

Chapter 3

Planning Issues and Special Applications

"Assess the long term impacts and benefits of a road."

KEY ROAD ISSUES should be addressed during the planning phase of a road project, prior to construction or upgrading roads. These key issues involve changes or impacts to an area that a road can cause that may be significant, irreversible, or difficult to mitigate. The benefits of a road project must be weighed against the long-term costs and impacts of that project. Once a road is built into an area, it can lead to long-term land use changes and unplanned growth, as shown in *Figure 3.1*. Sediment from roads can also be a direct source of water pollution. *Figure 3.2* shows some of the ways that roads directly contribute sediment to nearby streams when they are closeby and "hydrologically connected". Thus the social, environmental and fiscal cost-effectiveness of the road need to be examined.

Key issues include the following:

- Impacts on area growth, land use, deforestation, and impacts on local communities or indigenous populations (influences beyond the Right-of-Way of the road) (*Figure 3.1*);
- Optimum road location and system to serve area needs as well as specific project needs.;
- Long term potential use of the road versus current use;
- The appropriate minimum design standard to serve the road user and meet road needs ("right" sizing a road) (*Photo 3.1*);
- Avoiding local water quality impacts and degradation (keep roads away from and disconnected from water courses), as well as improving or maintaining water quality standards (*Figure 3.2*) (*Photo 3.2 and 3.9*);
- Minimizing impacts on local plants and animals, both directly and indirectly;
- Ability to provide sufficient long-term road maintenance;
- Ability to have knowledgeable technical personnel as well as good, locally experienced individuals involved in road projects. Hire good people. Assure that they have the working tools available that they need to do the job;
- Identifying and avoiding problem areas such as landslides, wet areas, poor soils, or excessively steep grades.

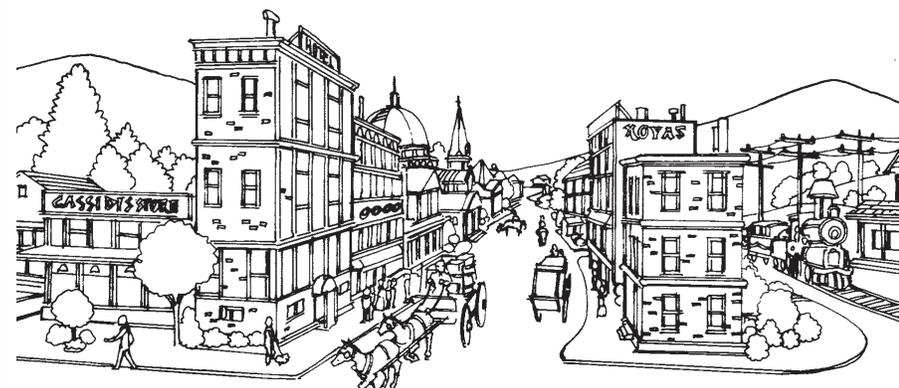
Indicators and Watershed Assessment for Problematic Roads

How do we decide when a road is creating or likely to cause problems? Today's road managers are frequently faced with additional expectations

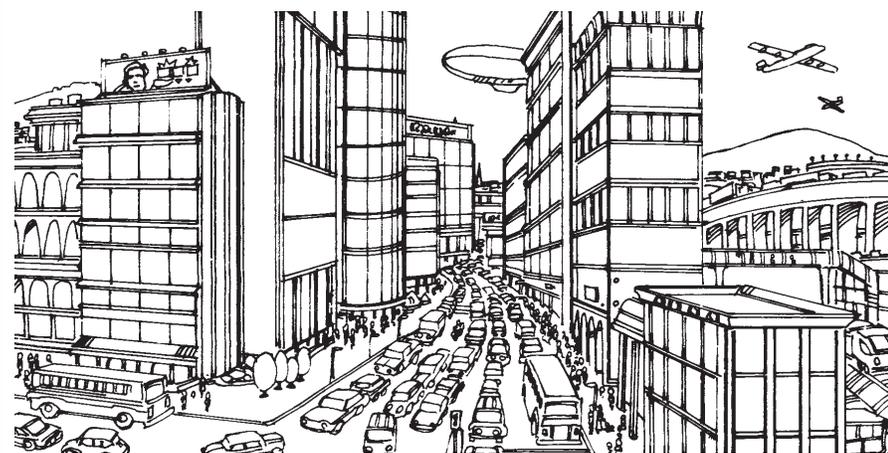
Figure 3.1 Planned and Unplanned growth along a road. Consider the long-term impact and consequences of road development. (Adapted from *Citizens for Responsible Planning*)



3.1a A low-volume road can become.....



3.1ba small road in a town after many years.....



3.1cand eventually become an overcrowded street in a city.

from society compared to those under which many low volume roads were originally constructed. Concerns about water quality, connectivity of roads and streams, endangered species, wildlife mortality and impacts, land use, and watershed and ecosystem health, are all influencing the way roads are viewed and managed. These concerns, along with economic concerns and dwindling budgets for maintaining low volume roads, are pressing road managers to better assess road conditions and impacts. They are now making reassessments about their road maintenance levels, design requirements, closure options, and storm-proofing methods.

Indicators are simple, tangible facts or conditions that can show progress towards goals or impacts. They can highlight trends, a need for additional studies, management opportunities, or needed design and construction modifications. The goals of assessment are to look for indicators and determine the impacts of roads on water, land, people, and related resources by reviewing road systems at the watershed or landscape scale.

The following issues should be considered:

- **Slope position and risk of slope failure.** Is there a risk of road or slope failure (and subsequent delivery of sediments to streams and sensitive resources) due to location of a road on an unstable or saturated hillslope, canyon, or valley bottom floodplain location?
- **Risk of road-stream crossing failure.** Does the road crossing



Photo 3.1 A low-volume, local road, with minimum adverse environmental impact, that serves local users by providing access between communities.

structure have adequate capacity for the site and adequate streambank protection?

- **Stream channel proximity and sediment delivery to water bodies and riparian areas (Photo 3.9).** Is the road too near a stream and are road-related sediments being delivered to wetlands, lakes, and streams?
- **Groundwater and surface water regimes.** Do roads intercept groundwater or interfere with direction, seasonal variation, or the amount of ground or surface water flows?
- **Wildlife, fisheries, and aquatic habitats.** What are the impacts of roads on fish and wildlife, migration routes, habitat fragmentation, and particularly sensitive species and their habitats, at both local and

landscape scales?

- **Human disturbance.** Is the road network responsible for poaching, dumping, off road

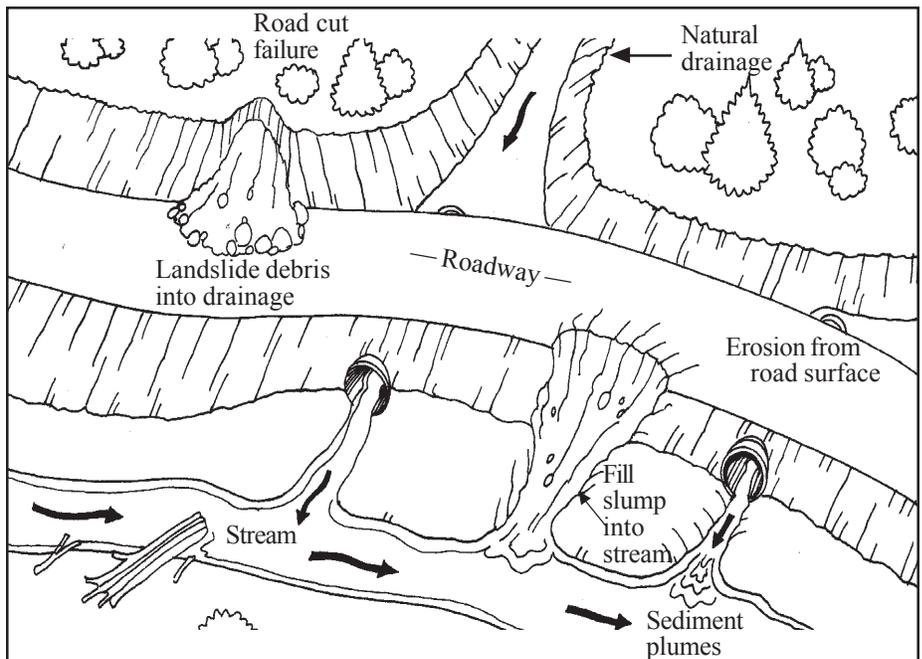


Figure 3.2 The many ways roads can be “connected” to streams and contribute sediment. Keep roads away from streams to protect water quality as well as reduce road maintenance and damage. (Adapted from M. Furniss, 1991)

vehicle use, illegal occupation and collecting, or pollution?

- **Road density.** Is the road system too big, inefficient, or wasting valuable land that has other, better uses?
- **Exotic species.** Is the road network responsible for the introduction and spread of exotic, non-native plants and animals?

A “yes” answer to any of the questions above can indicate the need for a more detailed assessment of existing or potential roads impacts. Additional information on assessments can be found in references such as the USDA’s, *Forest Service Roads Analysis*, 1999, or the Environmental Protection Agency’s *National Management Measures to Control Nonpoint Source Pollution*, Draft 2001.



Photo 3.2 A poor road location where the road has become a “creek” and is hydrologically “connected” to streams around it.

Reducing Vulnerability of Roads to Natural Disasters

Natural disasters such as major storms or earthquakes can have a major impact on all aspects of life and on infrastructure. When transportation systems are needed the most they may not be functional. Roads that are

damaged or closed during natural disasters often compound the effects of the disaster.

An assessment of the vulnerability of planned or existing roads should be made, considering the factors listed below, as well as social and

physical factors that affect the selection or priority of a project. Social factors include local community support and identified need of a project, the ability to do long-term maintenance, and contributing agencies or communities. Physical factors include avoiding problematic areas, feasibility of repairs or reconstruction, traffic use and standard of the road, and cost. An assessment is useful to identify and minimize problems and ideally reduce the potential impact to roads from disasters before they occur!

Many planning and design factors can be used to reduce the vulnerability of roads to natural disasters, or, in other words, used to “storm-proof” or limit the damage to roads during disasters or catastrophic events. PIARC World Roads Association’s *Natural Disaster Reduction for Roads*, 1999, provides excellent information on the topic. Some key considerations applicable to low-volume roads include the following:

- Identify areas of historic or potential vulnerability, such as geologically unstable materials or areas, areas subject to flooding, or areas with high volcanic or seismic hazards.
- Avoid problematic areas and road locations in areas of high natural hazard risk, such as landslides, rock-fall areas, steep slopes (over 60-70%), wet areas, and saturated soils.
- Avoid or minimize construction in narrow canyon bottoms or on flood plains of rivers that will inevitably be inundated during major storm events (*Photo 3.3*).



Photo 3.3 A poorly located road, in the hazardous flood plain area of a river, that has washed out during a major storm event.

- Provide good roadway surface drainage and rolling road grades so that water is dispersed off the road frequently and water concentration is minimized.
- Minimize changes to natural drainage patterns and crossings to drainages. Drainage crossings are expensive and potentially problematic, so they must be well designed. Changes to natural drainage patterns or channels often result in environmental damage or failures.
- Out slope roads whenever practical and use rolling dip cross drains for surface drainage rather than a system of ditches and culverts that require more maintenance and can easily plug during major storm events (*Photo 3.4*).
- Use simple fords or vented low-water crossings (vented fords) for small or low-flow stream crossings instead of culvert pipes that are more susceptible to plugging and failure. With fords, protect the entire wetted perimeter of the structure, protect the downstream edge of the structure against scour, and provide for fish passage where needed.
- Perform scheduled maintenance to be prepared for storms. Ensure that culverts have their maximum capacity, that ditches are armored and cleaned (*Photo 3.5*), and that channels are free of debris and brush than can plug structures. Keep the roadway surface shaped to disperse water rapidly and avoid areas of water concentration.



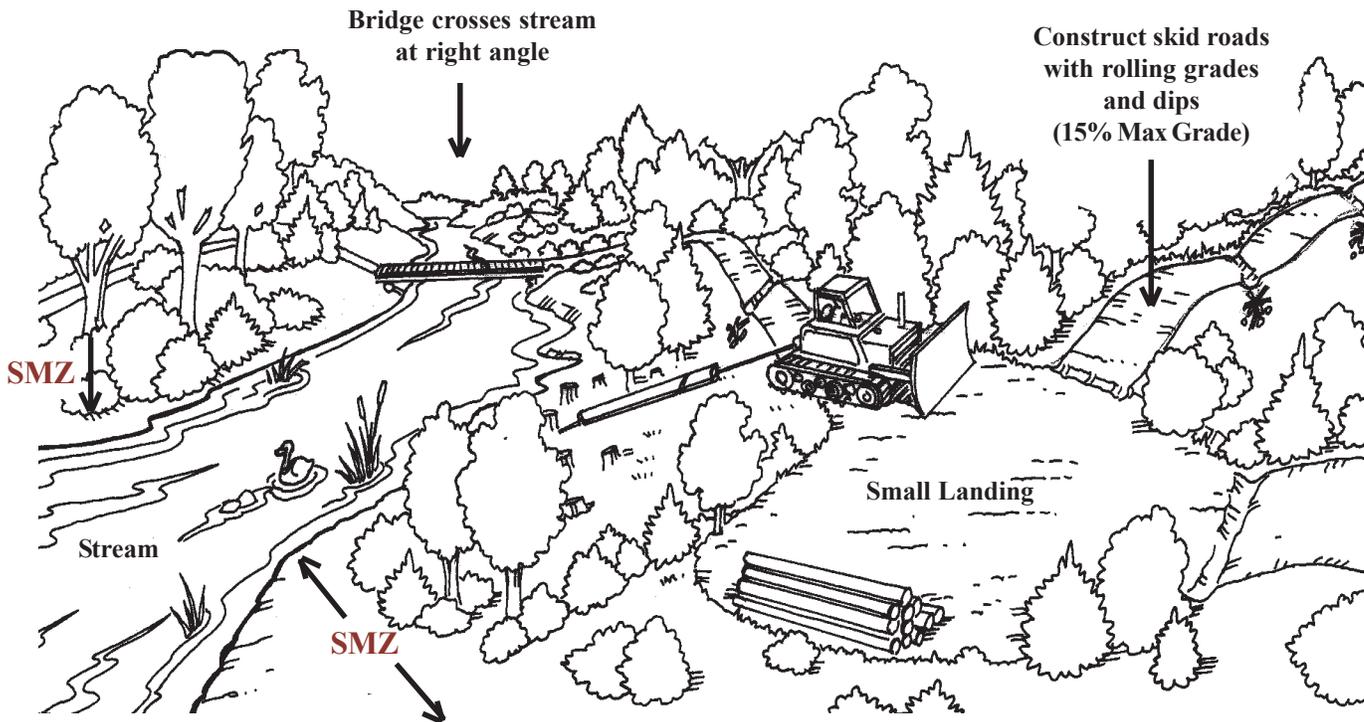
Photo 3.4 A road that has been heavily damaged during a storm because of an undersized, plugged culvert pipe and no overflow protection.

- Keep cut and fill slopes as flat as possible and well covered (stabilized) with vegetation to minimize slumping as well as minimize surface erosion. However, near-vertical slopes that minimize the exposed surface area may best resist surface erosion for well-cemented but highly erosive soils.
- Use deep-rooted vegetation for biotechnical stabilization on slopes. Use a mixture of good ground cover plus deep-rooted vegetation, preferably with a native species, to minimize mass instability as well as offer surface erosion control protection.



Photo 3.5 Maintain roads and drainage features to withstand major storm events with minimum erosion, such as with armored ditches that are kept clean.

Figure 3.3 Streamside Management Zone (SMZ) Activities



Winch logs from the SMZ. Construct small safe, efficient landing. Minimize activities in the SMZ. Keep landings and skid roads out of the SMZ.

- Locate bridges and other hydraulic structures on narrow sections of rivers and in areas of bedrock where possible. Avoid fine, deep alluvial deposits (e.g., fine sand and silt) that are scour susceptible and problematic or that otherwise require costly foundations. Avoid mid-channel piers.
- Design critical bridges and culverts with armored overflow areas near the structure to withstand overtopping, or that have a controlled “failure” point that is easy to repair. Alternatively, over-size the structure and allow for extra

freeboard on bridges to maximize capacity and minimize risk of plugging. Also avoid constricting the natural channel.

- Ensure that structural designs for bridges, retaining walls, and other critical structures include appropriate seismic design criteria and have good foundations to prevent failures during earthquakes.
- Place retaining structures, foundations, and slope stabilization measures into bedrock or firm, in-place material with good bearing capacity to minimize undermining and

foundation failure, rather than placing these structures on shallow colluvial soil or on loose fill material.

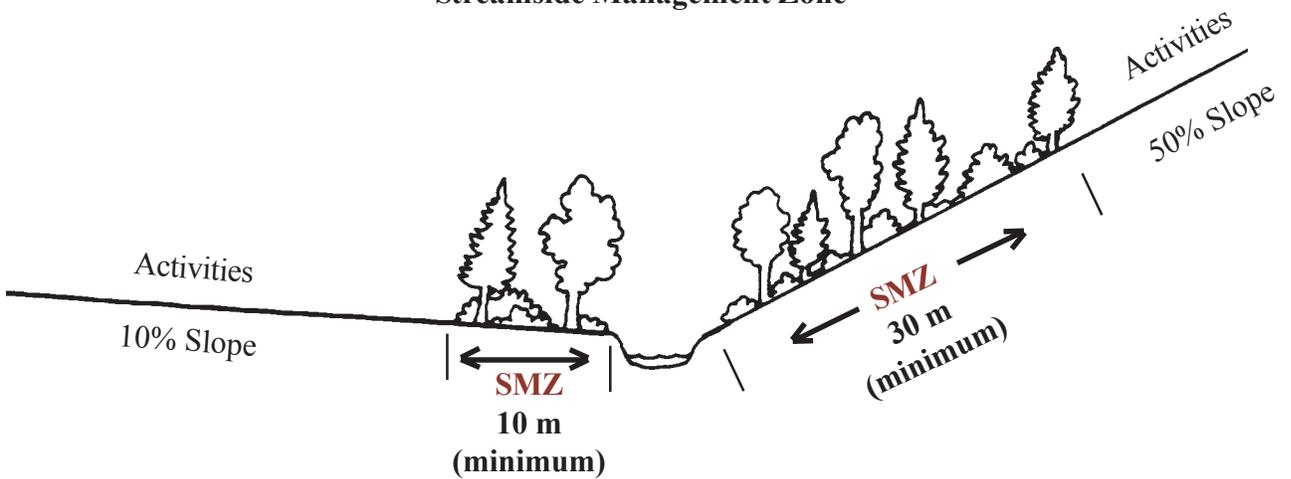
Streamside Management Zones

Streamside Management Zones (SMZs), or riparian reserves, are those areas adjacent to natural streams and rivers that require special consideration during construction or forestry operations. These SMZs are important zones for protecting water quality by serving as buffer zones to filter sedimentation that may occur from road construction and other land disturbance activities such as logging or quarry development.

Figure 3.4 Streamside Management Zone (SMZ) Widths as a Function of Slope. (See Table 3.1)



Streamside Management Zone



Activities may not need to be eliminated in SMZs, but they should be minimized and modified to ensure that stream channels and stream banks are protected from disturbance, as seen in *Figure 3.3*. The width of the SMZ will vary with the natural ground slope on each side of the stream and with the erosion potential of the soil (*Figure 3.4*). Steeper ground slopes will increase the possibility of sediment reaching the stream. *Table 3.1* gives a recommended minimum width of the

Table 3.1

Recommended Minimum Widths for SMZs

| Ground Slope | *Slope Distance Width of SMZ |
|--------------|------------------------------|
| 0 - 20 % | 10 m |
| 21 - 40 % | 20 m |
| 41 - 60 % | 30 m |
| 60% + | 40 m |

**Note-The indicated slope distances should be roughly doubled in areas with highly erosive soils, areas with bare ground or minimal ground cover, areas of intense rainfall, and near sensitive streams with fish.*

PRACTICES TO AVOID

- Getting construction debris in lakes and streams.
- Using mechanized equipment within the SMZ.
- Road or landing construction within the SMZ.
- Contaminating forest soils with fuel and oils.
- Cutting trees that shade the stream and cool the water.

RECOMMENDED PRACTICES

- Plan landings and access roads as part of pre-harvest activities.
- Limit the number of landings and constructed access roads.
- Keep landings small, consistent with a safe and efficient operation (*Photo 3.7*).
- Locate landings outside the SMZ (*Figure 3.3*).
- Construct landings with enough slope to drain properly but not exceed 5 percent.
- Locate landings to avoid skidding patterns that concentrate water from the skid roads onto the landing or off the landing into local streams.
- Maintain landings prior to and during periods of wet weather to avoid erosion problems.
- During and after operations are completed, rehabilitate landings and access roads with water diversion structures and erosion control measures.



Photo 3.6 Select the width of the Streamside Management Zone (SMZ) in accordance with the natural ground slope, amount of vegetation, and soil type. Minimize activities and disturbances in the SMZ.

SMZ. The actual width of the SMZ should be determined by the local land manager or an Interdisciplinary Team. The decision should be based upon local laws and regulations, as well as slope angle, soil type, vegetative cover, and sensitivity of the area (*Photo 3.6*).

Timber Harvesting

Timber harvesting activities should be accomplished in a manner that will insure the long-term protection of water quality. Timber harvesting requires access roads and landings in order to move forest products to markets. Different types of harvest systems require different road standards and road spacing to



Photo 3.7 Locate logging roads and landings away from SMZ's and water courses. Keep the roads and landing areas small and efficient.

be efficient. Generally speaking, roads and landings (not skidding and hauling operations) have the greatest potential for impacting water quality. When care is taken, erosion and sedimentation can be minimized.

Road Spacing

Total harvesting efficiency is a combination of logging costs and road costs. Animal logging is effective at very short skidding distances and requires a dense network of roads and landings, whereas helicopter logging can be effective at much greater distances and thereby uses a much wider spacing of roads and landings.

Road Standards

The type of harvest system used determines the size and location of forest roads. Generally, the type of haul vehicle determines the road standards of width, surfacing, alignment, grade, and position on the slope. In some cases, a large piece

of harvesting equipment such as a cable yarder may require special road standard considerations. The size and location of landings are also determined by the type of harvest system as well as other factors such as volume and type of product. High production systems will require larger, better stabilized, and more protected

landings than will low production systems. Larger landings and higher production systems have greater potential to cause water quality impacts.

Log Landings

Log landings should be located so that soil movement from the landing and skidding operations is minimized both during and after logging operations. Erosion control measures should be planned to effectively stabilize the landing using grading to control water flow, water bars, and revegetation or other ground cover.

Skid Roads and Skid Trails

Skidding should be conducted in such a way that soil disturbance is minimized. Skid trails and constructed skid roads can be a major impact to soil and water resources. Care and attention must be given to skid roads just as with truck roads, and the same Best Management Practices apply for these types of roads.



Photo 3.8 Stabilize skid roads and trails after use with water bars and apply a ground cover or other erosion control measures.

RECOMMENDED PRACTICES

- Design and locate main skid roads and trails before logging operations begin.
- Design and locate skid roads to follow the contour of the natural terrain.
- Winch logs from the SMZ or areas of steep slopes to avoid equipment movement in this area.
- Locate skid roads and trails in such a way that water from the skid trail is not concentrated into the log landing or into creeks (*Photo 3.9*).
- Cross natural drainages at right angles with skid roads.
- Construct skid roads with rolling grades and breaks in grade.
- Stabilize skid roads and trails with water bars and cover the bare ground with logging slash after operations cease to minimize erosion from exposed soils (*Photo 3.8*).
- Construct skid roads on grades of 15% or less except for short distances (20 meters) where 30% pitches (grades) are acceptable.
- Decommission or close skid roads after timber removal operations.

PRACTICES TO AVOID

- Contaminating forest soils with fuel and oils.
- Locating landings and skid roads within the SMZ.
- Using stream channels as skid trails.
- Constructing skid roads on steep slopes or with steep road grades.
- Operating skidding equipment within the SMZ.
- Logging and construction operations during wet weather.

Photo 3.9 Locate logging and other roads away from streams and lakes. This road is too close and thus is hydrologically “connected” to the stream. Sediment from the road will likely reach the stream.

