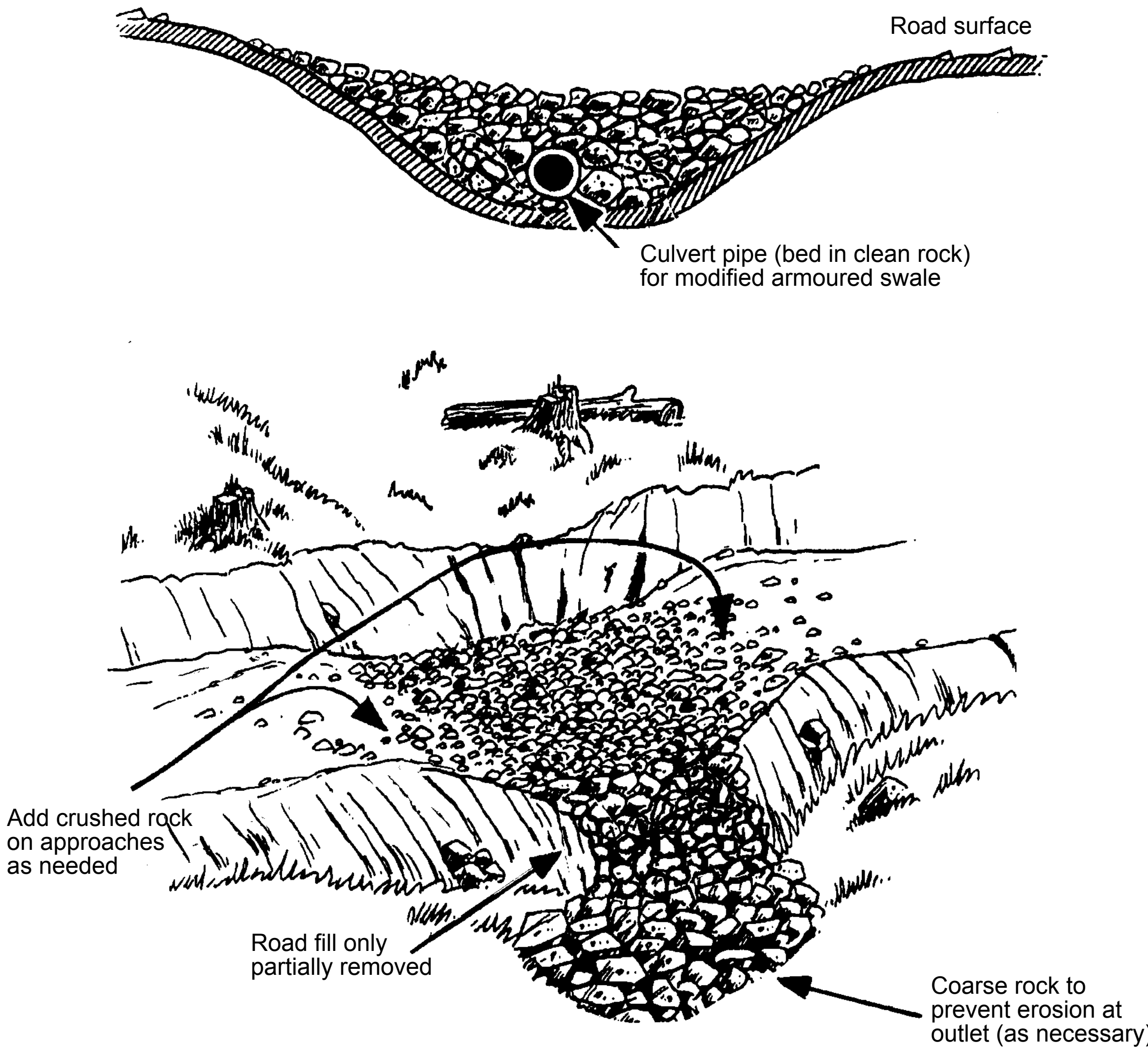

Figure 31. Example of an armoured swale.

Insloping/outsloping road surface

The purpose of insloping or outsloping the road surface is to control water without using ditches or cross-ditches. Insloping directs the water into the road cut, while outsloping directs the water across the road to the fill slope (or road shoulder) (Figure 32). This technique works to disperse water where the road grade is no steeper than about 6%. If used on steeper road grades, recognize that most of the water will tend to run down the road grade rather than flow into the ditch for insloped roads, or off the shoulder for outsloped roads.

This technique may be effective on roads where there is very little vehicle traffic. But where roads receive regular traffic, the insloping or outsloping will disappear with grading and development of wheel ruts. Outsloping also can be a driving hazard and is not recommended for roads travelled by heavy vehicles.

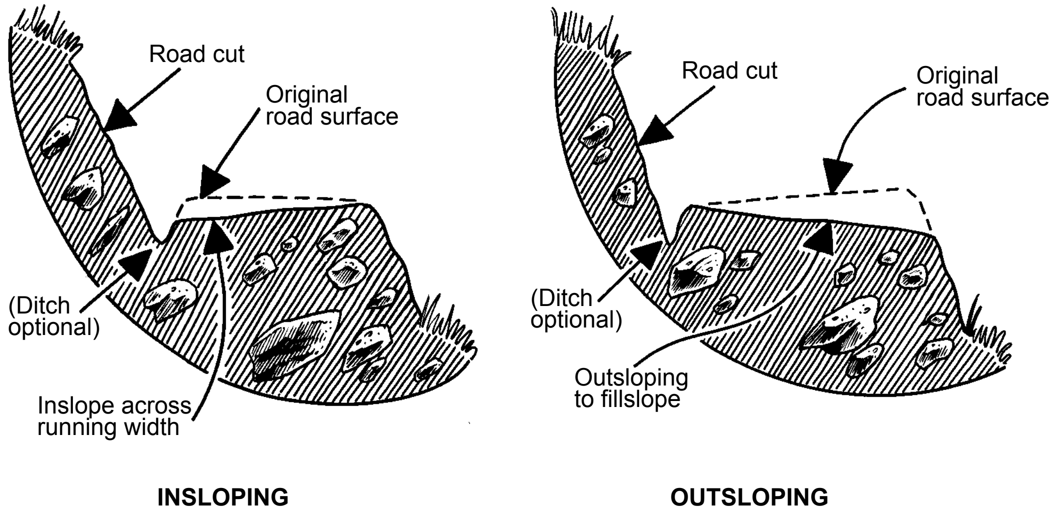

Figure 32. Insloping and outsloping the road surface.

Windrow or roadside spoil pile pullback

The purpose of windrow or roadside spoil pile pullback is to restore natural hillslope drainage paths where road maintenance activities have left a continuous soil berm on the outer edge (or inner edge) of the road. Larger berms may also be pulled back to reduce the weight on the outside edge of the road, or to satisfy silvicultural reasons (Figure 33).

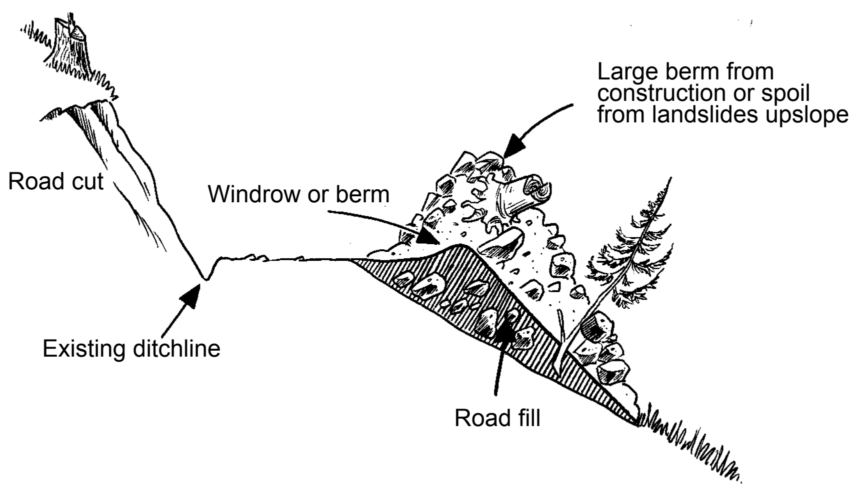

Figure 33. Grader windrow and spoil pile berm (site conditions before fill pullback).

Road fill pullback

In addition to water management, stable cut and fill slopes are required to prevent road-related landslides. Without regular maintenance, particularly on steep slopes, the stability of road cuts and fills can deteriorate. Usually, road fill pullback will be carried out only where required along selected segments of road, while water management techniques may be carried out at specific locations within or adjacent to the pullback areas. Where there is potential for unstable road cut or fill slopes to develop during periods of inattention, full road fill pullback or partial road fill pullback (where motor vehicle access may still be required) is commonly carried out. This removes marginally stable sidecast fill that has a high risk of failure, and effectively adds a weighting berm to the toe of the road cut.

Full road fill pullback

The purpose of full road fill pullback is to retrieve all potentially unstable sidecast material and place it tight against the road cut, thereby reducing the landslide hazard to the greatest extent possible. Usually no access or only limited access for foot or ATV traffic is possible after full road fill pullback (Figure 34).

Decompaction may also be necessary. This involves breaking up road fill materials to a depth equal to, or greater than, the depth of the ditch, and removing this material to outslope the surface before pullback material is placed overtop (Figure 34). This may be desirable to promote water flow across the road under the pullback material, to provide for the greater downslope reach of the excavator during pullback, and to allow the operator to determine the width of the natural bench for machine positioning.

If it is not feasible or desirable to decompact the road fill, then drainage collected from the filled-in road ditch can be discharged in a controlled manner by subdrains or open cross-ditches. Where very long and deep road fills are present, benching and/or ramping may be necessary to retrieve all the sidecast fill material.

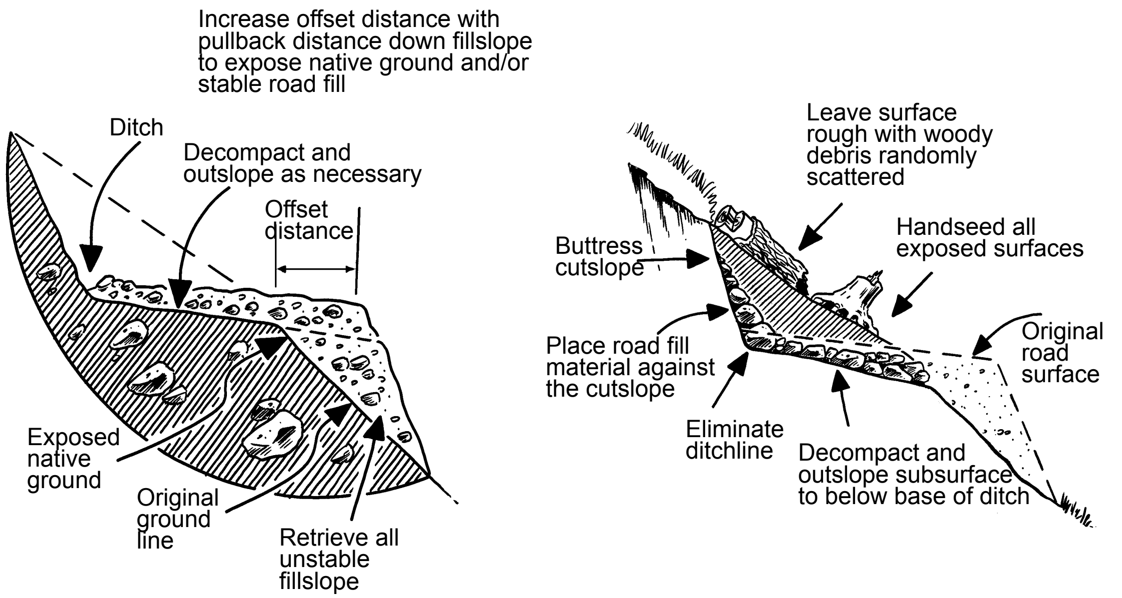

Figure 34. Example of full road fill pullback.

Partial road fill pullback

The purpose of partial road fill pullback is to reduce the likelihood of a landslide to a tolerable level along the road when full road fill pullback is not needed for immediate stability. Partial road fill pullback retrieves the unstable portion of the road fill and leaves the stable portion intact, but it may not reduce the road fill landslide hazard to the fullest extent possible. This technique may be appropriate to maintain motor vehicle access if the road is open to traffic or if road access is needed in the future. Full road fill pullback may be required at some future date to provide long-term stability of the road prism.

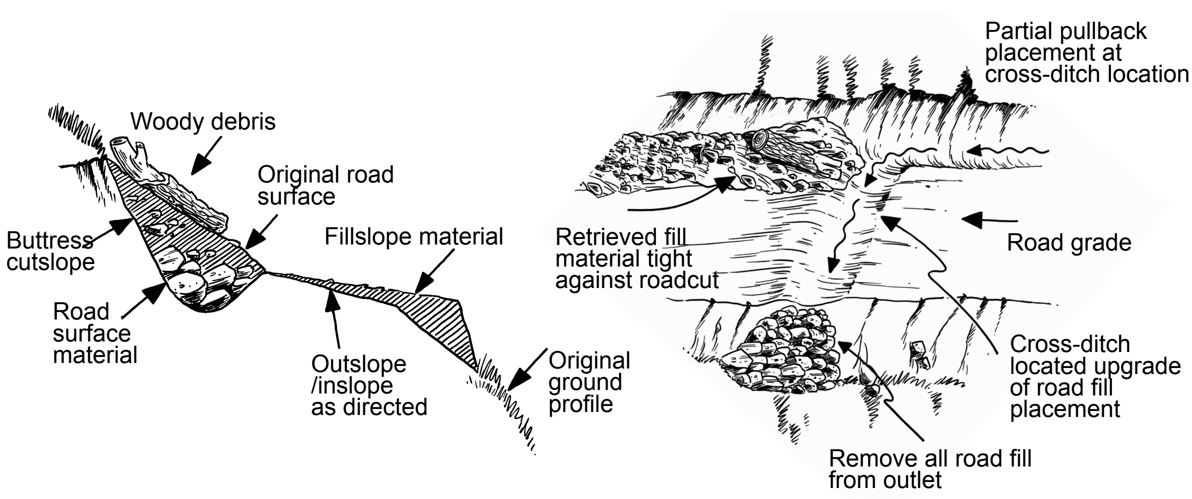

Figure 35. Partial road fill pullback.

Endhauling road fill pullback

Endhauling is the removal of excess road fill off-site by truck, and placing it in an approved waste area. Endhauling from unstable hillslopes helps restore the hillslope contour and profile, reducing the potential for future road fill–related landslides.

Gully restoration

Gully restoration involves pulling back all the fill material out of a gully channel. It is carried out during full road fill pullback to decrease the landslide hazard along the road approaches on the side walls of the gully. The size, depth, and shape of the pullback should mimic the natural ground profiles and contours of the gully system above and below the road. Armouring the gully channel and endhauling is often required. Similar techniques can also be used for entrenched creeks. Refer to the *Gully Assessment Procedure Guidebook* for detailed technical information on the deactivation of road crossings of gully systems.

Typical applications of deactivation techniques

Temporary deactivation activities

To meet specific site conditions, temporary deactivation work involves implementation of water management techniques to reduce landslide hazard and to control soil erosion and sediment transport, such as:

- removing or breaching any windrows on the outer edge of the road surface
- repairing or removing bridges as necessary
- constructing waterbars, cross-ditches, or other “fail-safe” or back-up drainage systems along the road, or insloping or outsloping the road as appropriate.

Partially pulling back road fill along road segments at high-risk sites may be necessary.

Semi-permanent deactivation activities

To protect resources at risk, semi-permanent deactivation work is site specific and may include some of the following techniques:

- removing all or some stream culverts and restoring channel and bank stability, or backing up culverts with cross-ditches as necessary
- replacing all or some cross-drain culverts with cross-ditches or backing them up with cross-ditches or other drainage systems as necessary
- installing cross-ditches or waterbars where there are:
  – steep grades
  – heavy ground water seepages

  - switchbacks or road junctions
  - ditches prone to plugging
  - places where ponding may occur
  - other potential drainage problem areas
- protecting road users during the period of deactivation by removing, repairing, or replacing those bridges that may place users at risk
- removing or breaching windrows on the road surface
- outsloping or insloping the road surface or constructing waterbars as appropriate
- carrying out measures to remove organic material (stumps, roots, embedded logs, topsoil) that may reasonably be expected to fail and de-stabilize the road fill
- pulling back potentially unstable sidecast fill.

Permanent deactivation activities

Permanent deactivation is different than semi-permanent deactivation in the following ways:

- Bridge and log culvert superstructures must be removed. The bridge or log substructures must also be removed if a failure of the substructure could be expected to adversely affect downstream values.
- Stream culverts will usually be removed to ensure there is no potential adverse impact on the stream. Where there is a low risk of damage to fish passage or water quality, pipe culverts at stream crossings may be left in place, *provided that the district manager approves the permanent deactivation prescription*.
- Cross-drain culverts should be removed and replaced with cross-ditches to re-establish drainage patterns, especially on steep road grades and side hills. If the likelihood of failure is minimal or the consequences of a failure are low, consideration may be given to leaving the cross-drain culvert intact, provided it is backed up with a cross-ditch or armoured swale as necessary.

Methodology to develop deactivation prescriptions

Definition and purpose of a prescription

A deactivation prescription is a written document that clearly communicates the objectives and the works to be performed.

District manager approval of prescriptions

For temporary deactivation, prescription approval is not required, unless the proponent is notified in writing that the proponent must prepare a deactivation prescription and obtain the district manager's approval of it. For all semi-permanent and permanent deactivation, the proponent must prepare a prescription and, unless exempted from doing so under the Forest Road Regulation, obtain the district manager's approval.

Note: The exemption is from obtaining the district manager's approval of the prescription, not from preparing a prescription.

A deactivation prescription will:

- report the level of required deactivation, the objectives of the planned deactivation work, the vehicle access requirements, and the techniques to be performed by station
- report special requirements (e.g., worker safety issues and other important requirements explained later)
- where required, provide relevant detailed information to the district manager for approval.

It is good practice to retain the following:

- original field notes
- final deactivation maps, tabular summary, and letter or report, as applicable
- any relevant correspondence.

Prescription development involves three sequential phases: office review, field assessment, and preparing maps, tabular summary, letter or report. These phases are discussed briefly below.

Office review

Prior to field work, conduct an office-based review of existing information and local knowledge to help identify the potential resources at risk, terrain stability concerns (especially below the road corridor), sediment and landslide hazards, and consequences at and adjacent to the road.

Field assessment

Carry out a field assessment and prescribe deactivation techniques at specific locations. This task typically involves the following activities: traversing the road corridor and identifying potential stability and drainage hazards, evaluating the risk to resources, and marking prescription activities in the field. It is important to consider the risk to downslope and downstream resources when developing prescriptions, not only the landslide hazard associated with the road.

The following should be evaluated before a deactivation technique or combination of techniques are chosen:

- the proposed level of deactivation and type of vehicle access following deactivation, as approved in the forest development plan. Where actual field conditions result in a changed level of vehicle usage, then an amendment to the forest development plan is required
- the stability of the road cuts and fills, condition of culverts and bridges, performance of the existing road drainage system, existing sediment sources, and potential for further deterioration of road structures and prism
- the stability of the terrain below (and in some cases above) the road corridor
- any existing access problems that may prevent or impede excavator access to the end of the road to start the deactivation work (locations where large landslides have destroyed the road grade in gully areas, large cut slope landslides, existing deactivation work, etc.).

An example field data form for foot-based field assessment is shown in Appendix 8.

Refer to Chapter 3, “Road Construction,” for examples of surface soil erosion and sediment control techniques that should be considered for road deactivation. Road works shutdown indicators and procedures are also provided in Chapter 3 and should also be considered when carrying out road deactivation works.

Preparing maps, tabular summary, letter or report

A deactivation map, or work plan, to scale is mandatory plus one or more of the following:

- a tabular summary of prescribed techniques, by station
- a letter or report.

These requirements are more fully discussed below. Examples showing the linkage between various site and project conditions, and the minimum content of a road deactivation prescription, are provided in Appendix 9.

Content of deactivation map (work plan)

The minimum requirement is a map at 1:5000 scale or other suitable scale. The following should be considered for illustration on the map, as deemed appropriate to effectively communicate the design requirements of the work to equipment operators and supervisory personnel:

- level of deactivation (temporary, semi-permanent, permanent) and intended duration (if not permanent)

- vehicle usage (4-wheel drive, ATV, no access)
- topographic information
- additional relevant planimetric information (e.g., streams, bodies of water, legal boundaries, landslides, utilities, highways)
- additional supporting information such as stream classifications, and timing windows and measures for work in and around stream crossings (where necessary)
- sites of potential concern for worker safety
- requirements for field reviews by a qualified registered professional
- special requirements for work carried out within a community watershed
- location of all prescribed deactivation techniques (road chainage and prescription symbol)
- legend for prescription symbols
- date of the assessment
- name of the assessor
- scale bar and north arrow.

Note: Some items above may be provided in the tabular summary rather than on the 1:5000 scale map if this would more clearly depict the work.

Content of tabular summary

Appendix 8 shows a suggested format for a tabular summary (spreadsheet) of prescribed actions to accompany and complement the above map. A tabular summary is usually required where more detail must be given to communicate the requirements of the project to forestry operations personnel, or where the risk of damage to adjacent resources is moderate or high, or where rechaining may be necessary to re-establish the field markings.

As a minimum, the tabular summary should contain the measured chainages along the road, the associated recommended actions, and more detailed comments about site conditions, worker safety issues, key reference points, rationale for road fill pullback, depth and width of cross-ditches, and other such practical information. The tabular summary can also be used as a tool to help estimate the costs of road deactivation works.

Content of letter or report

A report should accompany and complement deactivation maps and tabular summaries where there is a high risk to the environment, if the project is large or complex, or if roads traverse areas of moderate to high likelihood of landslides. For small projects, a brief letter rather than a report may be sufficient. Reports may require sign-off by a qualified registered professional, licensee representative, or the district manager. A report or letter should cover the following topics, as relevant:

- geographical location information (watershed name and number, cutting permit)
- background information
- description of deactivation objectives
- prescription methodology
- road reactivation considerations (road reconstruction, wet crossings, safety issues)
- site-level information
- results and recommendations
- site plans and illustrations.

Involvement of professionals in road deactivation

Linkage between TSFA and deactivation prescriptions

A qualified registered professional must prepare a deactivation prescription where the road crosses areas having a moderate or high likelihood of land-slides, as determined by a terrain stability field assessment (TSFA).

Pre-Code terrain issues

On an existing road where no TSFA exists, one will have to be completed as required by the Forest Road Regulation. A qualified registered professional can conduct the TSFA as a separate forest management activity prior to the development of a deactivation prescription for the road. However, it is more common for the TSFA to be carried out concurrently with a deactivation field assessment and prescription where the registered professional is qualified to conduct both assessments. A pre-Code TSFA may not be deemed acceptable. Appendix 10 provides a qualitative risk assessment procedure that may be appropriate to determine risk to adjacent resources.

Post-Code terrain issues

In the following situations, a new Code TSFA may be required:

- **Example 1:** A road TSFA was completed according to Code requirements and before a road was constructed. It showed a low likelihood of land-slides, but segments of the road now show visual indicators of slope instability and risk to adjacent resources
- **Example 2:** No road TSFA was prepared before a road was constructed, because it was not required by the Code. The road corridor now shows signs of instability and risk to adjacent resources.

Care should be taken in verifying indicators of slope instability in the following situations:

- Tension cracks or minor slumps in the road surface do not necessarily signal unstable terrain, but rather a failing road fill. Partial pullback of the road fill may be appropriate to stabilize the road prism and protect users of the road and adjacent resources.
- If the slope instability indicators occur outside the road prism (e.g., a small slide), or the instability within the road prism has the potential to affect adjacent resources (e.g., debris from a potential fill slope failure could reach a fish stream), the area should be considered unstable.

Professional field reviews – quality assurance

The rationale for a professional field review should be stated in the TSFA or the deactivation prescription, and should describe any specific concerns and the potential consequences of not carrying out professional field reviews. As well, it should identify the requirements of the person appropriate to complete the professional field reviews.

Note that the cost to carry out road fill pullback a second time to repair deficiencies can be much higher than the cost of the original pullback work. Thus, thorough field reviews are prudent for full road fill pullback above high-value resources (such as highways and residential development).

Professional field reviews – unanticipated subsurface conditions

Unanticipated subsurface conditions can be encountered during deactivation works. In such an event, and if potential adverse impacts to adjacent resources are identified, the forest tenure holder should consult a qualified registered professional for a professional field review before continuing with the project.

Modification of prescriptions

To address unforeseen site conditions, the proponent is often forced to modify the prescription. If the proponent has reasonable grounds to believe that the changes to the prescription would not adversely affect forest resources or future access objectives, the proponent may make the required changes without further approval. If there is a potential for adverse impact, however, the changes to the prescription must be approved by the district manager. At the start of the project, it is often useful to establish a protocol for the types of changes that can be made on site.

For prescriptions that must be prepared by a qualified registered professional, that person or another similarly qualified registered professional, in addition to the district manager, must also approve all changes to the prescription.

Revegetation requirements for deactivated roads

To control surface soil erosion and sediment transport, the Code requires that a proponent who deactivates a road must revegetate all exposed soils that will support vegetation. This should be done by applying seed in the first growing season. For information on application of grass seed, see Chapter 3, “Road Construction.”

Vegetation must be established, to the satisfaction of the district manager, by the end of the second growing season. The district manager may vary this time period or the process for revegetation if satisfied that the change will adequately manage and conserve the forest resources. The district manager may also consider natural revegetation appropriate if it can be suitably established within two growing periods. Revegetation is considered to be successful when there is uniform coverage on the ground. Spotty or clumpy patches of vegetation are not considered adequate.

The district manager should consider the following factors in assessing the adequacy of revegetation efforts:

- the mixture of the grass seed used
- the time and rate at which the seed was applied
- the appropriateness of the fertilizer and mulch used
- the number of attempts made to establish the vegetation.

Scarification

In addition to grass seeding requirements, it may be necessary to scarify the road surface or to re-use local topsoils or other measures to grow trees for soil erosion control purposes in those areas that are not part of the net area to be reforested, but where trees can be reasonably expected to grow.

Note: Scarification is for revegetation purposes, whereas decompaction is for water control during fill pullback activities.

Scarification (also known as “silvicultural fluffing”) is done to enhance revegetation. It involves breaking up the road surface to a minimum depth equal to about twice the length of the teeth on an excavator bucket (about 400 mm, or 16 inches). Scarification is more important for those road surfaces where the materials are well graded, or where high traffic volumes have compacted the road surface. A silviculture forester should be consulted to determine the necessity of scarification relative to planned tree species and site index parameters along the road.

Field observations (prescription indicators) that may lead to a scarification prescription are as follows:

- road surface is compacted
- road fill is stable; no pullback needed
- planting of conifers is better than existing revegetation at the site
- local experience indicates that conifers do poorly on compacted road surfaces
- road is stable and no further access is needed.

Woody species establishment

In addition to Code requirements for grass seeding of all deactivated roads where necessary, carry out additional revegetative measures for permanently deactivated roads, including the localized re-use of topsoil to grow trees for soil erosion purposes.

For permanently deactivated roads, consider planting pioneering species such as alder, willow, and, in some cases, lodgepole pine and Douglas-fir on areas of full road fill pullback or on areas that have been scarified. These species are important early colonizers of disturbed sites, and prepare the site for later successional forest species such as spruce, cedar, and hemlock.

The use of topsoil and tree planting to achieve revegetation (outside the net area to be reforested) on a permanently deactivated road should simply be for the purpose of controlling soil erosion. There is no requirement to reforest all permanently deactivated roads, even when it is feasible to reforest. The choice of reforestation rests with the person required to deactivate the road. A qualified forester or biologist should review the selection of tree species for planting on any permanently deactivated roads.

Soil bioengineering

Where revegetation is difficult, discussions with revegetation specialists may be helpful. Applying soil bioengineering systems for water management on steep slopes, and for riparian restoration, should be considered with the following objectives:

- drain excess moisture that may be creating slope instability (e.g., live pole drains, live silt fences, live bank protection, live gully breaks, and live staking)
- reduce slope angles relative to the growth of vegetation and prevent ravelling of fill slopes (e.g., wattle fences, modified brush layers, brush layers in a cut)
- control erosion along watercourses (e.g., live gravel bar staking, and live shade).

Control of noxious weeds

Knapweed and other noxious weeds are found along many old logging roads and should be considered during deactivation assessment. Consulting a range agrologist may be warranted to minimize the likelihood of spreading these problem weeds through machine travel or seed disturbance, if scheduling deactivation work outside the seed maturity time is not possible.

Deactivation hazard warning signs

Before deactivation activities begin, install hazard warning signs at appropriate locations to warn potential users of the road (either open or closed to traffic) of the hazards that can be expected on the road on a continuous basis or at a particular road location. Where an entire drainage or system of roads has been deactivated, the signs can be posted at the earliest location to forewarn of the upcoming hazards.

Sign maintenance can be a serious problem, especially during the hunting season. These signs may be destroyed as fast as they are erected. If this is an ongoing risk to road users, the person conducting an inspection should be prepared to replace them.

Post-deactivation inspections and maintenance

Refer to Chapter 5, “Road and Structure Inspection and Maintenance,” for information on the inspection and repair requirements for temporary and semi-permanent deactivation.

Acceptance of permanent deactivation

The ministry should inspect the road before accepting it as being permanently deactivated. The district manager may provide for a time period to elapse to test the ability of the deactivation work to withstand a normal cycle of weathering. Upon final inspection, the district manager may notify the person responsible for deactivating the road in writing that the road has been permanently deactivated.

Suggestions for further reading

British Columbia Ministry of Forests and B.C. Ministry of Environment, Lands and Parks. 2001. *Best Management Practices Handbook: Hillslope Restoration in British Columbia*. Victoria, B.C.

British Columbia Ministry of Forests. 2001. *Gully Assessment Procedure Guidebook*. Victoria, B.C.

____________. 2002. *Fish-stream Crossing Guidebook*. Victoria, B.C.

Bulmer, Chuck. (editor). 2000. *Forest Road Deactivation Practices in the Pacific Northwest*. B.C. Ministry of Forests, Forest Science Program. Victoria, B.C.

Forestry Continuing Studies Network (FCSN). 1997. *Advanced Road Deactivation Course Manual*. Victoria, B.C.

Forest Engineering Research Institute of Canada (FERIC). 2001. *Compendium of Watershed Restoration Activities: Techniques and Trials in Western Canada*. Vancouver, B.C.

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