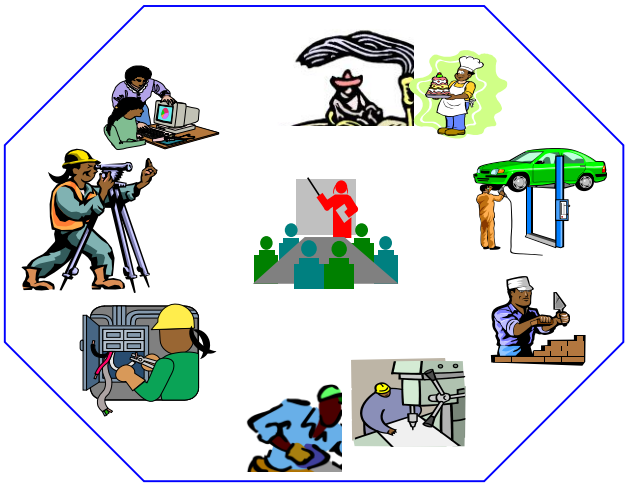
NATURAL RESOURCES CONSERVATION AND DEVELOPMENT

LEVEL III

Based on March, 2018, Version 3 Occupational standards



Module Title: Facilitating Forest Road Construction and Maintenance

LG Code: AGR NRC3 M LO (1-5) LG (46-50)

TTLM Code: AGR NRC3 TTLM 10 21v1

June, 2021

Adama, Ethiopia

THE WORLD BANK
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East Africa Skills for Transformation and RegionalIntegration Project (EASTRIP)

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Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- OHS, legislativeand organizational requirements
- Obtaining and assessing logging and topography details
- Applying environmental management considerations
- Identifying road location, design and construction requirements
- Checking raod use timeframe and weather conditions
- Log extraction methods and storage requirements
- Establishing and maintaining communication

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Understand and obey OHS, legislative and organizational requirements
- Obtain and assess logging and topography details
- Apply environmental management considerations
- Identify road location, design and construction requirements
- Checkroad use timeframe and weather conditions
- Know log extraction methods and storage requirements
- Establish and maintain communication

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1-OHS, legislative and organizational requirements

1.1. Introduction

Good planning can minimize the impact of a road on the environment and provide low maintenance, low-cost access for landowners. It will pay many times over to sit down and seriously plan for the road and road network before making irreversible decisions that cost extra money, waste time later and damage the environment

Two basic tenets of road planning should be followed.

- Minimize the number of roads constructed
- Existing roads should be used wherever possible, unless using such roads would cause more severe erosion problems than building a new alignment elsewhere.

Objectives

- To facilitate the sustainable harvest and renewal of timber resources.
- To minimize the loss of productive forest land and area occupied by forest roads.

1.2. Confirming and applying safety requirements

Most of the risks and hazards encountered while forest road construction are associated with the local terrain, weather and climate, the means of transportation used to access the construction area, and the degree of remoteness where the work takes place.

Depending on the type of forest road, individuals may need to be physically capable of carrying heavy loads construction equipment's.

1.3. Selecting and checking suitable personal protective equipment (PPE)

Although every attempt should be made to eliminate workplace hazards by modifying machines and work methods, there are often situations where the use of personal protective equipment is essential. For hazards that cannot be eliminated, proper personal protective equipment must be selected and used.

Personal protective equipment that provides protection for a certain part of the body (e.g. hand protection or respiratory protection) comes in different types. Each type of personal protective equipment is designed to protect against certain hazards only.It is imperative to match the personal protective equipment to each type of hazard that may be encountered in each work area. Using the wrong kind of protective equipment gives the worker a false sense of security. This is very dangerous. It is also very important to select equipment that provides not only the best protection but also good comfort, enables mobility of the worker, and is easy to maintain.

1.4. Forestry road classification

To facilitate the communication of provincial guidelines for forestry roads, a common set of descriptive terms for forestry roads has been developed. Three road classifications as show the table below will be used to describe forest roads within this module and in the road planning review process. These classifications are based upon the basic function of the forest road.

Table 1.Forestry road classification

	Primary	Secondary	Tertiary
Description	General access throughout the forest	Access to and within operating areas	Access to and within harvest blocks
Duration	Permanent	Three or more years	General short term
Season of use	All weather or winter	All weather or winter	Usually seasonal or winter

1.5. Forest road management planning process

The forestry road planning process involves three planning phases:

- ***Forest Management Plans (FMP)*** describe in general the company's strategies and activities for the duration of the long term plan including harvest operations, proposed road access and standard operating procedures.
- ***Annual Operating Plans (AOP)*** describes in greater detail planned harvest operations and the forestry roads to be developed in association with these operations during the planning year.
- ***Forestry Road Development Plans (FRDP)*** consist of maps, tables and text that describe all the existing and proposed roads within distinct geographic areas within a

1.6. Forestry Road Planning

During the planning process all available resource values, which may require protection, must be identified. The consequences of road development, positive or negative, should be identified during discussions. Other potential users of each road should be considered in order to satisfy more than one purpose, identify safety concerns and potentially consider fees for other commercial users.

During the planning process other issues should be addressed including:

- Access management, including retirement strategies with details of road decommissioning
- The timing and sequencing of harvest
- The pace and volume of harvest operations within the road network
- Future forest management responsibilities (ex: reforestation, surveys, fire protection)
- Options to mitigate potential negative impacts

1.7. Forest Management Plans

The forestry road management planning process begins with the identification of major concentrations of timber (operating areas) within FML or Provincial Forests. FMPs will broadly address forestry road development in order to gain access to these concentrations of timber. Deliberations during the discussion process for the FMP may yield more than one alternative road location within a proposed road corridor. Forest Management Plan map, with respect the FMP includes, but is not limited to:

- Potential effects on other resources and mitigation
- How discussion on road development will occur
- Maps identifying operating areas within the FML area
- The location of broad access corridors within which final road locations will be selected
- The construction scheduling and type of structure proposed and erosion control measures at major water crossings
- Alternative corridors and/or road locations, where applicable, will be discussed and considered
- Maps of road networks to and within each operating area
- Maps of existing all weather and main access roads in the FML
- The proposed duration and season of use of each forestry road system
- The strategy for maintenance, temporary closure and/or decommissioning of forestry roads
- Locations and strategies for wood storage and processing areas within the FML

Each company's standard operating procedures must be submitted with their FMP. The standard operating procedures related to forestry road development will describe the following:

- ✓ Center line clearing methods
- ✓ Right-of-way (row) clearing methods
- ✓ Debris disposal plans
- ✓ Construction standards
- ✓ Construction methods for water crossings
- ✓ Erosion control measures
- ✓ Visual buffer plans
- ✓ Borrow pit rehabilitation plans
- ✓ Monitoring and maintenance activities

1.8. Forestry Road Development Plans

A FRDP is an effective tool for communicating road development and mitigating negative impacts on resource values in a given operating area. The plan takes into consideration the network of existing and proposed roads.

The distinction between a FRDP and a FMP is that a FRDP provides more detail for a specific operating area. FRDPs will cover the active period of timber harvesting until temporary road closure or road decommissioning are complete. Each FRDP will include:

- A general description of the road development and timber harvest strategy
- A description of the company's discussions with first nations and local communities
- The proposed periods of activity within the operating area (ex: 2015 – 2025)
- A map showing the road system and indicating the designation of each primary, secondary and long term winter forestry road, as well as each water crossing
- An indication of the active period for each road
- An inventory of all stream crossings
- A table identifying the amount of all classes of forestry road to be constructed
- The access management strategy of the operating area and specific roads, including plans for road decommissioning
- Existing forestry roads
- Known resource values within the operating area

FRDPs are required for all new operating areas. Development of other FRDPs should be prioritized to address areas of particular concern. Priority should be given to operating areas where a significant amount of new roads are being constructed, operating areas where significant values are at risk, or other operating areas as identified.

1.9. Annual Operating Plans

AOPs will indicate the location of all primary and secondary forestry roads to be constructed or improved during the operating year and projected during the next two years. The proposed location of all forestry roads between blocks should be indicated in an AOP at least one year prior to construction.

For each primary and secondary road to be constructed, modified, or closed the AOP will indicate:

- The specific location of roads proposed for construction within previously determined access corridors
- The names and classifications of each road
- The timing of construction
- Where possible in advance of operations, the specific location of major rock quarries, gravel and borrow pits
- The location and construction methods and erosion control measures for watercourse crossings
- The proposed operating period (years and seasons)
- Access management plans including signage
- Proposed closure dates and methods
- How discussions on road development will continue where appropriate
- Where access for renewal will be required

An example of an Annual Operating Plan map

- ✓ ROW clearing methods and width
- ✓ Proposed merchantable timber utilization method for ROW clearing
- ✓ Debris disposal plans
- ✓ Visual buffer plans
- ✓ Erosion control measures
- ✓ Borrow pit rehabilitation plans

- ✓ Decommissioning and rehabilitation plan and schedule

Self-Check – 1	Written test

Name…… ID…… Date…….

Direction:Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.(2 points each)

1. What are the basic tenets of road planning?
2. Discuss briefly the forest road classification
3. Discuss briefly the forest road management planning process
4. Compare and contrast forestmanagement Plans and forest development plans
5. Compare and contrast forest management Plans and annual operating plans

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

2.1. Route Selection

A fundamental principle guides all road planning: the main lines of road alignment are decided in advance by a method of successive approximations on maps, plans, or rough sketches on an increasing scale, which are later checked by reconnaissance carried out on the ground. Many construction, maintenance, and operating problems with forest roads in the tropics could be avoided by systematic planning.

There are five phases in the systematic and increasingly detailed study of the terrain:

1. Examination of general information from maps, aerial reconnaissance, and aerial photographs to select a proposed route corridor

2. Drawing up of preliminary alignments using the information collected

3. Detailed ground reconnaissance to locate preliminary alignment possibilities

4. Establishing the final alignment by correcting the preliminary one using information gained by the ground reconnaissance

5. Marking out and staking the selected alignment with regard to the actual

2.2. Examination of Documents

The first phase consists in making a rough sketch of the general direction of the alignment. All available cartographic documents on the region must be used for this purpose.

1. General Maps and Mapping Tools

Any existing maps of the area should be acquired. In spite of any imperfections, these maps can be a considerable help in the initial planning stages.

Some information will be found in them which will be quite easy to check, such as existing transportation networks, ridge lines, principal rivers, and hydrologic features, including waterfalls or rapids on important rivers. Although some agencies may include accuracy assessments of the maps they produce, the actual number of control points checked is likely to be small and reconnaissance will usually be necessary to confirm map feature locations. Mapping documents vary from one country to another, but generally include:

- 1:200,000 quadrangle maps with or without contour lines
- 1:200,000 thematic maps: hydrology, geology, soils, physiographic features, vegetation, political boundaries
- 1:50,000 quadrangle maps with contour lines (20-m intervals), special area maps of reserves or parks
- 1:50,000 Landsat or SPOT satellite imagery
- 1:200,000 radar imagery
- Historic and recent aerial photo coverage at a scale of 1:20,000 to 1:50,000

Increasingly, hard-copy maps are often converted into a digital format through scanning processes and can be accessed and analyzed through a geographic information system (GIS).Maps produced from remote-sensing techniques are typically geo referenced. Hand-held and survey-grade GPS receivers with digital data loggers are now widely used to geo reference points during aerial and ground reconnaissance. Outside of tropical forests, digital terrain models (three-dimensional digital images of the terrain) are becoming available. Digital terrain models will undoubtedly become more available in tropical forests as lidar (light detection and ranging) technology continues to improve and drives costs down.

2. Aerial Reconnaissance

Aerial reconnaissance is often valuable when possible. The advantage is that the whole forest zone can be seen. Helicopters are best in rough topography because speed and elevations can be varied. A detailed plan of the different flights should be made beforehand. These flights should be plotted on a small scale map or rough sketch, even if they are not very accurate. The plan can be for flights of two kinds: either for a grid with a spacing of 5–10 km, or for flights between two points consisting of prominent landmarks which are easy to identify, such as the corner of a forest, a waterfall or rapid, a river junction, crossroads, isolated homesteads, or a village. If even small-scale aerial photographs of 1:50,000 are available, they should be used to plan reconnaissance trips. They are complete pictures of the terrain on which all the important topographical details can be marked. Each photograph can be examined and angles for direction can be measured on it.

With vertical photographs of fairly even ground, it is possible to obtain a good assembly of several adjacent strips. These photographs can be joined together to create a photo

mosaic and provisional map. This mosaic can be photographed, but it must not be forgotten that the errors in putting individual photographs together can be considerable.

Stereoscopic examination of a pair of photographs is essential to understanding the terrain and the forest. The stereo pair represents the common ground area of two aerial photographs which have been taken from different viewpoints, either along a flight line, or from adjacent flight lines. Stereoscopic examination of terrain provides a three-dimensional image that reveals the topographic nature of a landscape. It gives the impression of examining a small rough model of the ground. This examination, though fairly easy, requires some preliminary training. Training consists of learning to use a stereoscope correctly and to interpret the stereographic picture obtained.

3. Special Inventory Maps

A sketch map of the harvest area is necessary. Often large-scale maps are not available for native forest. Information for a sketch map can be recorded at the time of the inventory when inventory lines were cut across the forest. The whole section of forest to be inventoried can be divided into rectangular compartments with the principal lines running north and south and the secondary ones from east to west. The compartments have a rectangular shape and an area which varies according to the distances between the lines: it may be 1,000 m×250 m (i.e., 25 ha) or 500 m×200 m (i.e., 10 ha). This system of lines makes up a topographical grid on which you can reference and locate topographical features and the position of harvestable trees. The usual scale is 1:5000 to 1:20,000.

A preliminary examination of the inventory map makes it possible to pick out the best zones in the forest in which a road of predetermined specifications can later be constructed. Marked on this sketch may be:

- The areas to be harvested that will require roads
- Positive control points, such as a narrow part of a stream for a crossing or a saddle to cross a ridge, and potential landings
- Negative control points (places to avoid): marshy land, or land under water in the rainy season which would need an expensive embankment and which might often be unstable
- Areas where food crops have been grown in the past and without commercial trees, but where the absence of stumps would make crossing easier

Usually the inventory map is only concerned with the area covered by the property lines, license, or concession within the property boundary or affected by easements or regulations. There may be little information about the areas outside the boundaries of the property over which the main harvesting road has to cross until it meets either the public highway or a waterway. Aerial observation or aerial photographs can be useful in providing this information.

2.3. Preliminary Alignment

1. **Route Location**

Terrain familiarity is an essential part of route location. The first stage is to become thoroughly familiar with the terrain. The surface relief of the ground must be studied and understood. It is convenient to mark the position of significant landscape features, i.e., the lines of ridges and of valleys.

The watersheds or ridge lines are the upper intersection of two adjacent slopes. Valley bottoms or lines where water running off the surface join, and which are often followed by streams or watercourses, are the lower intersection of two adjacent slopes. Lines of the same nature divide and change direction rather like a roof. The convergence of water toward the lowest points causes the valleys to flow into each other and thus form a network.

Between two valleys there is a ridge line; these lines form a system enclosing the network of valleys.

If the details of the valley lines and the ridge lines are marked in systematically, a picture of the ground emerges (Fig.1). From this picture, the essential features of the land can be delineated to increase terrain familiarity.

It may not be known at the time of the inventory how much delay there will be in planning the haul roads, but it often happens that, as work cannot be carried out under the best conditions, the inventory operations immediately precede the planning of the alignment. In this case, these two operations can be given to the same person. When marking in topographical data, the head of the survey party gives special attention to any information which could be useful for planning the road. He notes rocky places, swamps, and very steep places unsuitable for an inexpensive alignment. He will be especially careful to mark the easy places, such as the lower saddles on ridges, rock outcrops, and riverbanks suitable for bridge sites. This information will facilitate planning

by indicating the parts of a preliminary alignment needing further study and will reduce the time taken subsequently in future detailed reconnaissance.

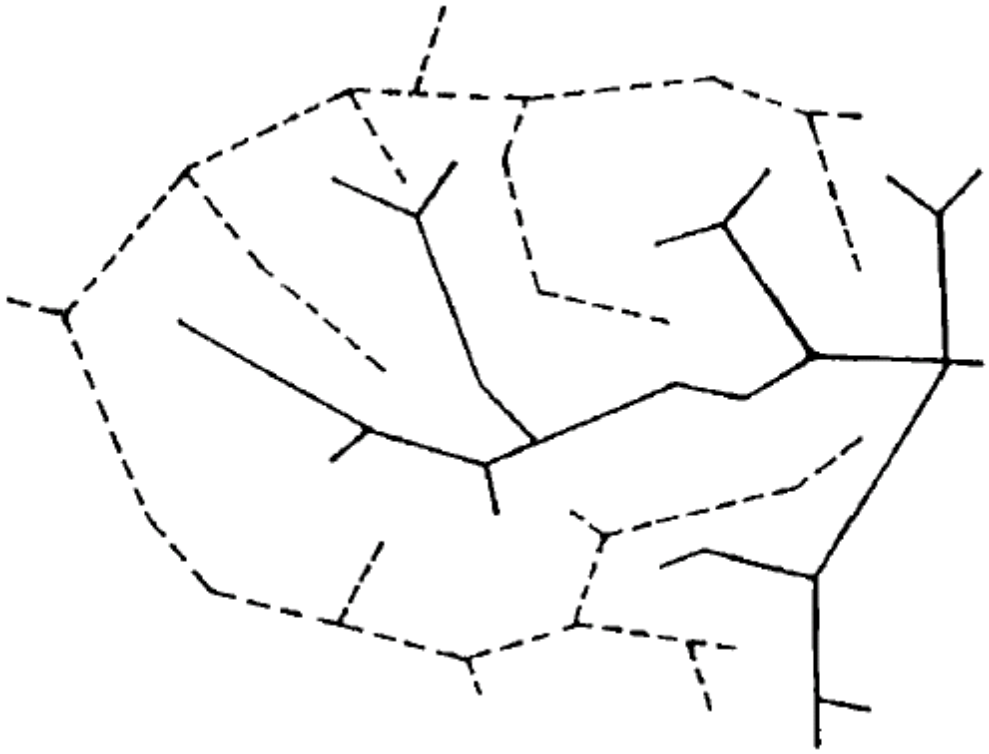

Fig.1. Lines showing features of the terrain. *Solid lines* are ridge lines, *dashed lines* are valley lines

2. Preliminary Logging Plan

In the second stage, a preliminary logging plan is prepared for the area. In flat terrain, optimal road spacing provides guidelines for design of secondary roads. In mountainous terrain, an iterative process identifying landings which are then connected by spur or secondary roads is usually used. The secondary roads are then connected by a mainline road. The routes of the secondary roads are dictated by the logging plan. It cannot be overemphasized that the roads and the yarding are interdependent and must be integrated. The logging plan must be feasible for economical road construction and log-truck operation.

The roads must serve the landings and economical yarding distances. Compromise is often necessary to arrive at the minimum total combined cost of yarding, trucking, and roads with regard to protection and silvi cultural considerations. The efficient plan is that which allows for the lowest overall extraction costs.

If a main forest road is to be built primarily for hauling logs, the first consideration in selecting the route of the main road is to serve the secondary branch and spur roads. The main route should reach suitable junction points where there is room for the branch roads to turn off from the main road. Such junction points include flats, benches, and saddles where there is space for the double width required for grade separation without excessive excavation. If the branch road gradient is steeper than that of the main road, adequate length is required for an easy vertical curve to allow for a safe transition between the two road segments. The junction should be staked and constructed to the point where the branch road subgrade clears the main road at the time the main road is built. The route which will give the minimum combined hauling distance over the secondary road and the main road from the center of the timber volume will generally be the most economical route.

The topography often will determine the selection of the route for the main road. Since the main road usually follows up the main drainage paralleling a sizeable river or stream, the route possibilities which may be encountered and relative advantages and disadvantages are as follows:

Wide valley bottom this condition affords the advantages of a downhill gradient, good alignment, and relatively low earthwork. Good landings are available for settings to be logged along the route. Disadvantages are flood hazard and the cost of bridges to maintain good alignment and to avoid rock cuts if the stream meanders. Protection of recreational resources, such as camping sites and fishing streams, requires special consideration. Stream channel changes are objectionable to fisheries agencies.

Narrow valley bottom this condition offers a downhill gradient and advantages over a hillside route of less excavation and better alignment, since the mouths of a side stream usually can be crossed on tangents with fills. Fewer but larger culverts may be needed. Disadvantages are flood hazards, bridges when it is necessary to cross the stream to avoid rock cuts or sharp curves, and the difficulty of avoiding interference with the stream channel.

Hillside route locating a main road on hillsides well away from the creek will eliminate flood hazards and stream damage to the road. Bridges are usually eliminated since side streams can be crossed with fills and culverts.

Steeper and more variable gradients are often required. Alignment on the hillside route is poorer since the route following the grade contours around ridges and draws. This also makes the road longer.

Excavation is larger as the side hill is steeper than the valley bottom. Takeoffs for branch or spur roads are more difficult. Higher cut banks expose more soil to erosion.

Ridge crest A ridge crest route offers the advantages of good alignment, light excavation, good drainage, and few culverts. If the ridge profile is uneven, more adverse pitches are encountered, although the possibility of making momentum grades is good. The principal disadvantage is that a main road above the bulk of the timber necessitates adverse grade spurs.

A hillside segment of road is required to reach the ridge, and the total length of haul may be longer.

3.4. Positive and Negative Control Points

In the third stage a preliminary alignment is made, step by step. In practice, it is a matter of fixing points and in planning a preliminary section between two successive points. **The positive control points are advantageous parts of the terrain to locate the road, such as:**

- Stream crossings suitable for bridges and culverts
- Gentle slopes in steep terrain
- Saddles or passes on ridges
- Benches in slopes suitable for curves, switchbacks, and road junctions
- Suitable sites for landings
- Suitable deposits of road-building materials
- Suitable log landings

2.4. Negative control points are the places to be avoided, such as:

- Terrain with low bearing capacity
- Steep and/or unstable slopes; landslide-prone areas
- Cliffs (with heavy blasting requirements)
- Swamps
- Flood plains

Determine the terminal control points that define (1) where to begin from an existing road or location survey and (2) where to end the present project. If the road may be

extended in the future, the upper terminal should be at a point suitable for continuing the road. This may necessitate projecting the road beyond the present project, to ensure that it does not “dead-end.” The lower terminal is usually the more flexible, and is subject to change when intermediate control points are found, and the grade contour is projected.

Look for major control points between the terminals. These are usually saddles or passes, benches for spur road junctions, and suitable crossings of large streams, where bridges or large plate culverts are required. Construction of switchbacks on steep ground can be prohibitively expensive as well as involve large earthwork and potential environmental impacts. In some situations, locating suitable switchback areas can be the most important control point on the road. If a logging plan is involved, landings along the road route may be control points. If projecting a main road from which stub spurs to landings will take off, suitable junction points for the spurs are controls. Work from the top down, as the valleys and control points tend to constrict at the higher elevations and to widen out at the lower elevations.

Look for minor control points along the probable route between major control points. These include points at which obstacles can be passed, such as above or below cliffs, rock outcrop or slides, and either side of the swamps. Look for evidence of soft or poorly drained ground, and the best places to cross or avoid them, and for the best crossings of side streams.

Where the route will follow a water grade along a main stream, study both sides of the valley to determine whether to project alternate routes paralleling the stream on each side of the valley, or, in the case of a meandering stream or a valley with cliffs or steep side slopes alternating from one side to the other, to project a route which would cross the creek at intervals. It may be necessary to project alternate routes and compare costs to determine the preferable route.

Other factors being equal, a route which gets the most sun is preferred. A road along the slope which gets the most sun will dry out faster after rain.

Consequently, it will be subject to less damage from traffic and will result in lower maintenance cost. After selecting the control points, the next step is to connect the positive control points by feasible road corridors.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. (2 points each)

1. What are five phases in the systematic and increasingly detailed study of the terrain (5 point)
2. Discuss the Positive Control Points (2.5 point)
3. Discuss the Negative Control (2.5 point)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

3.1. Introduction

A number of relatively inexpensive actions, if done in a consistent and disciplined manner, will protect the quality of the forest environment. Actions that contribute to environmental protection connected with design, road construction, bridge construction, and road maintenance follow.

3.2.Environmental protection during Design

- Use competent engineers to conduct road line surveys and design roads.
- Design roads for the required use. Identify those roads that should have restricted access during the wet season and integrate those plans with the harvest operating plans.
- Minimize the total length of roads required to meet management objectives.
- The total cost of road construction plus harvesting costs is often flat with respect to road density, so road density can often be reduced at little overall cost, particularly on gentle terrain.
- Fit the road as closely as possible to the terrain.
- Reduce the total area disturbed by opening the minimum clearing limits necessary and by not using excessive road widths, particularly in steep terrain.
- Avoid locating roads on wet soils, unstable slopes, or steep sideslopes.
- Avoid steep grades through soils which erode easily.
- Minimize earthwork by minimizing cutting and filling.
- Plan to end-haul where necessary, and use proper blasting techniques.
- Keep road grades as low as possible but roll grades as necessary to keep water moving so that sediment does not deposit in ditches.
- Use adequately spaced cross drains to keep water velocity down.
- Make sure culverts are installed, not only at certain distances, but also where they are actually needed.
- In steeper terrain, stake cut and fills limits to control earthwork during construction.

- Design road crossings to streams to divert road surface runoff and ditch flow before the road reaches the stream so that the road does not become a point source for sediment entering the stream. Harden road approaches to streams.
- Incorporate landing design, when possible, into the road design to ensure proper drainage so surface water from skid trails and landings does not flow onto the road.
- Consider periodic canopy bridges over roads for wildlife in areas that are safe from erosion and do not need drying after rainfall.

3.3. Environmental protection during Construction

- Use competent engineers to supervise road construction.
- Use appropriate size and power configuration of equipment. Too large a piece of equipment can overbuild the road. Too small a piece of equipment may require alternative building techniques, i.e., blasting versus ripping.
- Use only adequately trained, skilled, and experienced machine operators for road construction in sensitive and difficult terrain.
- Where large trees not designated for harvest are in the right of way, consider if small changes in alignment could avoid them.
- Earthwork should take place during relatively dry weather.
- Where side casting soil with tractors and shovels will cause siltation of watercourses, haul away excavated material for disposal at a safe location.
- Stabilize cuts and fills with retaining walls or some other suitable method, where there is danger of slippage into watercourses.
- Build proper ditches and culverts.
- Provide suitable drainage while the road is under construction and allow the road to stabilize before permitting heavy traffic. Construct the road at least 1-year prior to its first wet-season heavy-traffic use.
- Deposit cut material in stable locations above high-water levels and avoid depositing any materials or debris in streams.
- Keep machine activity in stream beds to an absolute minimum. Choose temporary stream crossings where they create a minimum of soil disturbance.
- Cross streams only at right angles.

- Where practical, seed cut banks and fill slopes with grass or alternative cover to reduce erosion and improve appearance. Give preference to native vegetation.
- Construct ditches on all roads to handle maximum flows expected.
- Use proper blasting techniques, particularly soft blasting to minimize disturbance.
- Avoid blasting excessive rock into watercourses.
- Use excavators to construct roads in steep terrain.
- When possible, surface roads with stronger, more durable material to reduce sedimentation.
- If available, use rock in selected locations (ditches, culvert outlets, and fords) to protect against erosion.

3.4.Environmental protection during Bridges and Culverts construction.

- Construct bridges and culverts to handle the maximum water flows expected, with special attention to areas of heavy rainfall.
- Design bridges and culverts to allow free passage of fish.
- Consider the use of temporary or portable bridges where access to forest areas is to be limited after harvesting.
- Orient bridges and culverts with the natural stream channels, with a minimum of disturbance of stream banks and bottoms. Arch culverts may be necessary to accomplish this goal.
- Incorporate in culvert design an entrance pool and discharge exit that eliminates bank erosion.
- Stabilize bridge and culvert backfills to prevent erosion.
- Consider fords as alternatives to culverts in crossing perennial streams carrying high loads of sediments or the combined use of a ford and culvert where torrents are to be crossed, with a culvert for the normal runoff and a ford for high floods.
- Use armored relief ditches in critical locations where blockage of a culvert could cause serious road and downslope impacts.
- During bridge construction, ensure that oils, chemicals, excess concrete, or other waste materials do not enter the stream or river.
- Allow treated material (piling) to dry prior to use in bridge construction.
- Burn or remove debris accumulated at a bridge construction site.

3.5. Environmental protection during road Maintenance activities

- Grade main and spur roads to remove berms and crown roads to prevent ponding. Where applicable, use berms to prevent erosion of fill areas.
- Clean out roads and ditches at landings or logging sites immediately after logging. Give special attention to damaged culverts and culvert openings.
- Identify bridges, culverts, and ditches that are potential problem areas, maintain them regularly, and check them frequently during periods of heavy rainfall.
- Deposit material removed from ditches during maintenance in a safe location away from streams.
- Appropriately close and retire roads not needed for continuous use to prevent erosion and to prevent access by wildlife poachers.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer the question listed below. Illustrations may be necessary to aid some explanations/answers. (2 point each)

1. Discuss briefly environmental protection during design
2. Discuss briefly environmental protection during construction
3. Discuss briefly environmental protection during culvert &bridge construction
4. Discuss briefly environmental protection duringroad maintenance activities
5. Discuss briefly environmental protection during logging operation

You can ask you teacher for the copy of the correct answers.

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Information Sheet 4- Identifying road location, design and construction requirements

4.1. Introduction

Proper location is key to providing a cost-effective and environmentally acceptable road. You should control the road location process and review the road location on the ground with the road contractor before road construction commences. A consulting forest engineer should be hired to review difficult or questionable road locations.

Road construction control becomes more important where complex topography creates more environmental challenges and more construction difficulties. A professionally engineered road design and construction staking may be warranted on ground where a large amount of earth must be moved or on environmentally sensitive locations.

4.2. Road location

Road location is the “foundation” of any road. A road constructed in a poor location can fail and cause serious environmental damage, as well as add financial strain from continuous and costly maintenance problems. Even if it does not fail, a poorly located road might not meet a landowner’s objectives, whether for harvesting timber or providing for future road access. Not enough emphasis can be placed on properly and carefully locating a road.

Roads are best located close to the crest of a ridge and constructed with outfall drainage (Figure 1). This means that less construction effort is required and drainage will be easier to achieve. It also means that you will avoid steep topography.

If you can’t locate the road on or close to a ridge, then the best road location is the one which minimizes the amount of earthworks and enables the most effective road drainage (Figure 2).

Figure 1: Ideal road location – Ridge crest

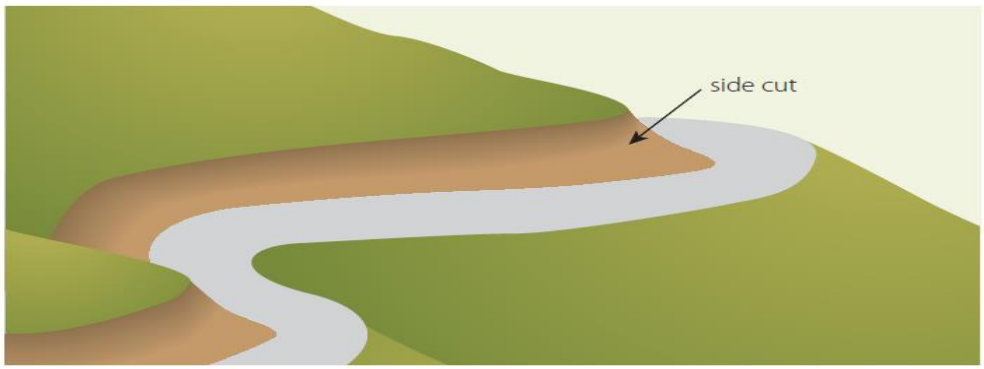

Figure 2: Mid–slope road with a side cut

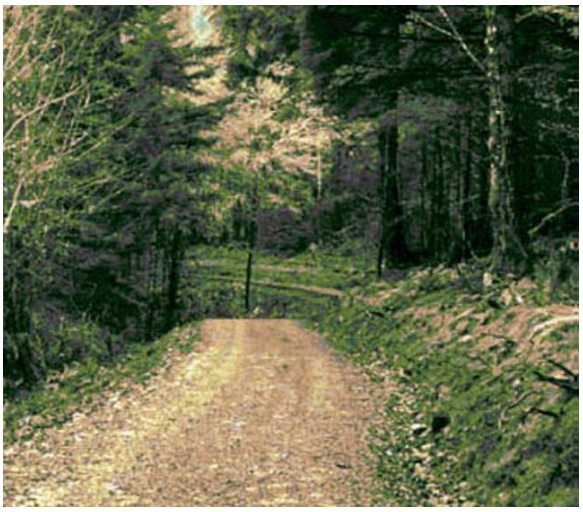

Fig 3. A stabilized forest road

At the outset of the project, road design elements and standards must also be determined for the type of road to be located and constructed. Road design elements include road grade, grade breaks, horizontal curves, turnout location, surfacing road

intersections, stream crossings, and harvest landings. Road standards for these elements would include subgrade width, minimum horizontal curve radius, cut and fill slope ratios, minimum and maximum grades, and so on. These, too, should be clearly defined in the road contract to assure the organization's management objectives are met.

Below are described two common methods used to establish road construction control on the ground. The first is the "direct location" method, where the road is located on the ground without mapping the site and without office calculations. This procedure is often used on relatively easy ground that requires few roadway cuts and fills. The second is a survey and design procedure used on a road location that requires field surveys and an office design. Survey and design are used on difficult ground requiring relatively large quantities of material for roadway cuts and fills. A common procedure used is the field survey's "P-line" (the preliminary surveyed line determined on site) and "L-line" (the location of the road determined during office design). In setting the L-line, the road engineer considers the on-the-ground characteristics such as cross-slope, horizontal alignment, and grade to adjust the "P-line" in order to minimize the movement of earth and environmental hazards.

A road location must be accomplished on the ground, regardless of the procedures used for road construction control (whether direct location or survey), to assure a road can be properly constructed to meet management and environmental objectives. In either method, the goal is to get a road from one point to another in the most efficient manner, with the least amount of earth movement and the least amount of follow-up maintenance and environmental damage, given slope, topography, and ground stability, as well as the operating constraints of the vehicle, such as turning radius and grade.

In applying the direct location method, most road design work is accomplished in the field during the location process. This less costly method requires a knowledgeable person who has considerable experience in road location, design, and construction practices. In general, the road locater works to efficiently get the road from point A to point B, while dealing effectively with difficult sections and environmental hazards, such as stream crossings, wet slumpy ground, sharp ridges, overly sharp turns, headwalls, and draws. The locator also plans for road intersections and log landings.

The direct location method is best suited for ground where “balanced” road sections can be located. A balanced section is a distance along the road location where the cut (the excavated material from the uphill side of the road) equals the fill (the compacted material on the downhill side of the road) within short distances (up to about 45 meter) along the roadway. This will occur on ground with cross-section slopes of approximately 35%–45%. An example of a balanced section is in Figure 3-1.

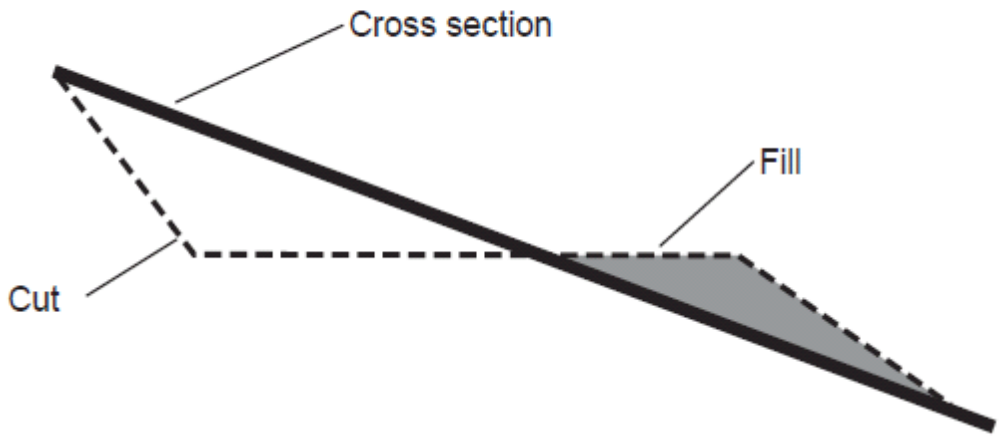

Fig.3-1. balanced earthwork section example.

Once a direct location has been established, the catch points are established and the clearing limits flagged (Figure 3-2). In some cases, the clearing limits are also the catch points, and thus only the clearing limits are flagged. When this has been accomplished, road construction can commence.

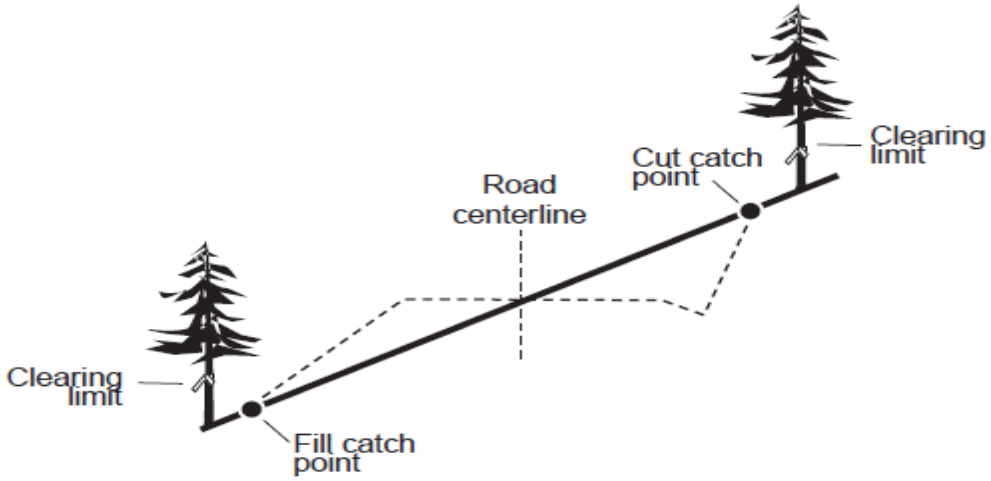

Fig.3-2. Construction survey staking a road section

Proper location is key to providing a cost-effective and environmentally acceptable road. The organization should control the road location process and review the road location on the ground with the road contractor before road construction commences. A consulting forest engineer should be hired to review difficult or questionable road locations.

Road construction control becomes more important where complex topography creates more environmental challenges and more construction difficulties. A professionally engineered road design and construction staking may be warranted on ground where a large amount of earth must be moved or on environmentally sensitive locations.

Forest roads can be a costly long-term investment. In the forest area, several licensed professional forest engineering firms are available to assist the landowner in all aspects of timber harvesting. A listing of regional forest engineering firms is in the money spent up front could yield savings in the future. It is paramount that roads be properly located to minimize the cost and environmental impacts.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Discuss all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 point each)

1. What is the consequence of poor location of road?
2. Sketch the two types of road location
3. Sketch the balanced section of the road
4. What are the advantages of proper location of road
5. Road location is the “foundation” of any road. Why?

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

5.1. Timing

Regular and timely road maintenance helps to ensure that the forest road system remains fully functional. Conversely, poorly timed maintenance can create problems that might have greater consequences than not maintaining a road. As examples, cleaning ditches during wet weather can cause excessive sedimentation, and grading a road during a hard rain event can lead to the contamination of the surfacing material. On the other hand cleaning culvert inlets and minor blockages of ditches during rain events can prevent more serious damage.

It is extremely important that any maintenance activity be conducted at a time when weather conditions allow for a minimal amount of soil disturbance and sediment movement. It is essential to maintain the integrity of the road surface and sub-grade while conducting maintenance activities.

5.2. Weather condition.

The following parameters should check while taking in to account weather condition.

- Amount of rainfall
- Duration of rainfall
- Intensity of rainfall
- Catchment characteristics
- Degree of run off
- The watershed characteristics of the area
- The existing natural drainage system
- Wind speed and direction
- The natural waterways

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer the question listed below. Illustrations may be necessary to aid some explanations/answers.

1. Discuss briefly the suitable time of road construction (3 points)
2. Discuss briefly the suitable time of road maintenance (3 points)
3. Discuss the possible weather conditions that should be for the construction and maintenance of road (4 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Information Sheet 6- Log extraction methods and storage requirements

6.1. Log Extraction

It is the methods of removing the log from the worksite with mechanical equipment and cables, considering site conditions and specific log location, in an order which minimizes downtime and risk of snags

6.2. Preliminary Logging Plan

In the second stage, a preliminary logging plan is prepared for the area. In flat terrain, optimal road spacing provides guidelines for design of secondary roads. In mountainous terrain, an iterative process identifying landings which are then connected by spur or secondary roads is usually used. The secondary roads are then connected by a mainline road. The routes of the secondary roads are dictated by the logging plan. It cannot be overemphasized that the roads and the yarding are interdependent and must be integrated. The logging plan must be feasible for economical road construction and log-truck operation.

The roads must serve the landings and economical yarding distances. Compromise is often necessary to arrive at the minimum total combined cost of yarding, trucking, and roads with regard to protection and silvi cultural considerations. The efficient plan is that which allows for the lowest overall extraction costs.

If a main forest road is to be built primarily for hauling logs, the first consideration in selecting the route of the main road is to serve the secondary branch and spur roads. The main route should reach suitable junction points where there is room for the branch roads to turn off from the main road. Such junction points include flats, benches, and saddles where there is space for the double width required for grade separation without excessive excavation. If the branch road gradient is steeper than that of the main road, adequate length is required for an easy vertical curve to allow for a safe transition between the two road segments. The junction should be staked and constructed to the point where the branch road subgrade clears the main road at the time the main road is built. The route which will give the minimum combined hauling distance over the secondary road and the main road from the center of the timber volume will generally be the most economical route

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer the question listed below. Illustrations may be necessary to aid some explanations/answers.

1. Discuss briefly log extraction methods in relation to road maintenance? (5points)
2. Discuss and prepare preliminary log plan (5 points)

You can ask you teacher for the copy of the correct answers.

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Information Sheet 7- Establishing and maintaining communication

7.1. Communicating Information relevant to work.

The value of Communicating Information with the workgroup ensures:

- designated goals are met
- professionalism is maintained
- products and services are promoted
- openness between employees and supervisor is improved
- Positive workplace relationships are developed.

The information to be shared may include:

- acknowledging satisfactory performance
- acknowledging unsatisfactory performance
- assisting a colleague
- clarifying the organization's preferred task completion methods
- encouraging colleagues
- open communication channels
- Workplace hazards, risks and controls.

For a group/team to work effectively members should use open communication channels by observing one another's satisfactory or unsatisfactory performance; recognizing workplace hazards, risks and controls; and clarifying the organization's preferred task completion methods.

Solving problems in a group has four major advantages:

1. Greater knowledge and information (synergy).
2. More approaches to the problem.
3. Increased acceptance of solutions.
4. Better comprehension of the decision.

Self-Check – 7	Written test

Name…… ID……

Date…….

Directions: Answer the question listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are the advantage of communicating Information with the workgroup (5. points)
2. What are the information to be shared by the road construction working group (3 points)
3. Mention the advantages of Solving problems in a group(2. Points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Operation Sheet 1- Identifying road location, design and construction requirements

ROCEDURE

1. Wear your PPE
2. Using the topography of the area and GPS make a reconnaissance survey
3. Observe the natural water shade of the area
4. Propose the road location
5. Checking road use timeframe and weather conditions
6. Propose Preliminary Logging Plan
7. Finalize ,document and report

LAP TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 3 hour. The project is expected from each student to do it.

Task-1 Go to the forest area proximity to your college &Collect and Collet the necessary data suitable for identifying road location, design and construction requirements

LG #47	LO #2- Implementforest road construction

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- . Communicating on road, track design and construction plan
- . Coordinating, scheduling personnel, materials and equipment
- . Planning operational procedures

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide,you will be able to:

- . Communicate on road, track design and construction plan
- . Know how to Coordinate, schedule personnel, materials and equipment
- . Plan operational procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.

2. Follow the instructions described below.

3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4. Accomplish the “Self-checks” which are placed following all information sheets.

5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets

7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

8. If your performance is satisfactory proceed to the next learning guide,

9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

1.1. Cross-sections and road

Common to most cross-sections are the cut and fill sections of the road, where the “cut” is the portion of the uphill bank that is removed, and the “fill” is where material has been added to and compacted on the downhill side of the road. Road sections are considered balanced when the volume of earth cut equals the volume of compacted fill (Figure1-2).

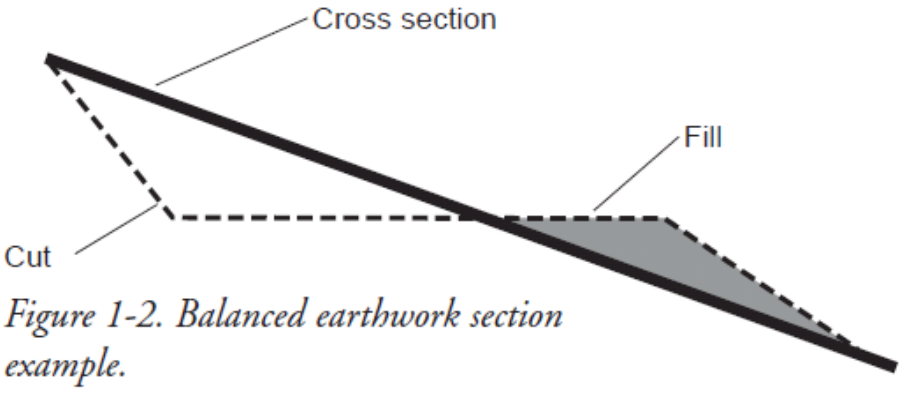

Figure 1-2. Balanced earthwork section example.

1.2. Road surface geometry (crowned Ditched, and out sloped roads)

A road surface is sloped to rapidly shed surface runoff water. There are three basic types of forest road surfaces to accomplish this: crowned, in sloped, and out sloped roads (Figure 1-3). The crowned road surface shown in Figure 1-3 carries surface runoff to both sides of the road. In sloped roads carry water to the interior (or uphill side) of the roadway and thus are constructed with a ditch and ditch relief pipe culverts to channel water under the roadbed and remove runoff to the downhill side of the road. Out sloped roads shed runoff to the outside and generally do not have a ditch on the inside.

Both in sloped and out sloped roads can be surfaced with rock (aggregate) or with native soil surface, depending on specific road use requirements, such as the season when logging will occur. Wet-season logging generally requires an all-weather rock surface. Both ditched and out sloped roads have common elements; the only exception is roadway surface drainage.

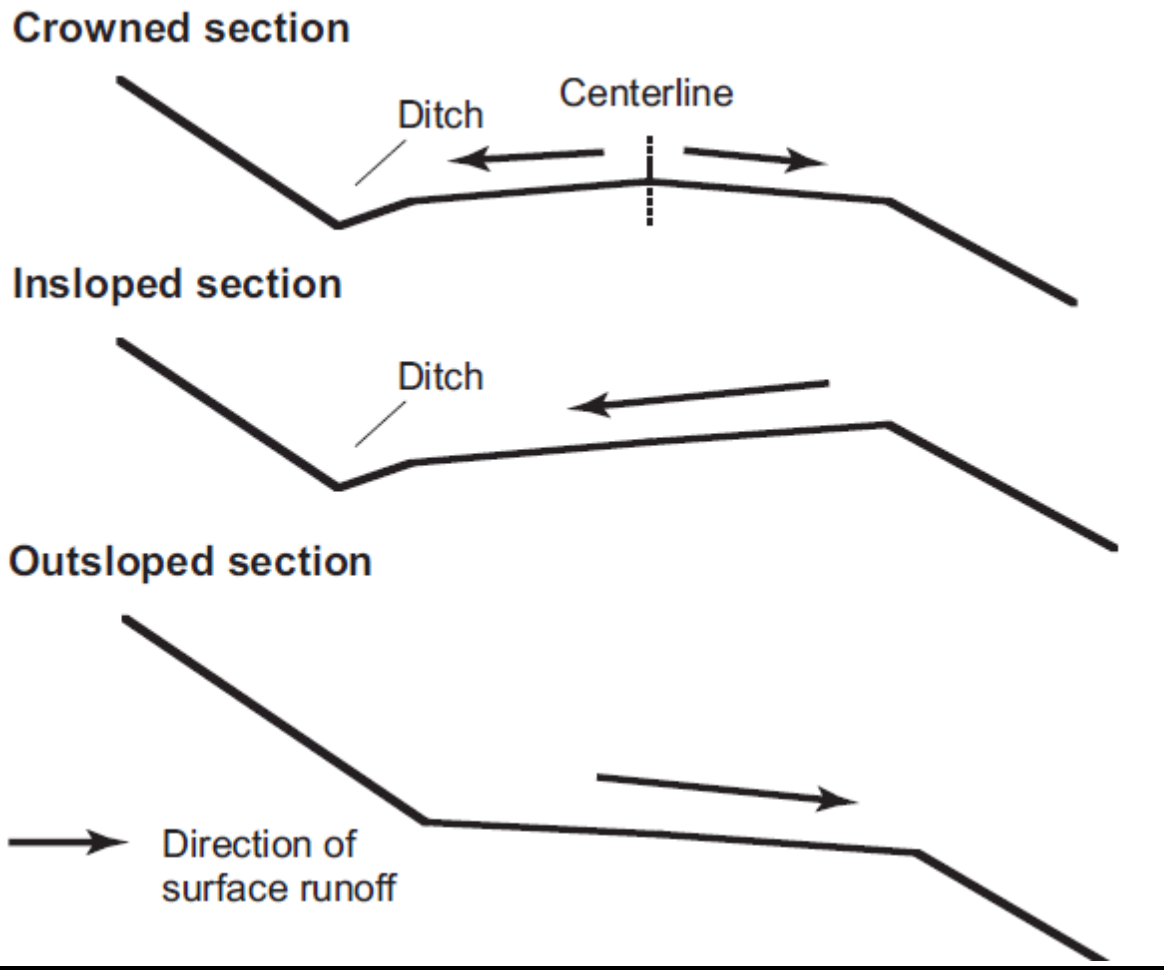

Figure 1-3. Ditched and out sloped roadway templates.

1.3. Types of road sections

Again, cross-sections are the natural ground profile perpendicular to the road; they show the slope and angle of topography at any given point. A road template shows the shape of a road set on the cross-section—that is, set on the slope of the natural ground. In addition to the three basic types of road surfaces (crowned, in sloped, out sloped), there are four general types of road sections: cut and fill, full bench, through cut, and through fill (Figure 1-6).

The cut and fill section, perhaps the most common type of road section, can be used on ground up to 55% cross-section slope. The full bench section is generally used on cross-section slopes greater than 55%. The through cut section issued where the ground must be cut through to avoid an overly steep road grade, such as on a steep hill crest. The through fill section is used to cross streams, draws, wet or swampy ground, and often on especially flat terrain where water is likely to sit.

1.4. Parts of the road

General road nomenclature for the various road elements are identified and illustrated in Figure 1-7. Though this example shows a cut and fill section, this general nomenclature applies to most road types.

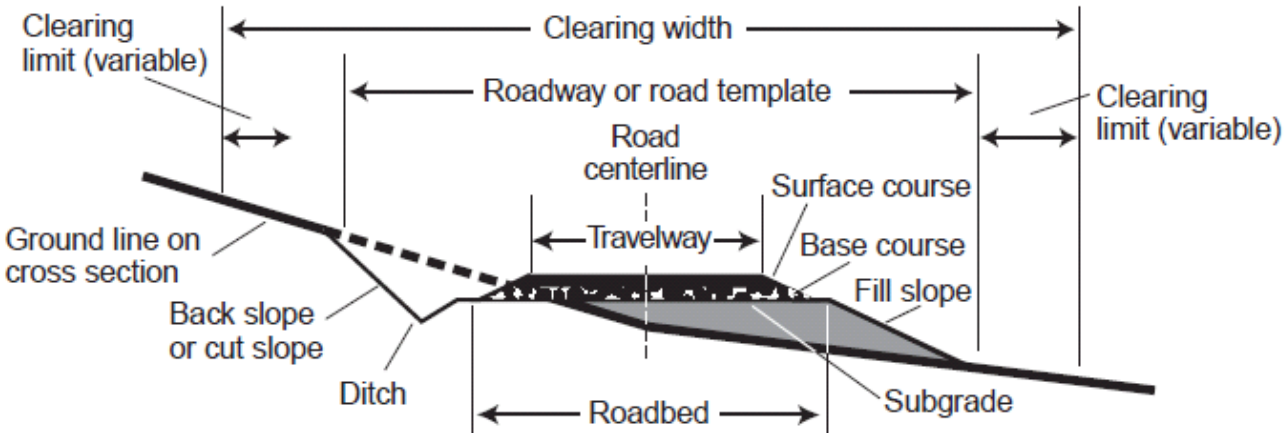

Fig.1-7. Road terminology

1.5.Cut and fill slopes

A newly constructed cut and fill slope is shown in Figure 1-8. The cut and fill slope angles on a road are expressed as a ratio of the horizontal distance to the vertical distance of the slope. Road cuts and fill banks should be constructed to slope angles that minimize slope failure and raveling (erosion of the cut and fill slopes). The roadway cut slope is expressed as the ratio 1:1; that is, the slope is on an angle with a horizontal distance of 1 foot and a vertical distance of 1 foot (or 45 degrees). The fill slope ratio is 1.3:1, where the slope angle has a ratio of 1.3 feet horizontal to 1 foot vertical (or 37 degrees).

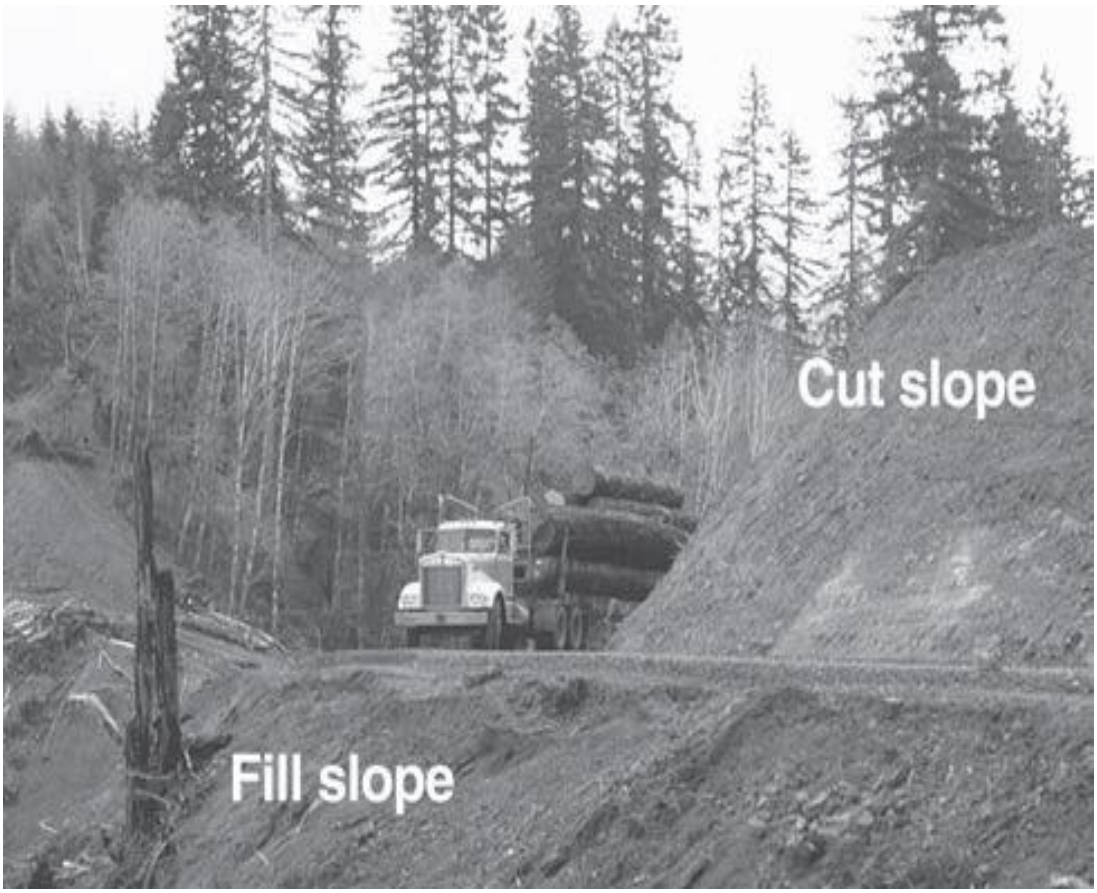

Figure 1-8. Example road cut and fill slope.

Depending on the soil and rock type encountered, cut and fill slopes are constructed to different slope ratios. Table 1-1 illustrates example slope ratios for various rock and soil types.

Table 1-1. Cut and fill slope ratio types.

Soil type	Cut	Fill
Common soil	1:1	1.5:1
Clayey soil	2:1–3:1	N/A*
Solid rock	0.5:1	N/A**
Fractured rock	0.75:1	1¼:1

*Clayey soils do not provide for adequate subgrade materials as they tend to hold moisture and do not drain.
**Solid rock is not used in constructed fills.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 points each)

1. Explain technically the Cross-sections and road
2. Sketch and explain the road surface geometry of crowned Ditched, and out sloped roads
3. Explain the parts of the road

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

2.1. Considerations in Selection

The essential machines and equipment for construction and maintenance work on forest roads are generally powerful, expensive, and usually operated under very difficult conditions. Equipment selection should consider:

- Choice of the right size for the conditions
- Maintenance requirements
- Ease of dismantling
- Operation by semiskilled personnel
- Strength and resistance of parts to wear
- Availability of parts
- Availability of technical support

Select the appropriate size and power configuration for the job to be done. Selecting equipment that is too large requires more room to maneuver and creates the possibility for the operator to easily overbuild the road. Selecting too small a piece of equipment forgoes construction choices such as the ability to rip or hammer rather than to blast in rocky terrain. Since the forest operations are often isolated, it is better to standardize equipment makes and models to the extent possible to minimize spare parts, maintenance tools, and skill requirements of maintenance personnel. Eventually, usable equipment parts can also be salvaged from retired machines. A major concern can be availability of parts, particularly for imported parts. This aspect should be investigated carefully prior to machine selection. A good idea is to visit neighboring operations to see what has worked and what has not. All road construction and maintenance equipment should be equipped for high-humidity, high-temperature operation, both mechanically and ergonomically.

Table Characteristics of road construction Equipment

Criteria	Bulldozer	Front-end loader	Hydraulic backhoe	Dump trucks or scrapers	Farm tractors
Excavation mode (level of control of excavated materials)	Digs and pushes; adequate control (depends on blade type)	Minor digging of soft material; lifts and carries; good control	Digs, swings, and deposits; excellent control; can avoid mixing materials	Scrapers can load themselves: "top down" subgrade excavation; used for long-distance material movement; excellent control	Minor digging and carrying; good control because it handles small quantities
Operating distance for materials movement	120 m; pushing downhill	100 m on good traction surfaces	20 m (limited to swing distance)	1 km, scrapers; 3 km, trucks must be loaded	35 m (approximately)
Suitability for fill construction	Adequate	Good	Limited to smaller fills	Good for larger fills	Not suitable
Clearing and grubbing (capacity to handle logs and debris)	Good	Adequate	Excellent	Not suitable	Handles small material only
Ability to install drainage features	Adequate	Digging limited to soft materials	Excellent	Not suitable	Adequate for small tasks only
Operating cost per hour	Moderate, depends on machine size	Relatively low	Moderate to high, but productivity excellent	Scraper very high, loader and trucks very high	Low
Special limitations or advantages	Widely available; can match size to job; can do all required with good operator	Cannot dig hard material; may be traction limited	Good for roads on steep hillsides; can do all required except spread rock for rock surfacing	Limited to moving material long distances; can haul rock, riprap, etc.	Very dependent on site conditions and operator skill

2.2. Types of Equipment

The minimum pieces of equipment required for road construction and maintenance are (1) 125–190-kW bulldozer, (2) a road grader, although for a small operation a towed grader is adequate, (3) a 30–45-kW four-wheel drive agricultural tractor with scoop bucket for towing a rubber-tired roller, grader, or drag, (4) a mobile workshop, and (5) two dump trucks. Costly machines such as self-propelling graders, scrapers, tracked or

rubber-tired front-end loaders are suitable for larger operations which require the work of several bulldozers. For work in steeper terrain, a 100–150-kW hydraulic excavator is recommended. An excavator at the larger end would be recommended if substantial ripping or hammering is anticipated. Characteristics of road construction equipment are shown in Table 10.1, with the exception of graders and compactors.

2.3. Selecting appropriate personnel.

Appropriate personnel may include supervisors, suppliers, clients, colleagues, and managers

A maintenance plan prescribes remedial measures required to maintain road integrity and meet objectives for user safety and environmental concerns. All responsibilities for road maintenance must be fully identified, understood and fulfilled.

In the conduct of their normal day-to-day activities, district employees may observe or identify road maintenance needs. Districts will develop a methodology for recording the information and forwarding it to person or party responsible for maintaining that segment of road.

Districts will utilize geotechnical specialists, biologists, or other professionals to provide design input for mitigation of chronic maintenance problem areas.

This road maintenance option provides the greatest flexibility. Personnel and equipment are in place and can easily be allocated to projects. Employees' experience and local knowledge can be invaluable in identifying chronic problem areas and developing appropriate road maintenance solutions. In addition, the personnel and equipment are available to support other functions, such as fire suppression.

The greatest advantage of Department personnel and equipment is the ability to react promptly to high priority situations, especially when unplanned emergencies arise.

The cost of maintaining the staff and heavy equipment that is required to accomplish the work is the biggest disadvantage of this option.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 points each)

1. Discuss the factors we should consideration in selection of road personnel
2. Discuss the factors we should consideration in selection ofroad materials.
3. Discuss the factors we should consideration in selection road equipment

You can ask you teacher for the copy of the correct answers.

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

3.1. Clearing and grubbing

Clearing the trees and brush from the road right of way is the first step in the road construction process. The clearing limit is the width that the trees, stumps, and organic debris are to be cleared across the future roadway. At a minimum, larger stumps that could fall on the road should be removed from the top of the cut bank, and the clearing limit should extend, at a minimum, to the toe of fills. The clearing limit itself will vary, depending on ground slope and the amount of cut and fill required. Example clearing limits are illustrated in Figure 4-1.

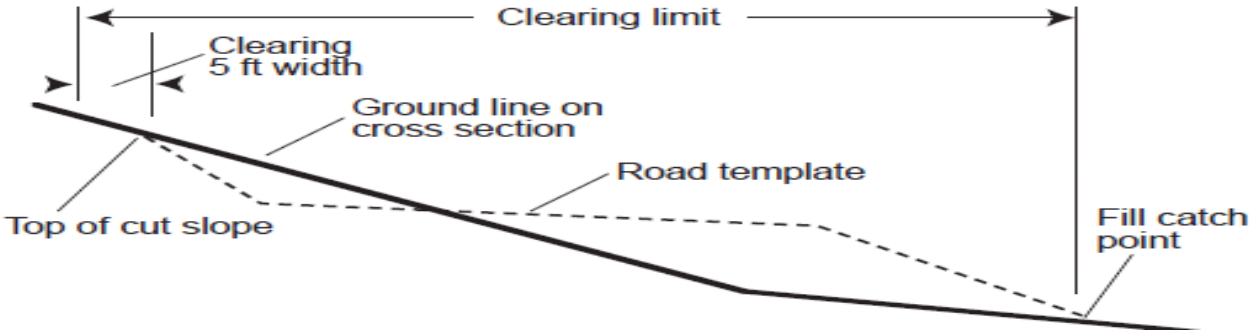

Fig. 4.1.Clearing limit

In most cases, the least costly method to dispose of stumps, un merchantable timber, and slash is to scatter it outside and along the downhill side of the clearing limits. Un merchantable material and stumps should be scattered with care to prevent any hazard during the logging operation and during seedling planting after harvesting is concluded. Care should also be taken to place un merchantable material away from merchantable trees. Placing a stump, or any slash, up against a standing tree might result in high stumping of that tree during harvest, and a waste of merchantable wood.

A pioneer road allows the removal of duff, slash, brush, and merchantable timber prior to major roadway excavation. This preliminary access road is constructed within the clearing limits of the future roadway to provide for machine access and the removal of right-of-way timber (the felled timber inside the clearing limits) (Figure 4-2).

Figure 4-2.Tractor clearing and grubbing.

Controls during the construction of the pioneer road must carefully guide the digging and removal of stumps and roots within the clearing limits of the roadway. Example clearing and grubbing specifications are given in Figure 4-3. These specifications will ensure that the fill material is free of large organic debris, and that hazardous trees that fall onto the roadway are removed during the construction of the pioneer road. Organic debris does not compact well; it tends to settle, causing slumps in fill subgrades.

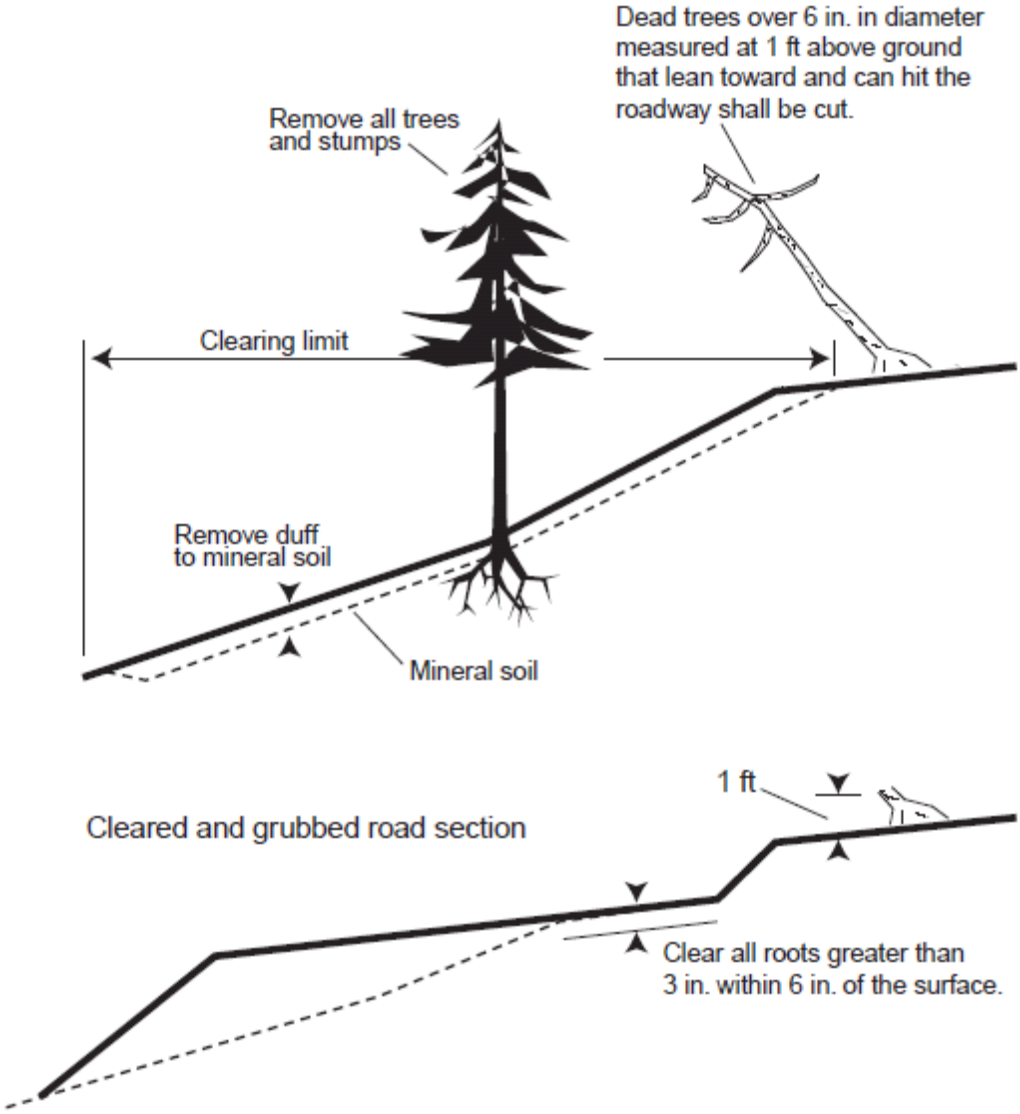

Figure 4-3.Example clearing and grubbing specifications for a section of forest road.

Slash and brush within the clearing limit must be cleared and disposed of. One or a combination of methods can accomplish this task, including scattering of the slash, or burning it in piles. In general, however, the least costly method is to windrow, or scatter, slash outside the clearing limits on the downhill side of the roadway.

3.2. Subgrade construction

The subgrade should be constructed of well-drained, compacted material. Figure 4-9 illustrates a well-drained road section constructed of well-compacted material.

Figure 4-6.Tractor constructing road subgrade.

Figure 4-7.Hydraulic excavator excavating roadway material.

Figure 4-8. Tractor with a hydraulic ripper attachment.

Figure 4-9. Road constructed with well-compacted and –drained subgrade

Unsuitable material such as wet clay pockets, or subsurface water that enters the subgrade, can cause serious and continual maintenance problems. Groundwater (underground water or channels) in the cut bank or under the subgrade must be cut off with a ditch to keep it from entering the subgrade. Spring water or any groundwater

running under the subgrade can be cut off with an under-drain that is constructed with a trench at an elevation lower than the flowing ground water, as shown in Figure 4-10. A perforated drainpipe or filter aggregate wrapped in a geotextile filter cloth is used to trap the water and carry it across and away from the road.

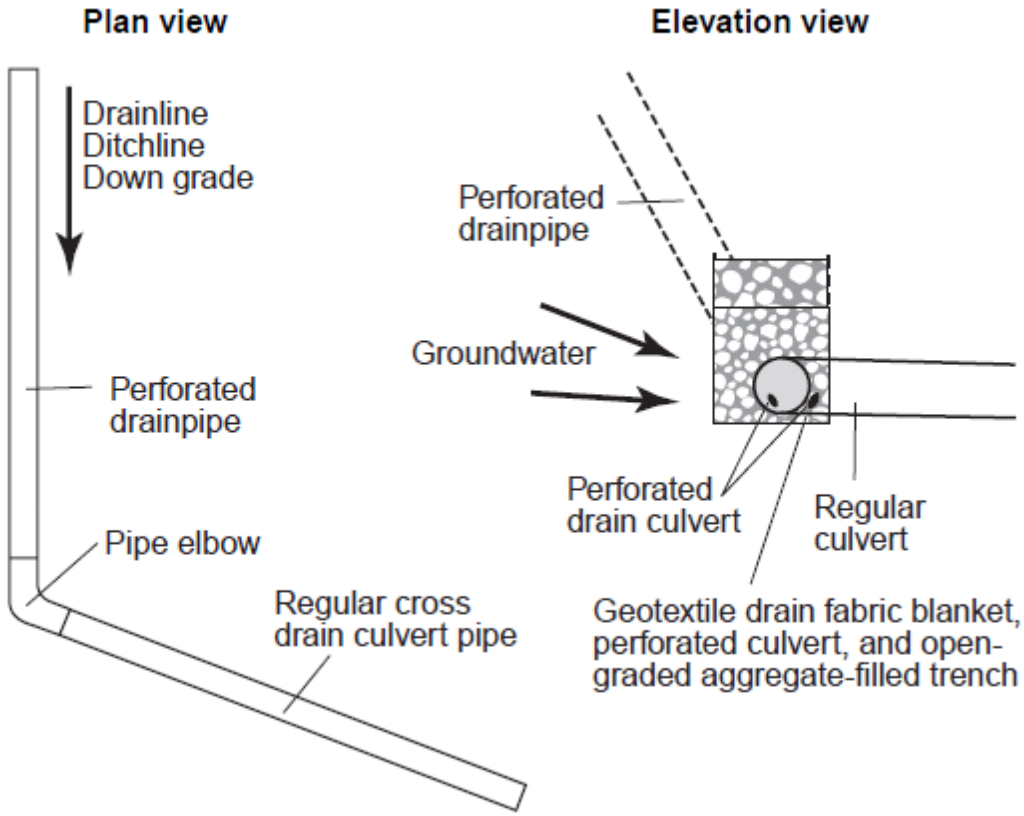

Fig.4-10.Under-drain used to cut off ground before it steeps in to the sub- grade.

Road fill material that is soil or soil mixed with rock should be placed in approximately 1-foot layers and compacted before adding the next layer. The amount of compaction achieved will depend on the moisture content of the soil and the energy expended on compacting. The ore the soil is compacted, the tighter the bonding of the soil particles and the smaller the air voids.

For ideal soil compaction, the soil is mechanically compacted at optimum moisture to within 90%–95% of its maximum density. This level of compaction often requires a mechanical roller, along with soil sampling and laboratory testing to determine optimum compaction, though the optimum is generally beyond the scope of small woodland operations. Various types of compaction equipment are used; for example, smooth wheel vibratory rollers and sheep-foot rollers. The drum in a sheep-foot roller has metal

projections, or “feet,” that sink into un compacted soil. When the projections no longer sink into the surface, the road is considered to be well compacted.

At a minimum, small woodland operations can require that the grade tractor and dump trucks, if used, help compact the fill by splitting tracks and tires (that is, driving between previous tracks) while operating back and forth on a fill (Figure 4-11). Under the proper conditions, this method will gain up to approximately 80% of optimal compaction. While not ideal, any compaction is better than no compaction.

Figure 4-11. Splitting wheel or cat tracks when spreading and placing fill material to obtain additional compaction.

Rocky material larger than 30 cm in diameter should be buried in the fill at least 60cm below the surface of the subgrade. Unsuitable material such as clay and organic matter is often excavated and moved to a suitable waste site. This material is replaced with suitable fill material

3.3. Road surfacing and a logger’s operating Season

Essentially, the two “seasons” for logging operations in are dry summers and falls, and wet winters and springs. During the dry season, less road surfacing is generally needed, whereas winter logging requires all-weather roads and higher standards, such as rock aggregate surfaces.

The two most common types of road surfacing are native-soil and aggregate (crushed rock) road surfaces. Aggregate surfacing provides more strength to the road surface for

vehicle passage than do native-soil road surfaces. In inclement weather, rock surfacing extends the life of the subgrade by helping to keep it from becoming rapidly saturated and significantly rutted. Figures 4- 12 and 4-13 illustrate native-soil and rocked-surface roads.

1. native-soil surfacing

Again, native-soil surfacing can be used when harvest operations are conducted during dry weather. This type of road surface is generally more susceptible to erosion than are aggregate-surfaced roads. Traffic control must be maintained during wet weather to avoid serious road surface ruts and subsequent erosion and runoff damage. Well-drained and compacted soil helps avoid road damage.

Figure 4-12. Native-soil-surfaced road

2. Rock surfacing

Aggregate is rock that is either excavated with a tractor or blasted into pieces small enough to be crushed with a mechanical rock crusher to the appropriate mix of particle sizes. If, for example, a road contract specifies a 6-inch minus base aggregate, the contractor must apply a specified range of sizes of crushed aggregate 6 inches and smaller. Rock aggregate surfacing is placed on a road subgrade to add strength to support vehicle traffic, provide wheel traction, provide a relatively smooth traveling

surface, and reduce road surface erosion. When compacted, the rock particles bind together for added strength.

Because the subgrade material found on site can vary in strength, the need for an aggregate surface can also vary. A rock subgrade may require no surfacing, while a weaker common soil subgrade could require a base and surface layer of aggregate for an all-weather haul. For effective log hauling, all-weather rock-surfaced roads can be constructed with varying sizes and depths of aggregate surfacing. Depending on the strength of the subgrade, a single layer or multiple layers of surfacing are used. A surfacing system using two different lifts (layers) of rock surfacing can provide added strength to support vehicle wheels, enhance wheel traction, provide for log haul operations during inclement weather, and reduce road surface erosion and subsequent road maintenance. There are two main procedures used in rock surfacing roads. The first is to use several lifts of rock of the same gradation. The second is to use a larger base rock and place a surface aggregate over the base. The advantage of the base rock is that it is generally less expensive than several lifts of smaller aggregate. The advantage of having the surfacing of the same size aggregate is ease of surface maintenance. When roads with base rock surfacing have rutting, the base rock can mix with the surface rock, causing extreme difficulty in re blading the surface with a motor grader.

On roads where base rock is used on the first lift, it is placed on the subgrade to provide added strength to support vehicle wheels and help retard moisture penetration into the subgrade. A traction surface lift is then placed on top of the base rock to provide for better traction and smoother running surface (Figure 4-14). On grades over 16%, a traction layer, 30cm- to 22cm minus dense grade rock, is placed on the top of the 6-inch-minus base rock to provide for enhanced vehicle wheel traction. Sometimes on short all-weather spur roads with grades less than 10%, only 6-inch-minus base rock is used.

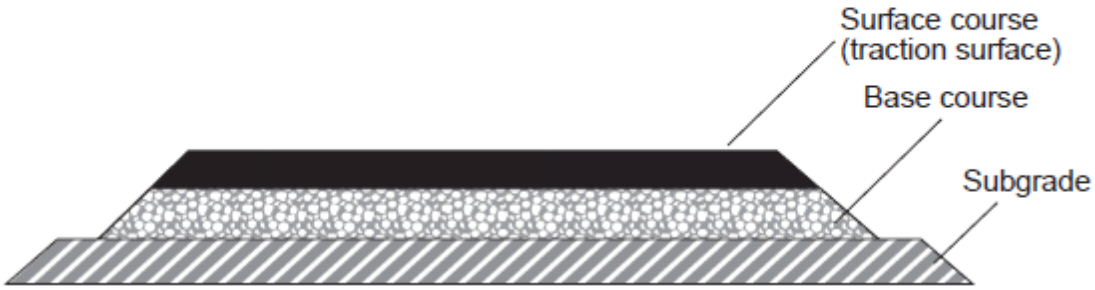

Figure 4-14. Rock roe surfacing, base and subgrade

3.4. Surface Compaction work

As with soil compaction, road surface aggregate must be compacted with a certain moisture content to attain optimum compaction and the greatest performance from the surfacing. As with soil moisture, tests can determine moisture content in aggregate. However, laboratory tests are uncommon. Instead, road builders use experience and judgment to determine the moisture content of the aggregate before compacting it.

The rock should be mechanically compressed to be sufficiently compacted. The trucks delivering the rock to the site can, and indeed should, begin compacting the road surface by splitting their wheel tracks while running on the newly placed rock. Landowners can require this in their road contract.Optimum rock surface compaction, however, usually requires a self-propelled smooth-wheel vibratory roller, shown compacting surface rock in Figure 4-15. Optimum compaction can be cost-prohibitive for some small landowners, but it is wise to follow the maxim: some compaction is better than no compaction at all.

Figure 4-15. Smooth-wheel vibratory roller compacting surface rock

3.5. Constructing stream-crossing structures

Stream-crossing structures are an important and costly element of forest roads. Because of environmental concerns in recent years, many constraints have been placed on road structures that cross streams. These requirements assure that the structures can handle flood flow capacity and provide for fish passage, while reducing sediment and turbidity yields. In the Pacific Northwest, all structures that cross perennial streams must be designed to carry the flow of a 50-year flood event (defined as a flood large enough in that particular stream to have only a 2% chance of occurring in any year).

Fish-bearing streams also require adherence to regulations pertaining to fish passage through drainage structures. Each state in the Pacific Northwest has specific regulations and procedures regarding fish passage through road drainage structures. For example, the Oregon

Department of Forestry classifies streams by whether they provide fish habitat. If a road crosses a stream with an “F” designation, bridges, culverts, and drainage structures would have to allow fish passage and be built following state guidelines. The velocity of water through a culvert pipe, for example, cannot exceed the capability of fish of particular age classes to swim through it. There would also be limitations on when the

stream could be entered with construction equipment. At a minimum, a 50-year flood event is the design flow criterion for forest road stream structures. To properly construct a stream-crossing structure that will withstand a 50-year flood and allow fish passage, a landowner will need the guidance of an engineer. For general advice, contact the department of forestry in your state. The road contract should also require that the contractor follow the state forest practices regulations, which sets specific guidelines for stream-crossing structures.

A professional engineer should perform drainage structure designs, especially on fish-bearing streams. State forest practices regulatory organizations have published literature to assist in proper design and installation of these structures. Requirements are constantly changing and will not be addressed in this publication; instead, landowners should contact their local forest practices forester, who can provide information on regulations and information regarding approved structures.

3.6. Road intersections

Road intersections must be constructed so that logging trucks and trucks carrying logging equipment on trailers (usually carried on “lowboy” trailers) can easily turn in the direction of the haul (Figure 4-24). Additional width for the curve will be added at the intersection to allow for vehicle off-tracking (lowboys, if they are necessary, off-track even more than logging trucks). Figure 4-24 shows a “Y” intersection. A “T” intersection could also work, but when a Y is used, the approach road at the intersection should be in the direction of the haul.

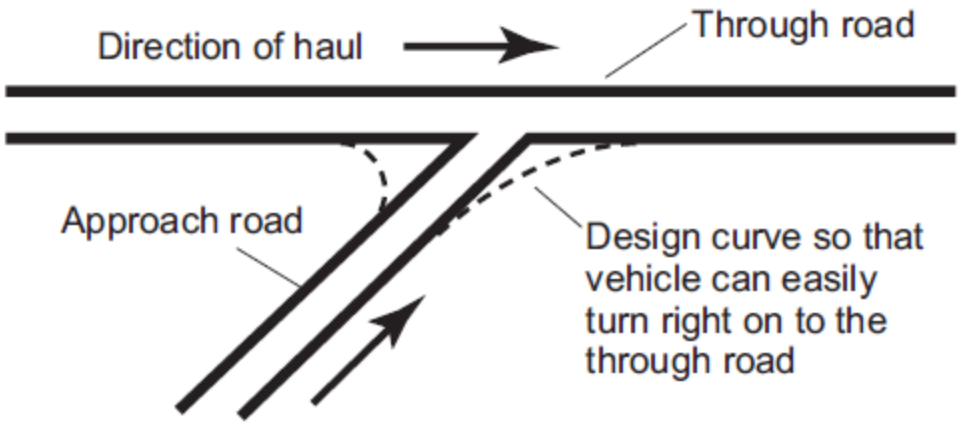

Figure 4-24 a properly designed road intersection

There must also be a common grade at a road intersection for a distance down each road from the center of the intersection. The distance depends on the geometry of the intersecting roads. This is done to provide for a gradual transition in road grade. Tight Y intersection on a steep grade should also be avoided because the cut slope of the approach road can undermine the intersected road's fill slope, or vice versa. To avoid this, the angle of the Y intersection should be made less severe, or the intersection should be relocated.

3.7. Constructing timber harvest equipment landings

Timber harvest log landings are designed and built to provide sufficient room for harvested logs as well as the safe operation of logging equipment. On difficult terrain, landings should be carefully planned and located at the same time the road is located to assure that logging operations are as efficient as possible. Landings are generally established in a harvest plan.

3.8. Constructing Erosion control

Erosion control is important for two reasons: to protect the road and to minimize or eliminate sediment transport into streams. On an adequately constructed and maintained road, the majority of erosion generally occurs during the first 2 years of life after a road is constructed because fresh cut-and-fill slopes are susceptible to accelerated erosion; small loose material ravels from cut banks and out of freshly cut ditches.

At a minimum, landowners can easily revegetate cut-and-fill slopes by hand with a seed spreader. County agriculture or forestry Extension agents can provide landowners with information on appropriate seed mixes and when and how to plant them. A well-established grass cover is illustrated in Figure 4-25.

Figure 4-25. Excellent planted grass erosion control on a road cut bank.

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Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. Enumerate the step by step procedure of road construction (6 points)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

ROCEDURE

1. Clearing and grubbing
2. Subgrade construction
3. Road surfacing and a logger's operating area construction
4. Undertaking surface compaction work
5. Constructing stream-crossing structures
6. Constructing road intersections
7. Constructing timber harvest equipment landings
8. Constructing Erosion control structures
9. Report and document the work done activities

LAP TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3**hour. The project is expected from each student to do it.

Task-1 Participate and construct forest road construction to the nearby forest area of your college and document & report.

LG #48	LO #3- Maintain forest roads

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Assessing roads and tracks
- Coordinating and scheduling personnel, materials and equipment
- Adhering site environmental conditions
- Organizing maintenance schedule for the site

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Assesse roads and tracks
- Know how to coordinate and schedule personnel, materials and equipment
- Adhere site environmental conditions
- Organize maintenance schedule for the site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.

2. Follow the instructions described below.

3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4. Accomplish the “Self-checks” which are placed following all information sheets.

5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets

7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,

8. If your performance is satisfactory proceed to the next learning guide,

9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Assessing roads and tracks

1.1. Introduction

Because of natural wear and traffic, a road must be maintained periodically.

In adverse weather conditions, a road may require regular maintenance, especially a road with a ditch. A road causes an unnatural change on the natural landscape. Over time, nature will continuously work toward reestablishing a natural landscape. Figure 1. Illustrates road deterioration caused by erosion and lack of proper periodic road maintenance.

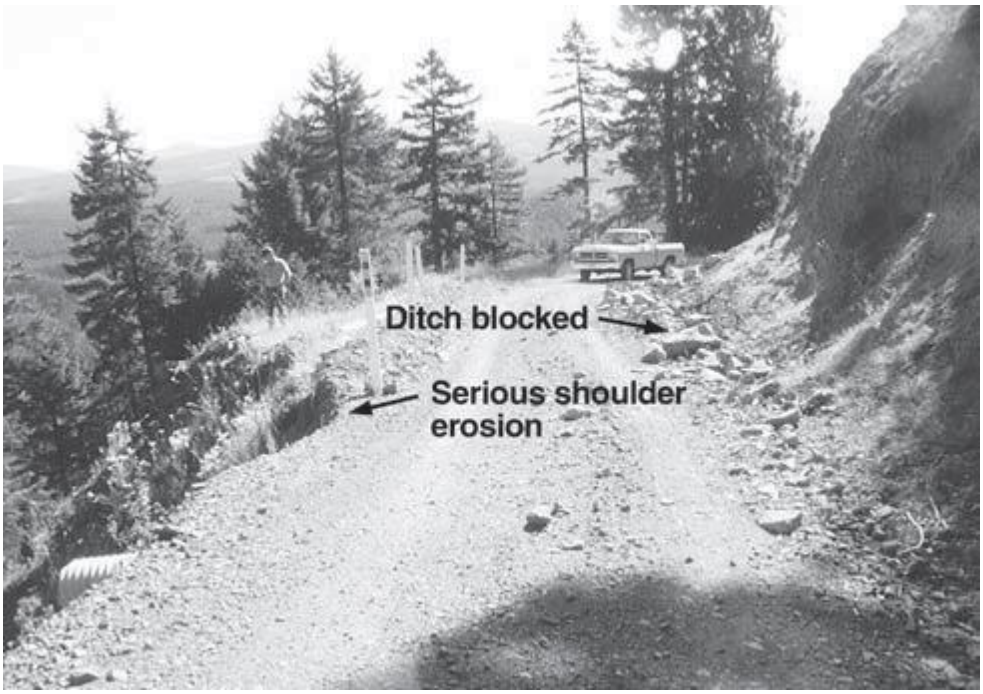

Figure 6-1.Roadway failure due to lack of proper maintenance.

In addition to natural damage, traffic damage not quickly repaired can seriously erode a road. The wheel rutting illustrated in Figure. 2 could cause serious erosion during a rainstorm, damaging both the road and the environment as surface runoff is channeled down the wheel ruts, which increases the erosive power of the water and can channel sediment into nearby streams. Damaged culverts can also cause serious roadway erosion. In addition, standing water in ruts can saturate the subsurface, especially if it is allowed to sit for a long time. This can cause the road to fail or the fill to slough off.

Effective road maintenance can preserve roads, keep down a landowner's long-run costs, and help reduce the impact on the environment.

Figure .2 Excessive wheel rut damage to the road surface.

An effectively managed road has a well-maintained surface, clear and well-maintained drainage, and effective erosion control. The road in Figure-3 is all-weather, aggregate-surfaced, ditched road. Ditched roads require regular maintenance at least annually and after each serious rainstorm, or after snow runoff in high country. Here, the surface is well maintained to provide proper surface drainage, and the ditch and relief culverts are maintained and kept clear of obstructions to provide for maximum flow. There is little evidence of erosion.

The out sloped, aggregate-surfaced, all-weather road shown in Figure.4 is well designed and constructed. This minimum impact road has remained continuously open to traffic after timber harvest operations were completed, even though it has not been maintained in the last 2 years.

It is worth highlighting that the ditched road shown in Figure 6-3 must be maintained periodically, though the out sloped road shown in Figure 6-4 had not been maintained in over 6 years after the completion of timber harvest operations. Furthermore, the slough

(sliding off) on the cut bank visible on the out sloped road in Figure.4 has no effect on road surface drainage. This does not imply that an out sloped road will never need maintenance. The landowner should periodically clean off the slough to keep it from migrating onto the road surface. However, this type of damage is much less serious than a blocked ditch on an in sloped road. On a ditched road, this amount of slough would have to be removed immediately because it could block the ditch, forcing the ditch water onto the road surface, and quickly causing serious erosion.

Fig.3.A well-maintained ditched road.

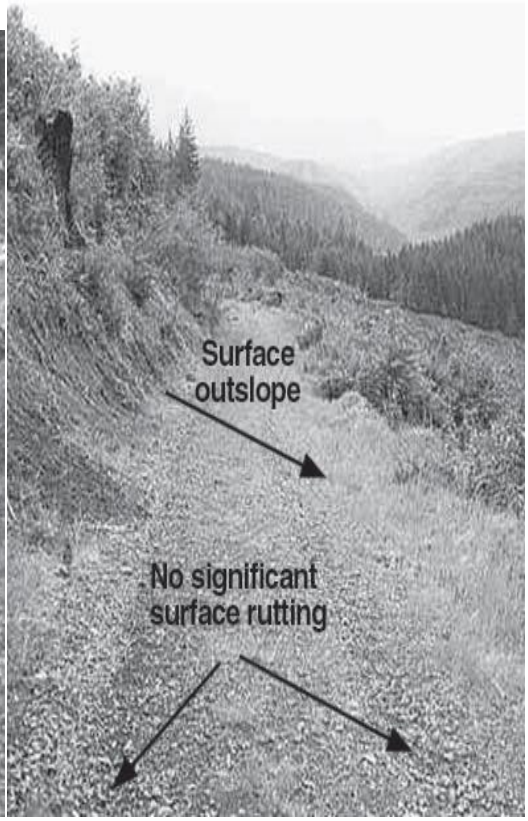

Fig.4. A well-maintained out sloped road.

1.2. Road surface failure

All native-surfaced and rock roads depress under vehicle wheel loads, never completely returning to their original shape (Figure -5). This is how ruts develop on road surfaces over time. A road surface may rapidly develop ruts if the subgrade or surface courses are improperly constructed or maintained, or if they carry overweight wheel loads for the existing road surface conditions.

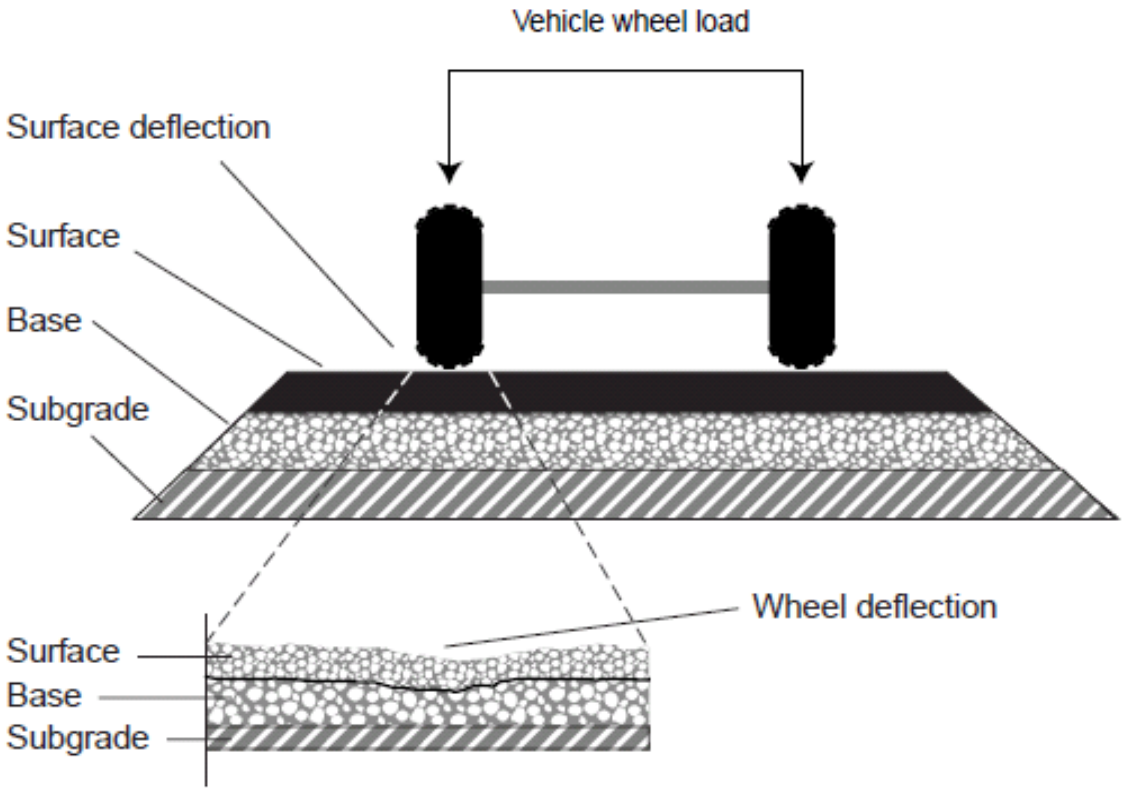

Figure 5.Rutting of a rocked road surface.

Because a combination of factors may damage a road, it can be difficult to determine why aggregate or soil-surfaced roads fail. Often, when signs of surface distress are detected, the entire road surface structure (the subgrade, base, and surface course) has already failed from invisible damage under the road surface.

One mode of failure is called shear failure, where the wheel load is too heavy for the road surface to support, and thus the surface material punctures into the subgrade (Figure -6). This type of surface failure is difficult to detect; often the only indication is small wheel ruts in the road surfacing. Shear failure can be avoided by adequately designing surface rock depth and by insuring that hauling vehicles are not overloaded.

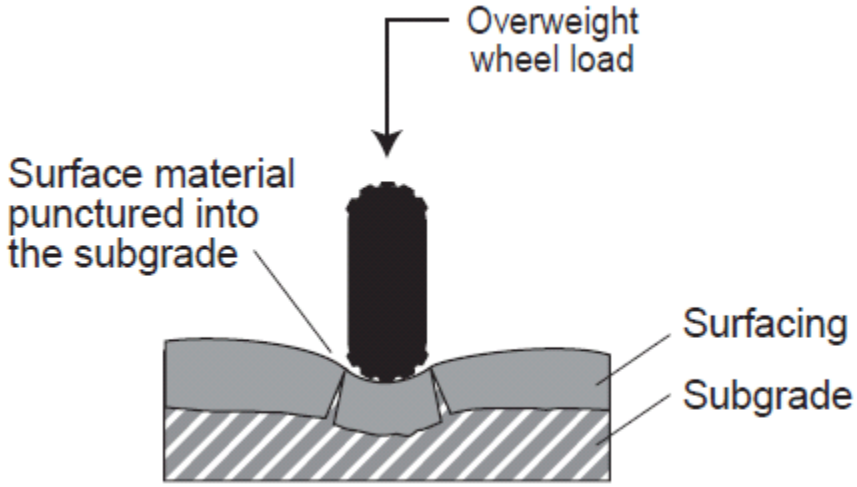

Figure 6.Shear failure of a road surface because of overweight wheel loads.

Traffic wheel loads on a saturated subgrade cause a second mode of road surface failure called pumping (Figure -7). The problem begins when the subgrade becomes saturated from standing water that seeps in horizontally from a blocked ditch, or vertically from wheel ruts. Moisture in the saturated subgrade is pumped up into the road surfacing when the subgrade soil is squashed from a wheel load and saturated soil particles migrate into the more-porous aggregate surfacing. The moisture and fine soil particles act as a lubricant, destroying the strength of the subgrade and surfacing. To avoid this type of damage, landowners should prevent standing water by keeping ditches free of obstructions and regraded roads to remove ruts. Under extremely wet conditions, the landowner or road contractor may need to close the road until the area dries.

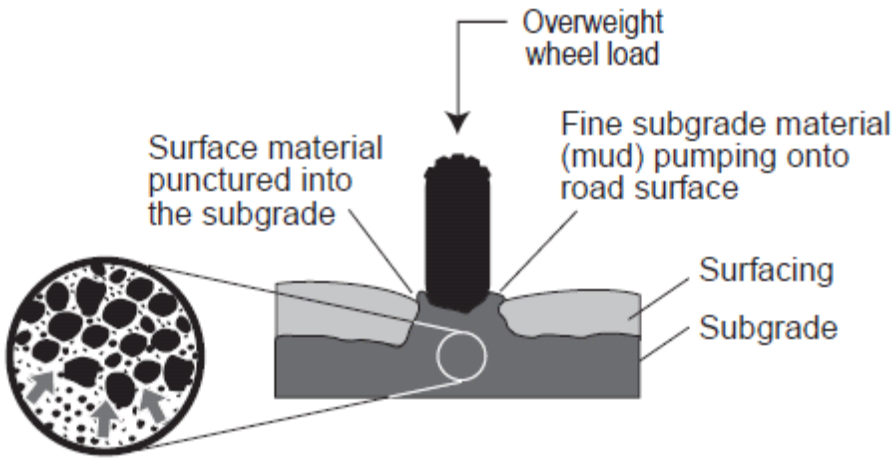

Figure 7.Migration of moisture-saturated subgrade soil particles into rock surfacing.

1.3. Vehicle damage and surface maintenance

Unfortunately, damage to the roadbed or subgrade and surfacing layers can be hidden by routine maintenance. For example, on aggregate-surfaced and earth surfaced roads, damage to the subgrade can be hidden when the road surface ruts are reshaped and smoothed over by a grader. This situation can cause serious future problems if the material in the ruts has pumped saturated subgrade soil (mud) up into the base or surface layer. The mixing of saturated subgrade base and surfacing is illustrated in Figure-8.

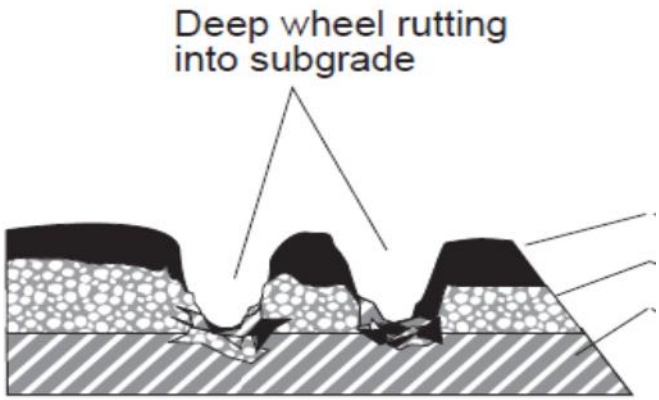

Fig.8. Excessive rutting on a base- and surface rocked road.

This type of damage can cause continual rutting problems as the road loses material strength in the wheel ruts. In severe cases, the wheel ruts must be excavated and the base and surface rock replaced, which is an expensive operation.

To avoid this, landowners should regulate forest road traffic during extreme wet weather. Vehicles, particularly heavy trucks, can cause this type of damage on one pass down a road.

1.4. Normal road surface deformation

Some types of road surface deformation affect only the surface layer. Shallow rutting and wash boarding (corrugations) are limited to the surfacing material and do not penetrate into the base course (Figure-9).

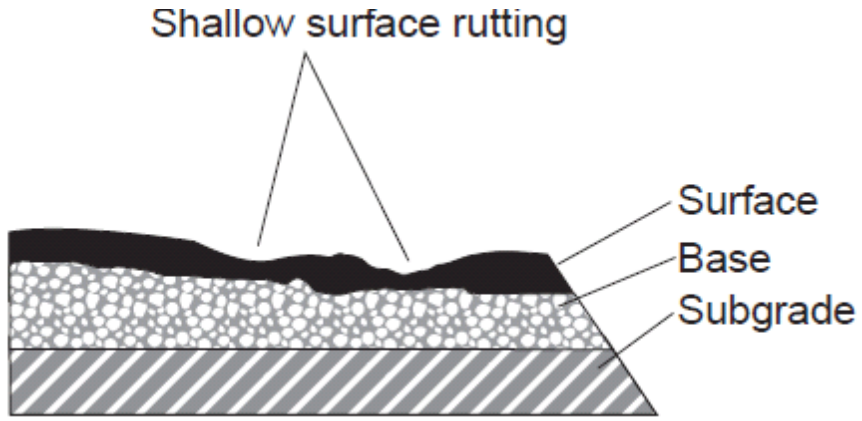

Fig.9. Shallow rutting that can be maintained with a motor grader.

Wash boarding is caused by the forward and downward motion of a vehicle's wheels breaking or bouncing on the road surface, which can begin to form small corrugations on the surface layer perpendicular to the direction of the road. Wash boarding can usually be corrected by reprocessing (reshaping) the surface rock. This is accomplished by shaving off a layer of the road surface rock with a road grader, then laying it back down and compacting it. Wash boarding and other shallow rutting is classified as normal deterioration that generally requires only routine maintenance.

The following indicates normal deformation of the surface layer:

- It is easily observed prior to blading.
- It is corrected by routine blading and reshaping.
- Ruts more than 6 inches deep can indicate more serious problems with the base and subgrade, and the road surface should be reshaped as soon as possible if it has ruts of between 5 and 15 cm (at 2 cm, ruts are easy to see and are sufficiently deep to carry a potentially damaging amount of water).

1.5. Roadway drainage maintenance

The first three concerns in road design, construction, and maintenance have been often stated as drainage, drainage, and drainage. Poor drainage can be a road's worst enemy. Moisture affecting road performance comes from four main sources: road surface runoff, blocked ditches, blocked culverts, and underground water tables or water-bearing strata. Any of these can cause deterioration and weaken the road structure.

Rain and snowmelt must be removed from the road surface as rapidly as possible because moisture can soak through the surface into the subgrade. Road surface geometry is designed to divert surface runoff as rapidly as possible, whether the road is crowned, in sloped, or out sloped. A ditch gathers and concentrates runoff; similarly, ruts (which channel water like a ditch) can render outslope drainage ineffective.

Improperly shaped road surfaces include ruts, plugged ditches, or berms left by a road grader on the outside shoulder of a road. These conditions can cause erosion, or cause water to pool and infiltrate the road surface, weakening the subgrade and causing potholes and ruts.

1.6. Ditch and culvert maintenance

Relief culverts drain ditches at periodic intervals. Without proper or timely ditch maintenance, a road can be catastrophically damaged. Figure-10 shows how plugged culverts cause catastrophic ditch and roadbed erosion into the subgrade.

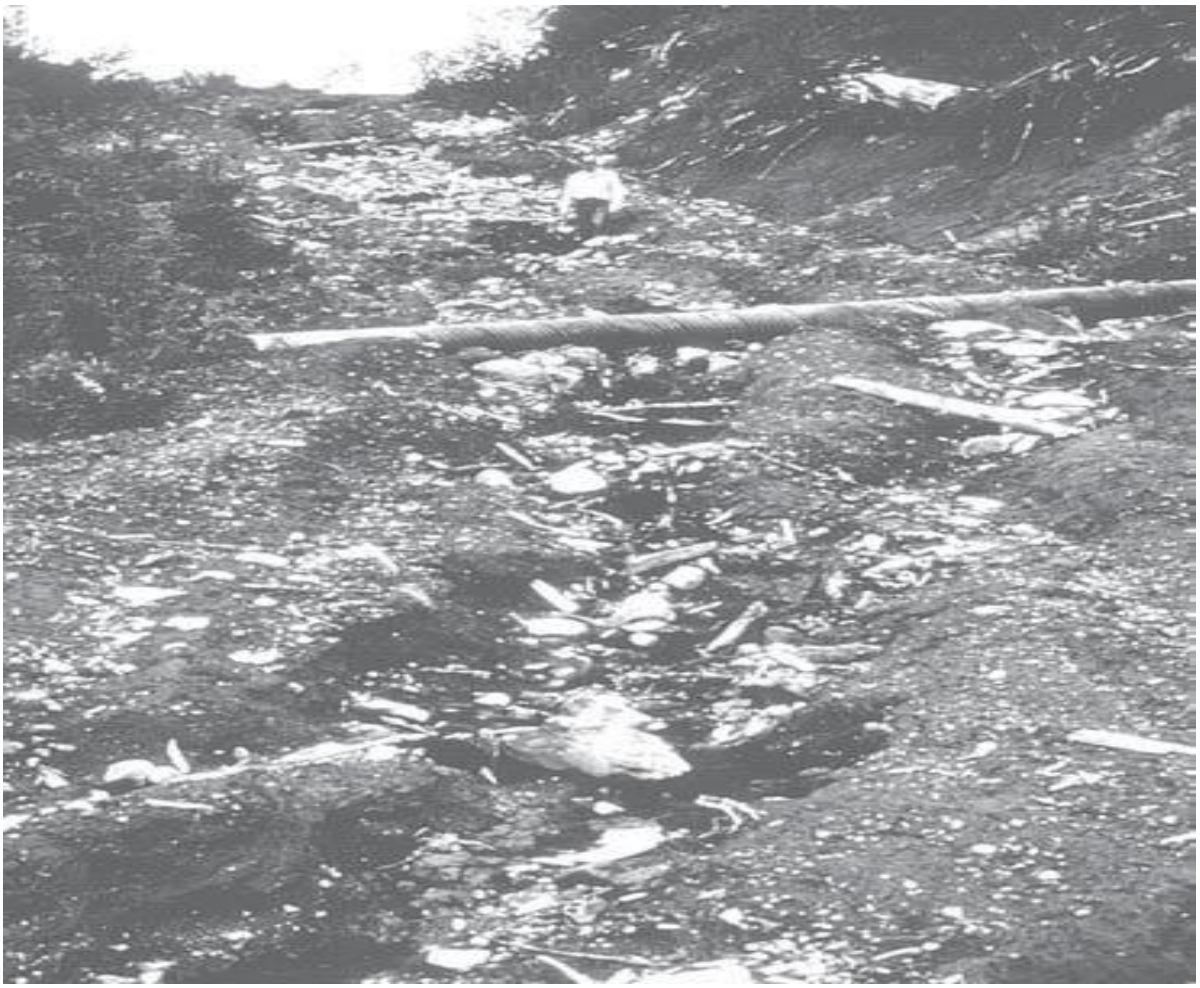

Fig.10.Catastrophic ditch and roadway erosion

On ditched roads, the ditch relief culvert inlets should be kept clear to provide for maximum drainage efficiency. Ditch catch basins should be cleaned of debris and the ditch blocks maintained. In some cases, ditches can be kept free of obstructions with a shovel. In other cases, a backhoe, motor grader, or loader must be used, with a dump truck to haul away the slough or berms left from maintenance of the road surface. Sometimes relief culvert inlets and outlets are smashed and need to be formed back into round, or replaced. Plugged and damaged relief culvert inlets can cause the water in the ditch to flow over ditch blocks, increasing flow volume and erosive power. When relief culverts are severely plugged, they can be cleared with water from a high-pressure fire hose (with great care in the vicinity of streams). In minor cases or with regular maintenance, culverts can be kept clear by hand. Unchecked, any of these problems can cause significant damage to any type of road (Figure-11).

Fig.11. Significant ditch erosion

There are several methods to stabilize soil in relief ditches and to reduce the force (velocity) of the water, including armoring the ditch with rock, growing grass in the ditch bottom, or installing drain relief culverts at more frequent intervals.

1.7. Stream-crossing structures maintenance

It is very important to properly maintain structures that cross streams, whether bridges or culvert pipes. These structures often represent a large investment. Timber bridges should be inspected periodically for damage caused by vehicles, insects, rot, or flooding. A professional engineer should inspect damaged bridges and perform a vehicle load rating analysis to determine whether the bridge is safe to carry the intended traffic loads. Similarly, culverts should be kept free of blockage and inspected periodically. Because stream-crossing culvert pipes are placed under road fills, when culverts fail, considerable sediment from the road fill can be transported directly into the stream (Figure-12), which can seriously harm fish habitat and water quality. The entire fill around and over the culvert in Figure 6-12 has been completely eroded into the stream channel. This occurred when the inlet became plugged and the stream ran over the top of the fill, destroying it. Again, it is important for the landowner to carefully maintain and clear out ditches and culverts to avoid this financially and environmentally costly situation.

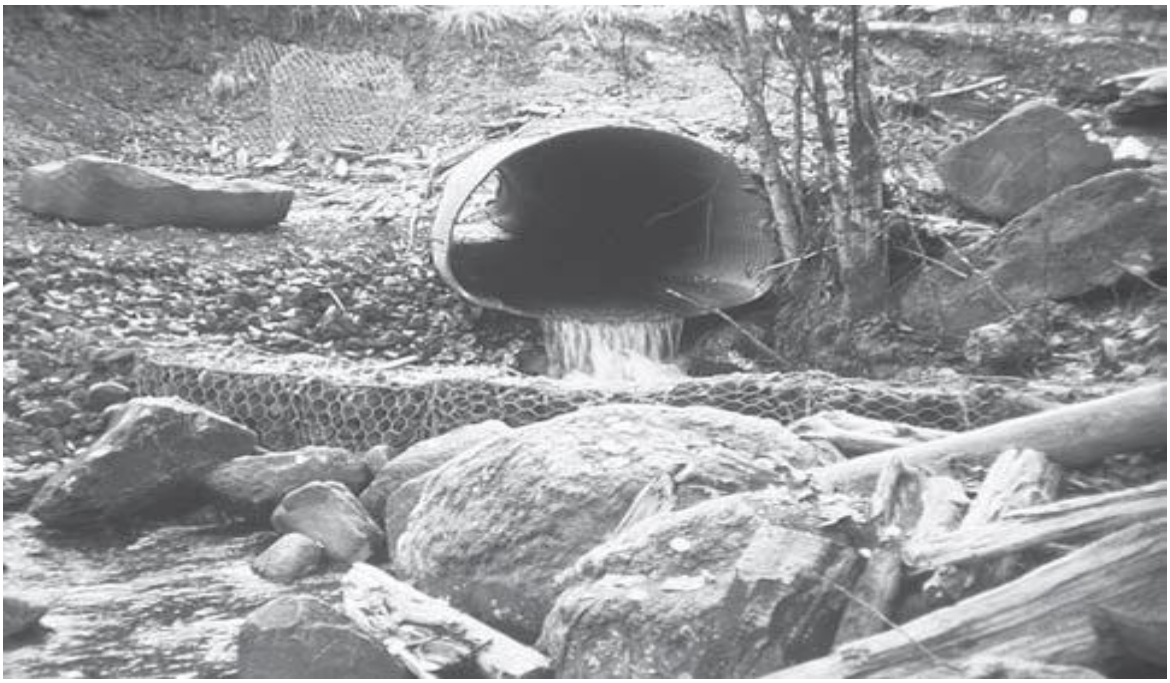

Fig.12. A complete fill washout because of a plugged culvert inlet

Trash racks can be used efficiently to catch debris before they block the inlet of a stream culvert. These should be carefully designed to provide for machine access if needed for clearing the debris from the structure (Figure-13). When necessary, trash racks should be constructed with enough room around them to allow backhoe access; a side approach might be needed in a deep fill to allow backhoe access. Trash racks can be costly to construct and maintain.

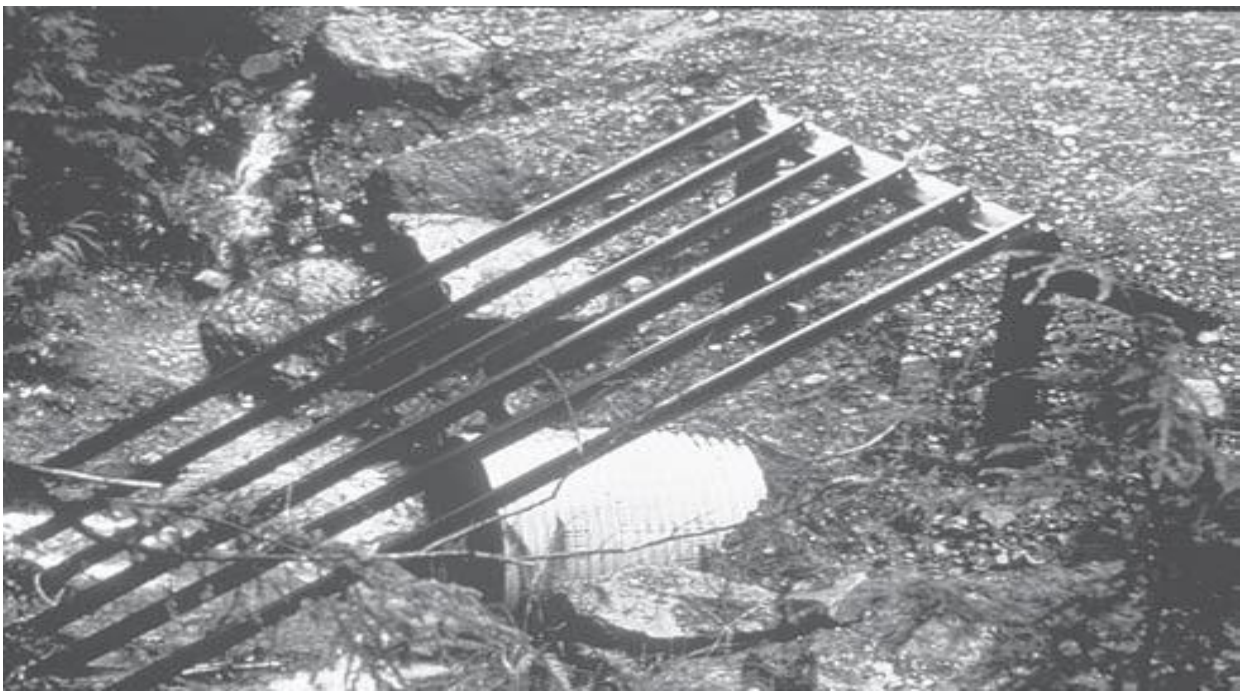

Fig.13.Culvert inlet trash rack

Stream culverts can be difficult to maintain when regulations require that woody debris must be left in fish-bearing streams. On some streams, keeping culverts clear of debris can be a serious problem.

Thus, if possible, culverts should be designed with enough room to allow a certain amount of debris to pass unobstructed during a peak flood. Culverts, like bridges, should be designed by a professional engineer to reduce future maintenance problems, to protect the environment, and to meet all required regulations.

Bridges are generally more effective than culverts in providing fish passage and in passing larger quantities of flood debris. However, depending upon the size of structure required, bridges are usually more expensive than culverts.

1.8. Traffic control

The ability to effectively close roads to all vehicle traffic when the road surface or subgrade is saturated can be critical in reducing costly maintenance and help control surface rutting, standing water, roadway erosion, and serious turbidity in streams. Potentially severe road damage can occur with one vehicle pass during extremely wet weather. Wet-weather traffic can also quickly escalate road maintenance costs, such as would be necessary for the severe rutting

Gates are often used as an effective method to control forest road access (Figure -14). To be effective, gates must be located so that it is difficult or impossible to drive vehicles around them. This can be accomplished by locating them in a narrow break in a dense forest or beside any other natural feature that can block access around the gate. Access around gates can also be blocked with deep ditches called “tank traps,” to preclude vehicle passage. A gate must also be strong enough to discourage vandalism, especially if it is in a remote location.

The shop-fabricated gate in Figure -14 has steel posts sunk in concrete and a steel gate padlock box, which make it more vandal-proof than other types of gates. This type of shop-fabricated gate has been successfully used to secure remote forest roads .

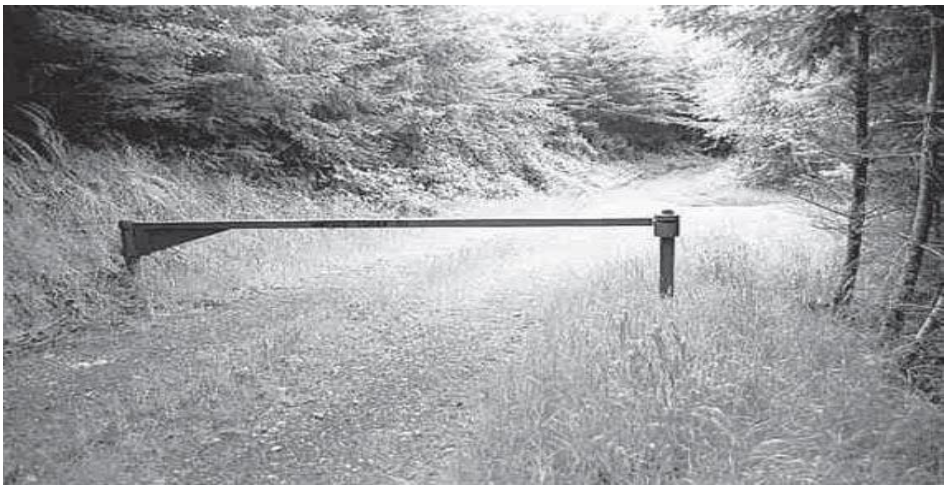

Fig.14. A forest road vehicle gate

The Powder River gate is another possibility for closing forest roads (Figure -15). This commercially fabricated gate is often used between cattle enclosures on farm and ranch roads. The widely used Powder River gate can be readily purchased; however, because it is usually constructed with wood posts and without a gate lock box, it is more easily vandalized. Even with a gate, it can be difficult to control access for all four-wheel-drive vehicles. During the critical wet season it may be necessary to increase control of vehicle access.

Fig.15. Basic powder river gate

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (1 point each)

1. What are the cause and the remedies of road surface failure
2. What are the cause and the remedies ofvehicle damage and surface
3. What are the cause and the remedies of roadway drainage damage
4. What are the cause and the remedies of roadway damage
5. What are the cause and the remedies ofditch and culvert damage
6. What are the cause and the remedies of Stream-crossing structures

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

2.1. Introduction

Forest road maintenances to include the process of assessing road defects and undertaking the necessary rectification work

Regular maintenance inspections of forest roads must be done to assess road infrastructure conditions and the adequacy of ditches and culverts, particularly before and during high runoff periods. Remedial work identified by the inspections must be carried out as soon as warranted by the risk to water quality and road users.

Carry out road maintenance inspections:

- after major storms
- during spring breakup
- Prior to fall rains.

Tools or Materials require may include road base, gravel, crushed rock, sand and bluestone, together with cords and pipes for water crossings. Equipment include earthmoving equipment

Appropriate personnel may include supervisors, suppliers, clients, colleagues, and managers

A maintenance plan prescribes remedial measures required to maintain road integrity and meet objectives for user safety and environmental concerns. All responsibilities for road maintenance must be fully identified, understood and fulfilled.

In the conduct of their normal day-to-day activities, district employees may observe or identify road maintenance needs. Districts will develop a methodology for recording the information and forwarding it to person or party responsible for maintaining that segment of road.

Districts will utilize geotechnical specialists, biologists, or other professionals to provide design input for mitigation of chronic maintenance problem areas.

This road maintenance option provides the greatest flexibility. Personnel and equipment are in place and can easily be allocated to projects. Employees' experience and local knowledge can be invaluable in identifying chronic problem areas and developing appropriate road maintenance solutions. In addition, the personnel and equipment are available to support other functions, such as fire suppression.

The greatest advantage of Department personnel and equipment is the ability to react promptly to high priority situations, especially when unplanned emergencies arise.

The cost of maintaining the staff and heavy equipment that is required to accomplish the work is the biggest disadvantage of this option.

Road Maintenance Plan: A document that contains professional work which provides road standards, design specifications, and other information to facilitate the maintenance of a road

- Identifying the current or expected road use and the purpose of maintenance; for example
- ✓ for industrial use only
- ✓ accommodating other public use as well as industrial use
- ✓ managing environmental integrity on inactive roads (for example, wilderness roads on crown land)
- Setting objectives for road maintenance appropriate for road integrity, user safety, and hazard to down slope or downstream elements at risk;
- Setting hazard and risk criteria in order to prioritize road inspection schedules and maintenance work;
- Setting the frequency and scope of inspection schedules commensurate with the potential for unsafe conditions or environmental hazards;
- Setting conditions of road use;
- Recognizing where member or specialist input is needed to prepare plans for specific remedial work. This may include requirements for field reviews and professional signoff on completed work similar to that for road construction.
- Providing for the implementation of remedial work on a priority basis flowing from inspections and road maintenance plans.
- Tracking work that has been completed and work that remains outstanding.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (2 points each)

1. When do we carry out road maintenance inspections?
2. Mention the tools or materials and machineries used in maintain forest road
3. Elaborate briefly an acceptable road maintenance plan

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

3.1. Direct environmental impacts

The primary environmental impacts of roads differ depending upon terrain. In native area of forests on gentle terrain, roads provide access to previously inaccessible areas. Roads are the basic infrastructure for development. In manyto agriculture, pasture land, and communities. Roads can also function as linear barriers for wildlife and fragment the forest.

On steeper terrain in both natural and planted forests, roads can contribute significantly to erosion and mass movement of soil. They can also divert water flow, becoming artificial “streams” that can affect water delivery time to rivers.

Cut slopes can intercept groundwater flow, and road drainage can accumulate water in areas where it has not been before or divert water to areas that have not previously had overland flow. Improperly located roads placed on unstable slopes can create soil mass movement, as can over steepened fill slopes or buried organic material which later decomposes into slippery lenses within the road prism.

Improperly designed stream crossings can funnel sediment into streams, and poor equipment maintenance policies can introduce chemicals into streams. Sediment from roads can make its way to streams, affecting downstream water quality for aquatic life and human use. Proper location, design, construction, and maintenance of roads can avoid or reduce many undesirable side effects of forest roads

3.2. Undertaking Best management practices

Considerable progress has been made in recent years in the introduction of environmentally sound forest harvesting and road practices in many parts of the tropics. A number of tropical countries have developed harvesting codes of practice which also include guidelines for forest roads.

The primary objectives of the harvesting codes are to promote forest harvesting practices that improve standards of utilization and reduce environmental impacts, thereby contributing to the conservation of forests through their wise use. Harvesting codes typically contain information on harvest planning, forest road engineering, cutting, extraction, landing operations, transport, postharvest assessment, and training, supervision, and safety for the forest workforce.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. What are direct environmental impacts in adhering site environmental condition
2. How do you implement environmentally best management practices

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 4- Organizing maintenance schedule for the site

4.1. Scheduling Maintenance

Essentially, the two “seasons” for logging operations in are dry summers and falls, and wet winters and springs. During the dry season, less road surfacing is generally needed, whereas winter logging requires all-weather roads and higher standards, such as rock aggregate surfaces.

Forest road maintenances to include the process of assessing road defects and undertaking the necessary rectification work

Regular maintenance inspections of forest roads must be done to assess road infrastructure conditions and the adequacy of ditches and culverts, particularly before and during high runoff periods. Remedial work identified by the inspections must be carried out as soon as warranted by the risk to water quality and road users.

Carry out road maintenance inspections:

- After major storms
- During spring breakup
- Prior to fall rains.

4.2. Organize maintenance schedule for the site

Frequency of Maintenance: Several factors help determine how frequently road maintenance activities will need to be performed are mentioned below:

1. Planned Use and Design

A road that has been planned and designed to accommodate a large volume of traffic will require more frequent maintenance. This applies to routine maintenance as well as the replacement of surfacing material. These roads might be mainline logging roads or roads that will carry a high level of recreational traffic. A road that is designed for occasional use, such as a short spur to access a timber sale will require less frequent maintenance.

2. Position on Slope

- Roads located on ridge tops will require less frequent maintenance due to fewer drainage structures, shorter cut banks, and a higher degree of slope stability.

- Roads located in valley bottoms require somewhat more frequent maintenance, due to the greater number of drainage structures and their proximity to larger streams. Depending upon their proximity to valley slopes, roads in valley bottoms may or may not have greater cut and fill slope stability than roads on ridge tops.
- Roads located on side hills require the greatest maintenance frequency. Cut banks are higher and more prone to raveling, cut and fill slope stability issues are more frequent, and there are generally a large number of drainage structures.

3. Local Knowledge of Chronic Problem Areas

Local conditions may dictate more frequent maintenance on certain roads or at certain sites, such as culverts that are prone to beaver activity, recurring slide areas, or streams that carry unusually high sediment loads. The knowledge and experience of district employees are important in identifying these sites and ensuring that they get the attention they need. Solutions will also be explored to determine if the particular chronic problem could be mitigated.

4. Timing

Regular and timely road maintenance helps to ensure that the forest road system remains fully functional. Conversely, poorly timed maintenance can create problems that might have greater consequences than not maintaining a road. As examples, cleaning ditches during wet weather can cause excessive sedimentation, and grading a road during a hard rain event can lead to the contamination of the surfacing material.

On the other hand cleaning culvert inlets and minor blockages of ditches during rain events can prevent more serious damage. It is extremely important that any maintenance activity be conducted at a time when weather conditions allow for a minimal amount of soil disturbance and sediment movement.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (1.5.Pointeach)

1. How do you organize maintenance schedule for site
2. How do you organizeposition on slope for site
3. How do you organize local knowledge of chronic problem areas
4. How do you Organize timing of maintenance schedule for site

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Operation Sheet 1- Undertaking forest road maintenance program

PROCEDURE:

1. Wear safety cloths
2. Collect all tools, materials and equipment.
3. Maintain Clearing and grubbing
4. Maintain Subgrade
5. Maintain Road surfacing and a logger's operating area
6. Maintain surface compaction work
7. Maintain stream-crossing structures
8. Maintain road intersections
9. Maintain timber harvest equipment landings
10. Maintain erosion control structures
11. Report and document the work done activities

LAP TEST	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hour. The project is expected from each student to do it.

Task-1 Participate and undertake maintenance of forest road construction to the nearby forest area of your college and document & report

LG#49	LO-4 Monitor and review forest road construction and Maintenance

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Developing and adhering monitoring schedule
- Making checks to ensure the OHSProcedures
- Making checks to ensure the site environmental conditions

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Develop and adhere monitoring schedule
- Make checks to ensure the OHSProcedures
- Make checks to ensure the site environmental conditions

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information sheet: 1- Developing and adhering monitoring schedule

1.1. Introduction

Forest road and bridge monitoring and maintenance involve the following activities:

- assigning road inspection priorities based on risk analysis
- road inspections
- bridge and major culvert inspections
- road prism maintenance
- structural maintenance of the subgrade
- clearing width maintenance
- ditch and culvert maintenance
- road surface maintenance
- maintenance of structures
- Inspection and repair of deactivated roads.

Required maintenance activities should be determined from field information documented during formal inspections, and from information and incidents provided by road users. From this, a maintenance plan should be prepared to remedy the identified deficiencies.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. Discuss and elaborateForest road and bridge monitoring and maintenance activities. (6 points)

You can ask your teacher for the copy of the correct answers

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information sheet: 2- Making checks to ensure the OHS Procedures

2.1. OHS requirements

OHS requirements are to be in accordance with Federal and Regional Legislation and regulations, and organizational safety Policies and procedures. Requirementsinclude:

The use of the following personal protective equipment and clothing should be checked before using

- safety equipment
- first aid equipment
- firefighting equipment
- hazard and risk control
- elimination of hazardous materials and substances
- safe forest practices including required actions relating to forest fire
- manual handling including shifting, lifting and carrying

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers(3 point each)

.

1. Explain briefly the OHS requirements in forest road construction.
2. Write and elaborate the safety equipment, first aid equipment, firefighting equipment used in forest road construction

You can ask your teacher for the copy of the correct answers

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

3.1. Environmental management considerations

Environmental management considerations may include ground growth, canopy, general forest lean, wind speed and direction, fallen trees, density of trees, ground slope, soil and water protection, ground hazards and obstacles

- Priorities will be assigned to each task, with the highest priority being assigned to sites that have the highest potential for damage to the road or damage to down slope natural resources.
- When allocating road maintenance resources, it is important to match the type and size of maintenance equipment to the maintenance activity being performed, and to ensure that operators are properly trained to perform the function.
- It must be remembered that because forest road systems exist in a dynamic environment, any plan for road maintenance must also be dynamic.
- Equally as important as maintaining a road to its original design standard is limiting its use to the designed standard. This will prevent maintenance problems from developing and prevent damage to natural resources.
- A road that is surfaced with a minimal amount of crushed rock will not support timber hauling in the winter months, and will not be expected to do so. Care must be taken during the planning process to ensure that roads are adequately designed, constructed, and maintained for the planned use.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers. (6 point each)

1. What are the factors that should be considered in environmental management of forest road construction

You can ask your teacher for the copy of the correct answers

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

LG#50	LO5- Record and report work outcomes

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Recording and reporting road construction and maintenance process
- Reporting problems or difficulties
- Recording and reporting materials or machinery damage
- Communicating hazards information
- Documenting and reporting

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- How to record and report road construction and maintenance process
- How to report problems or difficulties
- How to record and report materials or machinery damage
- How to communicate hazards information
- How to document and report

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,

9.If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

5.1. Recording and reporting work out comes

An important aspect of a road maintenance program is documentation. Maintenance activities will be documented for a number of reasons such as planning future maintenance needs and the tracking of maintenance costs. Documentation can also provide some protection in the event that there is a legal dispute relating to road maintenance. Each district will develop and use an interim system that documents road maintenance activities. When the Information Management section of this manual is completed, it will contain guidance on the documentation of road maintenance activities.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. Discuss the reason why road construction and maintenance activities are documented after conducting road construction and maintenance.(6 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information sheet: 2- Reporting problems or difficulties

2.1. Introduction

Regardless of the maintenance methods employed, the knowledge, skills, and abilities of the supervisors, equipment operators, and other workers are crucial to the successful maintenance of the road system. They need knowledge of good road maintenance practices and the ability to apply them in the proper situations. They also need the ability to recognize unusual conditions that may require the use of specialized equipment or the advice of technical specialists.

Maintenance work should always be carried out by workers permanently engaged in this occupation. Continuous maintenance by a small crew to clean culvert entrances, unplug ditches, repair mud holes, and remove objects from the roadway is always more economical than intermittent work carried out by a larger crew. Each crew should be assigned to a specified road. Typical hand tools include a wheelbarrow, shovel, pick, axe, and machete. Maintenance work requiring mechanized equipment is given to a team responsible for the whole road system. Schematic books with examples of proper final shapes for road sections should be provided to all maintenance crews. While doing so reporting the problems encountered in imperative

To protect the road infrastructure and reduce vehicle operating cost, periodic maintenance is necessary. The frequency of this maintenance is a function of season of use, level of use, location, and road surface materials. A road that has been planned and designed to accommodate a large volume of traffic will require more frequent maintenance. A road that is designed for occasional use will require less frequent maintenance. To reduce the maintenance load, roads that are seldom or occasionally used become good candidates for road closure between periods of use. In mountainous areas, roads located on ridge tops willrequire less frequent maintenance owing to fewer drainage structures, smaller cut banks, and usually a higher degree of slope stability. Roads located in valley bottoms require more frequent maintenance owing to the greater number of drainage structures and their proximity to larger streams. Roads located on side hills require the greatest maintenance frequency. Cut banks are higher

and more prone to raveling, cut and fill slope stability issues are more frequent, and there are generally a large number of drainage structures.While doing so reporting the problems encountered in imperative

2.2. Expected Problems in road construction and maintenance

The followings are the common problems encountered in forest road construction and maintenance activities

- Malfunctioning of machineries and equipment's
- Difficult terrain
- Un expected rainfall
- Delayance of construction materials
- Stream conflict
- Conflict among workers
- Structural failures are among the others

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

2. Discuss briefly expected Problems in road construction and maintenance (6 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information sheet: 3- Recording and reporting materials or machinery damage

3.1. Inspecting materials, equipment and machineries

After completion of activities, all tools and equipment must be cleaned. The forest road construction working environment should be kept clean of any west materials and plant debris.

The importance of suitable tools and equipment can not be over-emphasized. "Suitable" means "adapted to the work and the workers". Inappropriate, broken and poorly maintained tools and equipment slow down the work and may cause injuries.

It is preferable to provide the workers with the appropriate tools rather than asking them to bring their own several-purpose, agricultural tools to the workplace. People from different areas, males and females differ in body size. The tools should be adapted in size and weight to the different body sizes of the workers. Providing good tools is a relatively inexpensive way to raise productivity. Tools can be issued every morning and returned in the evening, or they can be issued for longer periods. A record should be kept of which tools are issued and to whom. An inventory of all tools and equipment should be made regularly reported and documented to the supervisor. It is important not to reissue damaged or badly worn tools to the workers. Material and tools for maintenance should be available at the site.

- With time and heavy use, blades will become blunt, will chip and even break. Blunt or broken blades affect productivity, apart from being uncomfortable to work with. Regular maintenance is important.
- Loose handles are dangerous and should be fixed immediately. Raised safety grips on the handles reduce the force needed to guide the tool and prevent tools from slipping out of the hands. Repair or maintenance can be done by sharpening the blade with a file or, when the blade is extremely damaged, by cutting back the blade and then sharpening it again.
- Check regularly that tools are in good working order. Supervisors play a major role in observing if the tools are suitable for the different tasks, if they are properly maintained and sufficiently durable.

- If there is any broken tools and equipment, it should be maintained. Broken handles and blunted tools should be checked on time, maintained and made ready for work.
- All tools and equipment should be well organized and stored in groups of similarity after maintenance.

Self-Check –3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

3. Mention the parameters to be collected and registered on Recording system ofroad construction and maintenance (6 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 9 points** **Unsatisfactory - below 9 points**

Information sheet: 4- Communicating hazards information

4.1. Carrying out Interactions with other staff and Supervisor

A positive relation between good working conditions, a good working atmosphere on site, and high productivity usually exists and its magnitude varies from operation to operation. The relationship should be understood and used as a basis for promoting improvements in working conditions. Examples include the provision of safe drinking water on the site, which enables more productive work by reducing physical discomfort, and the treatment of minor injuries on site, which reduces loss of working time.

Interactions with other staff and supervisor are carried out in a positive and professional manner. Remember that safe interactions little or no claims cost, but also in a good reputation. Your name is on your hand. Having something negative interactions makes bad public relations. Think of all the advertising money you spend, and then think of the number of people who might directly witness landscape demonstration. Think of the employees who could be diligent.

Using multiple lenses and methods to measure other staff and supervisor satisfaction ensures that your measurement is accurate and complete. Too often supervisor satisfaction is reduced to a simple equation that compares supervisor expectations to supervisor perceptions.

In fact, there are many contexts and points of view relevant to the discussion of customer satisfaction.

Even if you are committed to measuring current supervisor perceptions based on your past experience, you may want to consider complementing your approach with other techniques (Academic Roundtable).

Experience auditing is a specialized and rigorous form of mystery shopping that involves the use of personas, scenarios and objectives to document and measure the variety of communication cues exchanged between staff and customers.

Monitoring can be directed personal observation or at phone and may also be referred to as quality monitoring or performance evaluation as well as Supervisor Duties

- Keep the workplace free from hazards

- Inform employees of how to protect themselves against hazards that cannot be controlled
- Conduct regular jobsite safety inspections
- Have someone trained in first aid on site if you have no emergency response service

4.2. Sharing Information relevant to work is shared with team members.

Sharing information relevant to work with team members to ensure designated goals

The value of sharing and updating information

The sharing and updating of information with the workgroup ensures:

- ✓ designated goals are met
- ✓ professionalism is maintained
- ✓ products and services are promoted
- ✓ customer service is improved
- ✓ Positive workplace relationships are developed.

The information to be shared may include:

- acknowledging satisfactory performance
- acknowledging unsatisfactory performance
- assisting a colleague
- clarifying the organization's preferred task completion methods
- encouraging colleagues
- open communication channels
- Workplace hazards, risks and controls.

For a group/team to work effectively members should use open communication channels by observing one another's satisfactory or unsatisfactory performance; recognizing workplace hazards, risks and controls; and clarifying the organization's preferred task completion methods.

Group problem-solving

Solving problems in a group has four major advantages:

1. Greater knowledge and information (synergy).3. Increased acceptance of solutions
2. More approaches to the problem.4. Better comprehension of the decision.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. How do you carrying out Interactions with other staff and Supervisorin road construction maintenance (6 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 9 points** **Unsatisfactory - below 9 points**

Information sheet: 5- Documenting and reporting

5.1. Introduction.

An important aspect of a road maintenance program is documentation. Maintenance activities will be documented for a number of reasons such as planning future maintenance needs and the tracking of maintenance costs. Documentation can also provide some protection in the event that there is a legal dispute relating to road maintenance. Each district will develop and use an interim system that documents road maintenance activities. When the Information Management section of this manual is completed, it will contain guidance on the documentation of road maintenance activities

5.3. Preparing maps, tabular summary, letter or report

A place where forest road construction 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.

1. Content of A place where forest road construction 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 road (temporary, semi-permanent, permanent) and intended duration. • vehicle usage (4-wheel drive, ATV, no access)

✓ topographic information

✓ additional relevant plan metric 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 prescriptionsymbol)
- ✓ 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.

2. Content of tabular summary

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 chainagesalong 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 construction 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 construction considerations (road reconstruction, wet crossings, safety issues)
- ✓ site-level information
- ✓ results and recommendations

5.3. Preparing a standard format for reporting and documenting

From planning up to finishing of every forest road construction activity it should be reported to the supervisor and documented following the reporting and documenting presented below

ROAD INSPECTION AND MAINTENANCE REPORT

Date: Y M D	*File No.*	*Road Name*	*Road Project No.*
Forest Region	*Forest District*	*Local Road Name*	*Local Road No.*

Licensee or Agency	*Forest Licence or TSL*	*Road Permit or CP No.*	*Amendment No. or Block No.*	*Road Section No.*

GPS Co-ordinates at Start of Inspection:

Other Tenure Comments:

Inspect for the following items to ensure integrity of the road:

Structural Integrity:		**Drainage Systems:**	
• Tension cracks visible	SI-01	• Natural drainage patterns maintained	DS-01
• Cutslope failures	SI-02	• Culverts clear and working	DS-02
• Fill slope failures	SI-02	• Culverts washed out	DS-03
• Slides or mass land movements	SI-04	• Culvert and /or ends damaged	DS-04
• Shoulder slumps	SI-05	• Culvert markers	DS-05
• Frost boils	SI-06	• Adequate fill over culverts	DS-06
• Subgrade unable to support wheel loads	SI-07	• Ditch blocks in place and working	DS-07
• Washouts	SI-08	• Adequate cross-drain culverts	DS-08
Road Surface:		• Undersized cross-drain or stream culverts	DS-09
• Depth of surface material adequate	RS-01	• Ditches scoured	DS-10
• Potholes	RS-02	• Ditches unobstructed (debris, grass, vegetation)	DS-11
• Washboard	RS-03	• Ditchline sloughing	DS-12
• Rutting from vehicle wheels	RS-04	**Safe Fish Passage:**	
• Windrows present	RS-05	• Fish stream culvert inlets and outlets	FP-01
• Damage from cattle	RS-06	• Inadequate structure	FP-02
• Road surface erosion	RS-07	**Road Safety:**	
• Sediment transport from road prism	RS-08	• Site distances	SA-01
• Dust	RS-09	• Brushing	SA-02
Bridge Surface		• Snags and danger trees	SA-03
• Waterway opening free of logs and debris	BS-01	• Other road hazards (loose rocks, stumps, etc.)	SA-04
• Bearing surfaces free of gravel and dirt	BS-02	• Traffic control signs	SA-04
• Wood stringers free of dirt accumulations	BS-03	• Road radio frequencies posted	SA-06
• Running planks missing or damaged; nails protruding	BS-04		
• Damaged guide rails or curbs	BS-05		
• Gravel build-up on bridge deck	BS-06		

Inspect for the following items to ensure integrity of the road:

Structural Integrity:		**Drainage Systems:**	
• Tension cracks visible	SI-01	• Natural drainage patterns maintained	DS-01
• Cutslope failures	SI-02	• Culverts clear and working	DS-02
• Fill slope failures	SI-02	• Culverts washed out	DS-03
• Slides or mass land movements	SI-04	• Culvert and /or ends damaged	DS-04
• Shoulder slumps	SI-05	• Culvert markers	DS-05
• Frost boils	SI-06	• Adequate fill over culverts	DS-06
• Subgrade unable to support wheel loads	SI-07	• Ditch blocks in place and working	DS-07
• Washouts	SI-08	• Adequate cross-drain culverts	DS-08
Road Surface:		• Undersized cross-drain or stream culverts	DS-09
• Depth of surface material adequate	RS-01	• Ditches scoured	DS-10
• Potholes	RS-02	• Ditches unobstructed (debris, grass, vegetation)	DS-11
• Washboard	RS-03	• Ditchline sloughing	DS-12
• Rutting from vehicle wheels	RS-04	**Safe Fish Passage:**	
• Windrows present	RS-05	• Fish stream culvert inlets and outlets	FP-01
• Damage from cattle	RS-06	• Inadequate structure	FP-02
• Road surface erosion	RS-07	**Road Safety:**	
• Sediment transport from road prism	RS-08	• Site distances	SA-01
• Dust	RS-09	• Brushing	SA-02
Bridge Surface		• Snags and danger trees	SA-03
• Waterway opening free of logs and debris	BS-01	• Other road hazards (loose rocks, stumps, etc.)	SA-04
• Bearing surfaces free of gravel and dirt	BS-02	• Traffic control signs	SA-04
• Wood stringers free of dirt accumulations	BS-03	• Road radio frequencies posted	SA-06
• Running planks missing or damaged; nails protruding	BS-04		
• Damaged guide rails or curbs	BS-05		
• Gravel build-up on bridge deck	BS-06		

Additional Comments Regarding Inspection:
Comments Regarding Remedial Actions:

Location (km) or GPS Co-ord	Comments and/or Code	Remedial Works to Be Completed by Date:	Remedial Works Completed Date:

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. Mention the parameters to be collected and registered on Recording systemin forest road construction and maintenance (6 points)

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 9 points** **Unsatisfactory - below 9 points**

Operation Sheet 1- Recording and reporting work activities

PROCEDURE

1. Collect and collate the possible machinery tools
2. Collect and collate road construction activities
3. Collect and collate road maintenance activities
4. Collect and collate the possible problem encountered
5. Collect and collate Finally report and document it in summary form and graphically

LAP TEST	Performance Test

Name…… ID……..

Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2.hour. The project is expected from each student to do it.

Task-1 Go to the rear by forest road construction of your college and collect and collate Finally report and document it in summary form and graphically

Reference Materials

BOOKS

1. Brian W. Kramer,2001,forest road contracting, Construction, and Maintenance for small forest woodland owners
2. Forest Road EngineeringGuidebook,Second edition,June 2002,British Columbia, Forest Minister.
3. John Sessions,2007,Forest RoadOperations inthe Tropics ,Department of Forest EngineeringOregon State University
4. Köhl, M.,Magnussen, S.,Marchetti M. 2006, Sampling Methods, Remote Sensing and GIS Multiresource Forest Inventory, ISBN: 3-540-32571-9
5. Montagnini, F., Jordan C. 2005, Tropical Forest Ecology - The Basis for Conservation and Management, ISBN: 3-540-23797-6
6. Sarajevo/Banja Luka,2005,guidelines for road design,Construction, maintenance andSupervision
7. Sessions, J. 2007,Forest Road Operations,ISBN: 3-540-46392-5

WEB ADDRESSES

1. Irrigationhttp://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html
2. http://www.navcen.uscg.gov/gps/default.htm.
3. FAO):http://home.gdbc.gov.bc.ca/
4. Irrigation Ltd (subscription based):http://www.terrapro.bc.ca
5. Soil surveyhttp://www.nrcan.gc.ca/gsc

AKNOWLEDGEMENT

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

We would like also to express our appreciation to the TVET instructors and respective industry experts of Regional TVET Bereau, TVET college/ Institutes, Holeta Polytechnic College, East Africa Skills for Transformation and Regional Integration Project (EASTRIP) who facilitate the development of this Teaching, Training and Learning Materials (TTLM) with required standards and quality possible.

This Teaching, Training and Learning Materials (TTLM) was developed on June, 2021 at Adama, Pan- Africa Hotel.

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